



# **An exploration of the contexts of physical activity that impact mental health and wellbeing in adolescents**

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**Authors Declaration:**

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Doctor of Philosophy is entirely my own work, and that I have exercised reasonable care to ensure the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

Signed:

ID No: 19210544

Date: 9-6-22

A handwritten signature in black ink that reads "John Murphy". The script is cursive and fluid, with the first letters of the first and last names being capitalized and prominent.

John Murphy (Candidate)

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## Abstract

**Title:** An exploration of the contexts of physical activity that impact mental health and wellbeing in adolescents

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**Introduction:** Physical activity is well recognised as a key risk factor for the management and prevention of mental ill-health. Meta-analytic evidence has shown the leisure-time life domain had the strongest associations with positive mental health. Sport, a sub-domain, of leisure time physical activity has also shown positive associations with increased mental health.

**Aim:** Explore contexts of physical activity with the strongest associations with mental wellbeing in Irish adolescents.

**Method:** A multi-method series of five interlinking studies including a national questionnaire, a non-randomised controlled trial and two rounds of focus group interviews.

**Results:** Study one found a minority of adolescents met WHO's physical activity guidelines. Frequency of activity were found to decline with age. Frequency of activity was positively correlated with wellbeing and negatively correlated with symptoms of anxiety and depression. Males had higher levels of wellbeing and lower levels of anxiety and depressive symptoms across all sub-groups.

Study two found that participating in games twice a week led to significant decreases in symptoms of anxiety and depression. Mental wellbeing significantly increased in those who participated two and three times a week. Increases in mental wellbeing were similar in effect size to increases in self-efficacy.

Studies three and four identified five main themes that contribute to and support positive mental wellbeing through physical activity and sport: improvements and achievements; meaningful experiences; setbacks and losses leading to higher resilience; facilitating and maintaining social connections; and opportunities for mindfulness and distraction.

Adolescents reporting elevated symptoms of depression increased from 39% to 46% with almost 3 in 5 females reporting symptoms of depression ranging from mild to extreme. There was an 8% reduction in the amount of adolescents who participated in 3 or more sports. No changes in physical activity levels were found overall, despite changes within sub-groups and patterns of physical activity.

**Conclusion:** Higher frequencies of physical activity and participation in sports are associated with lower symptoms of anxiety and depression, and higher levels of mental wellbeing. Improvements and achievements from physical activities, meaningful experiences and the psychological skills developed through playing sports appear to be the main contributors to higher levels of wellbeing and may offer 'protective effects' against symptoms of anxiety and depression.

## **Chapter 1:**

### **Introduction To Thesis**

## 1.1 Publications

### Published

Murphy, J., Coulter, M., Sweeney, M. R., & McGrane, B. (2022). "You Get to..." a Qualitative Study of Perceived Influence of Physical Activity and Sport on Mental Wellbeing among Adolescent Girls. *Advances in Physical Education*, 12(2), 87-105.

Murphy, J., Sweeney, M. R., & McGrane, B. (2022). The effect of a games-based intervention on wellbeing in adolescent girls. *Health Education Journal*, 81(4), 463–478.

Murphy, J., Sweeney, M. R., O'Hagan, A. D., & McGrane, B. (2022). Associations Between Self-Reported Sleep, Wellbeing and Physical Activity in Irish Adolescents. *European Scientific Journal, ESJ*, 18(8), 1. <https://doi.org/10.19044/esj.2022.v18n8p1>

Faulkner, J., O'Brien, W. J., McGrane, B., Wadsworth, D., Batten, J., Askew, C. D., ... & Lambrick, D. (2021). Physical activity, mental health and well-being of adults during initial COVID-19 containment strategies: A multi-country cross-sectional analysis. *Journal of science and medicine in sport*, 24(4), 320-326.

Murphy, J., McGrane, B., & Sweeney, M. R. (2021). Physical Activity, Mental Health and Wellbeing of Irish Adolescents During Covid-19 Restrictions. A Re-Issue of the Physical Activity and Wellbeing Study (PAWS). *Physical Activity and Health*, 5(1), 215–228. DOI: <http://doi.org/10.5334/paah.127>

Murphy, J., Sweeney, M. R., & McGrane, B. (2020). Physical activity and sports participation in Irish adolescents and associations with anxiety, depression and mental wellbeing. Findings from the physical activity and wellbeing (paws) study. *Physical activity and health*, 4(1).

### Under Review

Murphy, J., McGrane, B., White, R.L. & Sweeney, M.R. (2022). Self-Esteem, Meaningful Experiences & The Rocky Road. Contexts of physical activity that impact mental health in adolescents. *Mental health And Physical Activity*

### Oral Presentations

Murphy, J., McGrane, B., White, R.L. & Sweeney, M.R. (2022). Self-Esteem, Meaningful Experiences & The Rocky Road. Contexts of physical activity that impact mental health in adolescents. *PE-PAYS. University of Limerick*. June 2022

#### **Poster Presentations**

Murphy, J., Sweeney, M. R., & McGrane, B. (2021). The impact of a school-based physical activity intervention on mental health outcomes in Irish adolescent females. *BASES 2021*. (November, 2021)

Murphy, J., Sweeney, M. R., & McGrane, B. (2021). Exploring the contexts of physical activity with the strongest associations with positive mental health in Irish adolescents. *Institute of Education Postgraduate Unconference*. Dublin City University (June, 2021)

Murphy, J., Sweeney, M. R., & McGrane, B. (2020). The impact of a school-based physical activity intervention on mental health outcomes in Irish adolescent females. *Scottish Physical Activity Research Conference*. University of Edinburgh (November, 2020)

Murphy, J., Sweeney, M. R., & McGrane, B. (2019). Exploring the impact of a school-based combined nutrition education and physical activity peer-led intervention on health markers in Irish adolescent females: A mixed methods approach. *All Ireland Post-Graduate Conference in Sport Sciences, Physical Activity and Physical Education*. Athlone Institute of Technology (May, 2019)



## 1.2 Background

Mental health disorders are the second leading cause of the global burden of illness and are growing rapidly (Kassebaum et al., 2017). Depression alone accounts for more than 44 million years lived with disability (Schuch et al., 2018). Mental health disorders are associated with increased healthcare costs (Chisholm et al., 2016), premature mortality (Walker, McGee & Druss, 2015) and heightened medical comorbidity (Vancampfort et al., 2016). Mental health disorders currently account for nearly half (45%) of the disease burden in the world's adolescents and young people (Gore et al., 2011). Approximately 70% of health problems, and most mortality, among the young arise as a result of mental health disorders (McGorry, 2005). Ireland, Portugal, Germany, and Finland have the highest rates of reported depression in Europe for those aged 15 years and over, all with greater than 10% prevalence rates for chronic depression (Biddle et al., 2018). The *My World Survey, A National Study of Youth Mental Health* in Ireland (Dooley & Fitzgerald, 2012) found approximately one third of adolescents to be suffering from elevated levels of depression (30%) and anxiety (33%). A follow up study, *My World Health Survey 2* reported that 40% of participants suffered from mild to very severe symptoms of depression and 49% suffered from mild to very severe symptoms of anxiety (Dooley, O'Connor, Fitzgerald & O'Reilly, 2019). This increase highlights the growing and worrying upward trend of mental health difficulties experienced by Irish adolescents. Given the breadth of mental health disorders and the accompanying individual and societal burdens, strategies that may reduce the onset of symptoms of anxiety and depression are urgently needed (Cuijpers, Beekman & Reynolds, 2012).

Physical activity is well recognised as a key risk factor for the management and prevention of mental ill-health, including anxiety and depression (Teychenne et al., 2020). The rise in mental health disorders among young people has occurred alongside a decline in levels of physical. International research from both self-report and objective measures of physical activity suggest the majority of young people are not meeting the recommended 60 minutes of moderate-to-vigorous physical activity each day (Aibar et al., 2013; Belton et al., 2014; Ekelund et al., 2012). This global trend has also been observed in Irish adolescents as the Health Behaviour in School-Aged Children study found only 25% of Irish children self-reported meeting the physical activity (PA) guidelines with a greater proportion of males (31%) than females (18%) meeting guidelines (Kelly, Gavin, Molcho & Nic Gabhainn, 2012). The Children's Sport Participation and Physical Activity Studies suggest that physical activity levels appear to be trending downwards. The 2010 edition found 12% of adolescents met physical activity guidelines (Woods, Moyna & Quinlan, 2010) while this had dropped to 10% in the 2018 edition

(Woods et al., 2019). Similar to other studies, PA levels were lower in older children and adolescents, and males reported higher levels of PA than females when matched for age and socioeconomic status. Although in line with other countries of similar demographics, these findings highlight the alarmingly low levels of PA in Irish youth.

Physical activity guidelines have been developed and refined over several decades, since the late 1970s, by leading international experts in the field (Oja & Titze, 2011). The broad purpose of physical activity guidelines is to provide recommendations to improve overall health and wellbeing. The original guidelines were published with a view to reducing the onset of cardiovascular disease-related mortality, and, subsequently, were developed to encompass other prevalent chronic conditions such as diabetes and cancer (Piercy & Troiano, 2018). Although the physical activity guidelines make reference to reducing the risk of depression and anxiety in adults and reducing the risk of depression in young people, the evidence behind these recommendations is not as strong as those for physical health (Biddle & Vergeer, 2020). It is also unclear if the same volume, type or intensity of activity is required for supporting positive mental health as for physical health. Recommendations for physical health detail the volume, intensity and type of activity that should be undertaken by both adults and young people but make no reference to other contextual factors that have been shown to play a contributory role in the support or development of optimal mental health. Contextual factors across the lifespan include the life-domain that physical activity occurs in, autonomous motivation, peer support, social interaction, access to green space, and progressions and achievements over time.

A clearer understanding of the bi-directional relationship between physical activity and mental health, or ill-health, may facilitate the delivery of successful interventions in future while also aiding the design and implementation of specific physical activity guidelines for mental health (Teychenne et al., 2020). The current evidence suggests there is a combination of both physiological and psychological factors involved in this relationship. The specific contribution of physiological and psychological factors is, as yet, unclear with a number of hypotheses currently proposed. A recent paper by Lubans et al. (2016) suggested three main interlinking components: the neurobiological processes, and the psychosocial processes, all of which are linked through behavioural processes.

When examining the roles of volume, intensity and type of exercise on mental health there is inconclusive evidence regarding any one specific recommendation that can be made (Teychenne et al., 2020). More physical activity is better, but the current physical activity

guidelines for physical health may not need to be met. Benefits were found when engaging in aerobic exercise, resistance exercise, and yoga, with some of the largest benefits observed in those who engaged in a combination of more than one form of physical activity as a sample of 5,100 females had the lowest probability of co-occurring depression and anxiety when engaging in both aerobic exercise and resistance exercise when compared to either aerobic or resistance only (ARRR = 0.61, 95% CI = 0.43 to 0.86 and 0.47, 95% CI = 0.33 to 0.67 respectively) (Ofstedal et al., 2019). Varying intensities also showed inconsistent results with both high and low levels of intensity conferring similar benefits, although high intensity interval training still warrants further research due to the potentially increased levels of drop out (Costigan, Eather, Plotnikoff, Hillman & Lubans, 2016). Recent research has shifted from volume, intensity and type of physical activity to the context or life-domain through which it is engaged. The guidelines for health do not distinguish between where physical activity is undertaken and state that *“physical activity includes recreational or leisure-time physical activity, transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities”*. The variety of life-domains outlined suggest the context of physical activity is largely irrelevant and benefits to physical health from physical activity are predominantly physiological. As the aforementioned mechanisms of physical activity and wellbeing suggest combinations of both physiological and psychological processes, it gives reason to believe the domain of physical activity plays a significant role for the prevention of mental ill-health and the promotion of positive mental health. A meta-analysis of domain-specific physical activity and associations with mental health found leisure-time physical activity ( $r = .11$ , 95% CI = 0.07 to 0.17,  $p < 0.001$ ) and active travel ( $r = 0.13$ , 95% CI = 0.02 to 0.23,  $p < 0.01$ ) to be positively associated with mental health while leisure-time physical activity ( $r = -.11$ , 95% CI = -0.16 to -0.06,  $p = 0.007$ ) and school sport ( $r = -.09$ , 95% CI = -0.11 to -0.07,  $p < 0.01$ ) were inversely associated with mental ill-health (White et al., 2017). However, physical activity was not consistently associated with lower mental ill-health across domains. Work-related physical activity was positively associated with mental ill-health while household chores and physical education had no relationship with mental health or mental ill-health (White et al., 2017). Interestingly, the positive association observed between active travel and mental health was primarily in adults while studies involving adolescents showed null and negative associations between active travel and mental health (White et al., 2018). Life-domain was found to significantly moderate the strength of the relationship between physical activity and mental ill-health ( $p <$

0.001) and explained 46% of the variance, thus highlighting the need to investigate the most appropriate contexts of physical activity that best support mental health and wellbeing.

Acknowledging that organised sport is a widespread community activity, it is important to consider the extent to which sport participation may protect against symptoms of anxiety and depression, and enhance wellbeing. Azstalos et al., (2009) found that participation in sports, and no other form of physical activity, was consistently associated with significantly less stress (OR = 0.375, 95% CI = 0.2 to 0.7,  $p < 0.001$ ) and distress (OR = 0.48, 95% CI = 0.25 to 0.91,  $p < 0.001$ ). Similarly, Wijndaele et al., (2007) found that participation in sport and no other form of physical activity could discriminate between three meaningful clusters of perceived stress, social support and coping behaviour. A recent meta-analysis also found that symptoms of anxiety and depression were significantly lower among sport-involved adolescents than in those not involved in sport (Panza et al., 2020). A small negative correlation was found between sport participation and anxiety ( $\rho = -0.12$ , 95% CI = -0.15 to -0.10). A small negative correlation was also found between sport participation and depression ( $p = -0.08$ , 95% CI = -0.10 to -0.06). Recent cross-sectional analyses found sport to have a significant protective effect against symptoms of depression and anxiety in adolescents (McMahon et al., 2017). It is therefore arguable that sports participation may represent effective preventive and intervention strategies against stress and distress, both leading causes of symptoms of anxiety and depression. The main reason for less stress/distress may be that sports participation usually represents a chosen leisure-time activity that includes recreation, enjoyment and social interaction (Azstalos et al., 2009). These attributes are associated with enhanced psychological wellbeing, but they rarely can be attributed to types of physical activity that imply compulsion to a certain extent, such as housework or active transportation. Current physical activity guidelines acknowledge that all types of activity, once added up, can contribute to enhanced physical health, suggesting cause and effect are largely biological. Since some forms of activity, although matched for volume and intensity, lead to varying psychological benefits, it suggests that other psychosocial processes are involved in determining benefits for mental health.

During the data collection period for this thesis the World Health Organisation announced a global pandemic caused by the coronavirus disease (Covid-19). National containment strategies were introduced in March 2020 which included physical distancing and self-isolation regulations with a view to reducing person-to-person transmission of Covid-19. As most attention in the early stages of Covid-19 restrictions was understandably focused on public health measures to contain the virus, the focus subsequently broadened to the wider and

long-term ramifications such as social isolation, delayed help-seeking for other health conditions and reduced opportunities for leisure-time physical activity (Smith et al., 2020; McGrath, Murphy & Richardson, 2020). Leisure-time physical activity has been identified as the context, or life-domain, with the strongest associations with positive mental health (White et al., 2017). Reductions in opportunities for leisure-time physical activity, along with restrictions forcing the postponement of many competitive sporting events, is likely to have negative effects on the mental health and wellbeing of adolescents.

#### Summary and significance of thesis:

Increasing physical activity in and of itself is not likely to be worthwhile in terms of reducing the prevalence of mental ill-health, as individuals with occupations that involve higher amounts of physical activity are more likely to experience mental ill-health. This suggests physical activity is not automatically associated with greater mental health and reduced mental ill-health, and that contextual factors are crucial to such relationships (White et al., 2017). Current evidence suggests that leisure-time physical activity is likely to be an optimal domain to promote mental health and prevent mental ill-health. Gaining knowledge of the specific factors that mediate or moderate the relationship between physical activity and mental health, particularly through the leisure-time domain, will help lead to the development of contextually tailored interventions and physical activity guidelines, and improve the effectiveness of physical activity as a prevention and treatment method.

### **1.3 Researcher's Philosophical Stance**

When considering the methods and findings of the studies described in this thesis, it is important to acknowledge the researcher's own guiding experiences and philosophical stance. Stemming from ontology (what exists for people to know about) and epistemology (how knowledge is created and what is possible to know) are philosophical perspectives (generalised views of the world), which form beliefs and drive actions (Moon & Blackman, 2014). The researcher has spent a considerable part of life engaging in sport and physical activity, and has derived great enjoyment from this. The enjoyment, coupled with many physical and mental benefits, has since led the researcher, as a PE teacher and sports coach, to guide others to be physically active. The philosophies underpinning the relationship between physical activity and mental health, and the researchers' understanding of them,

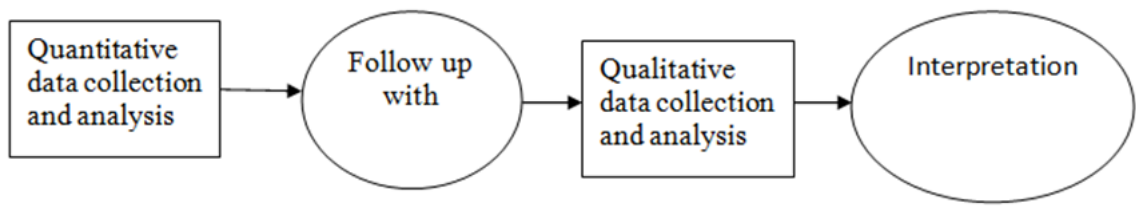
have continued to develop throughout the research journey (monism, existentialism and phenomenology). The researcher acknowledges their bias towards living a physically active lifestyle and the various physical and mental benefits that are associated with this. Looking at mental health and wellbeing as concepts, the literature will show there are many different ways to undertake and interpret research, with no single stance providing a complete understanding (Poucher, Tamminen, Caron & Sweet, 2020). This study, however, primarily aims to view physical activity through the lens of associated psychological benefits, and primarily focuses on those who have previously, and continue to benefit psychologically from their engagement in physical activity and sport. Interpretations made throughout the thesis have been influenced by the researcher's own experiences, understandings and interpretations. A researcher who engages in mixed-methodological research using a belief system grounded in post positivism will take a scientific approach to research (Creswell & Poth, 2016). A social theoretical lens is employed. The term *postpositivism* is used rather than *positivism* to denote this approach as positivists do not believe in strict cause and effect but rather recognise that all cause and effect is a probability that may or may not occur. Postpositivism has the elements of being reductionistic, logical, empirical, cause-and-effect oriented, and deterministic based on a-priori theories. This is often seen at work among individuals with prior quantitative research training and in fields such as the health sciences in which qualitative research often plays a supportive role to research and must be couched in terms acceptable to quantitative researchers. In practice, postpositivist researchers view inquiry as a series of logically related steps, believe in multiple perspectives from participants rather than a single reality, and espouse rigorous methods of qualitative data collection and analysis. Postpositivists use multiple levels of data analysis for rigor, employ computer programmes to assist in analysis, and write qualitative studies in the form of scientific reports, with a structure resembling quantitative articles. With a previous qualification in physiology, the researcher has engaged in this postpositivist approach to mixed-methodological research.

#### 1.4 Explanatory Sequential Mixed Methods Design

The mixed methods research tradition is less well known than quantitative or qualitative traditions because it has emerged as a separate orientation during the past 30 years (Subedi, 2016). Mixed methodologists present an alternative to the QUAN and QUAL traditions by advocating the use of whatever methodological tools are required to answer the research questions under study. Mixed methods has been defined as *“a type of research design in which QUAL and QUAN approaches are used in types of questions, research methods, data collection and analysis procedures and inferences”* (Tashakari & Teddlie, 2003). Mixed methods research provides better inferences and minimises unimethod bias (Tashakari & Teddlie, 2003) and is often selected by researchers in order to search out the opportunity for a greater assortment of divergent views (Subedi, 2016).

Mixed methods research questions are concerned with unknown aspects of a phenomenon and are answered with information that is presented in both numerical and narrative forms (Tashakori & Teddlie, 2003; Bryman, 2006). A unique aspect of any given mixed method study is that it requires at least two research questions (one QUAN, one QUAL). This indicates that research questions drive the selection of research methods, which are often mixed method in nature. A common approach to framing research questions in mixed methods design is to begin with one single question that is overarching in nature before expanding it into separate QUAN and QUAL sub-questions (Subedi, 2016).

Creswell (2011) outlined six types of mixed method design, one of which is explanatory sequential design. According to Creswell and Plano-Clark (2017), explanatory sequential design initially consists of collecting quantitative data and then collecting qualitative data to help explain or elaborate on the quantitative results. The rationale for this approach is that the quantitative data and results provide a general picture of the research problem; more analysis, specifically through qualitative data collection is needed to refine, extend or explain the general picture (Creswell & Plano-Clark, 2017). In this design, a researcher first collects and analyses the quantitative (numeric) data. The qualitative (text) data are collected and analysed second in the sequence and help explain or elaborate on the quantitative results obtained in the first phase. The second, qualitative phase builds on the first quantitative phase and is highlighted in figure 1. An overview of how an explanatory sequential mixed methods design was applied to the current study can be seen in figure 2.



**Figure 1:** *Explanatory sequential design*

### **1.5 Aims & Objectives**

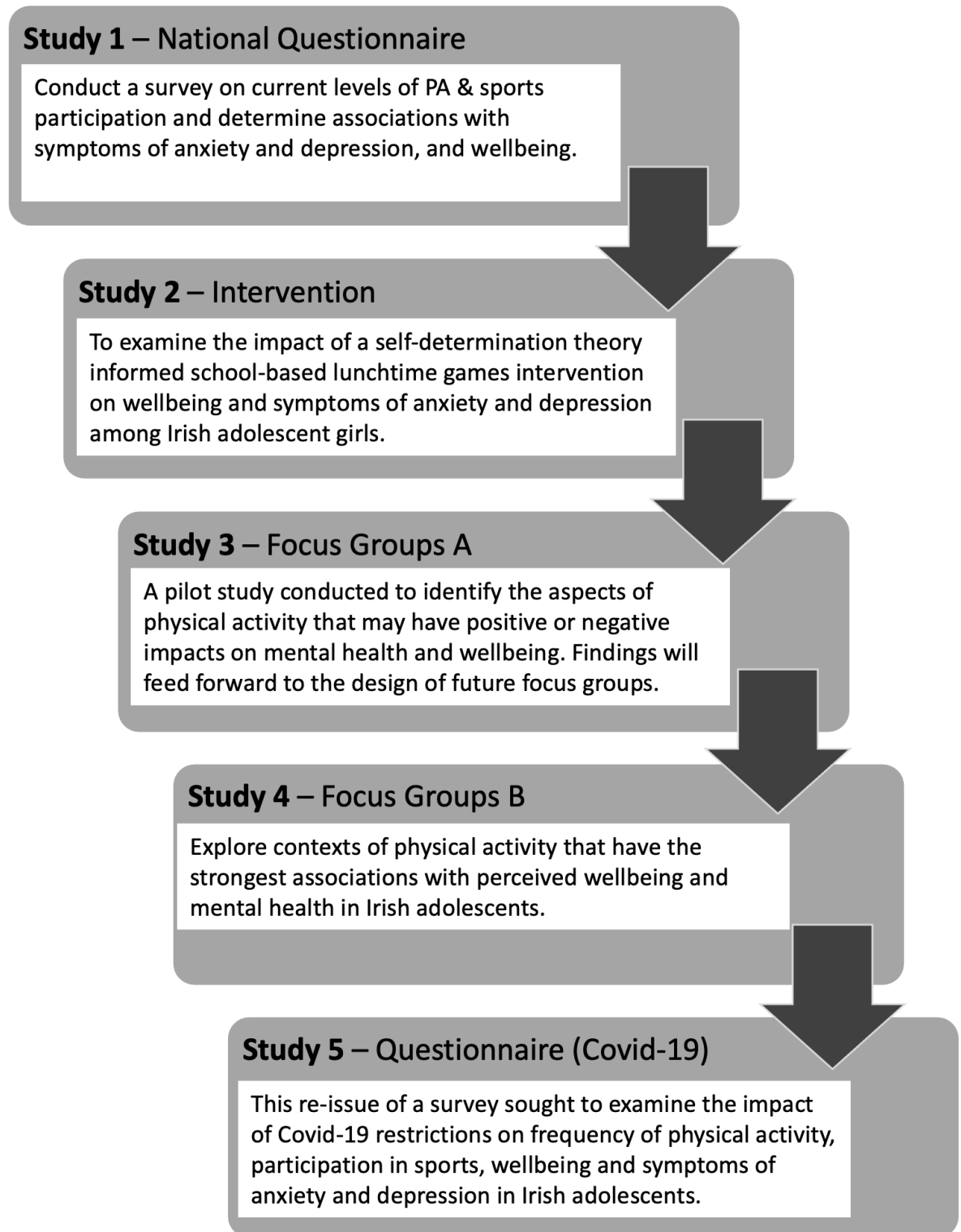
#### **Primary Aims**

1. Examine associations between frequency of physical activity and engagement in sport with wellbeing, and symptoms of anxiety and depression in a sample of Irish adolescents.
2. Explore which contexts of physical activity have the strongest associations with mental health and wellbeing in Irish adolescents.

#### **Secondary Objectives**

1. Examine the impact of a self-determination theory-informed school-based lunchtime games intervention on wellbeing, and symptoms of anxiety and depression in Irish adolescents.
2. Explore the impact of Covid-19 restrictions on physical activity levels in Irish adolescents.
3. Explore the impact of Covid-19 restrictions on wellbeing, and symptoms of anxiety and depression in Irish adolescents.
4. Identify aspects of leisure time physical activity that best support positive mental health and wellbeing in Irish adolescents.
5. Explore potential differences in physical activity experiences between males and females to identify if they impact differently on mental health and wellbeing.
6. Identify the aspects of team sport that may offer a “protective effect” against symptoms of mental ill-health.





**Figure 2:** Schematic overview of the studies involved in this thesis

## 1.6 Thesis Structure

The current chapter has provided a brief overview of the overall thesis, highlighting the background and rationale, primary aims and six key objectives of the research project. Chapter two provides a comprehensive review of the current evidence base regarding mental health, physical activity and their relationship with each other during adolescence. This chapter also addresses current gaps in the literature regarding the impact that contexts of physical activity may have on mental health and wellbeing. Chapter three presents results from a national survey of physical activity, sports participation, wellbeing, and symptoms of anxiety and depression among adolescents in the Republic of Ireland (published in *Physical Activity and Health*). Chapter four provides details of the impact of a self-determination theory informed school-based lunchtime games intervention on wellbeing, and symptoms of anxiety and depression among a sample of Irish adolescent girls (published in *Health Education Journal*). Chapter five contains results from exploratory focus groups that were conducted to identify aspects of physical activity that may have positive or negative impacts on mental health and wellbeing. Findings from this study were used in the design of subsequent focus groups in a larger sample of adolescents (published in *Advances in Physical Education*). Chapter six provides an account of the contexts of physical activity that have the strongest associations with perceived wellbeing and mental health in Irish adolescents (In review at *Mental Health and Physical Activity*). Chapter seven provides details of a re-issue of the questionnaire from chapter three during Covid-19 related restrictions. This re-issue sought to examine the impact of restrictions on frequency of physical activity, participation in sports, wellbeing, and symptoms of anxiety and depression (published in *Physical Activity and Health*). A discussion and conclusion of the research presented in this thesis is provided in chapter eight, along with potential impacts, limitations, and future directions in research and practice from this body of work.

## **Chapter 2:**

### **Literature Review**

#### **2.1 Background & Introduction**

There has been a surge in research exploring the lives of children and adolescents in the last two decades. A significant portion focuses on health related measures such as anthropometry, physical fitness, diet, and physical activity and lifestyle behaviours. Increasing overweight and obesity prevalence rates among adults, adolescents and children have placed urgency on continued monitoring, as well as the development of targeted prevention and management systems. The relationship between the above factors and psychosocial measures has received growing attention in the past 10 years. A recent topic of growing interest is how physical interacts with and impacts upon mental health. The majority of research has been dedicated to establishing if there is a relationship or not with specific emphasis on the optimal frequency and dose. The aim of this review is to explore current literature with regard to physical markers of health, mental wellbeing and how they relate to adolescents (12-18 year olds), with a focus on Ireland and the Irish post-primary school setting.

##### **2.1.1 Search Methods**

A number of data sources were used to search for relevant literature throughout the duration of the study.

1. The online MEDLINE/PubMed database of references and abstracts on life sciences topics was first used to identify peer reviewed publications. Search terms, with the adjunct keyword 'adolescents,' included 'physical activity,' 'wellbeing,' 'depression,' 'anxiety,' 'self-efficacy,' 'self-esteem,' 'self-concept,' 'exercise,' 'mental health'.
2. Reference searching from initially sourced publications was used to identify a wider body of published research. At this stage, the online databases of key adolescent physical and psychological health were searched individually and they include: The Journal of Adolescent Health, Psychology of Sport & Exercise, European Children & Adolescent Psychiatry, International Journal of Behavioural Nutrition and Physical Activity and the Journal of Paediatric Psychology.

3. International reports and publications such as those from the World Health Organisation ([www.who.int](http://www.who.int)) were accessed by searching their respective websites.

4. National reports and publications from governmental bodies (e.g. The Department of Education and Skills, the Department of Children and Youth Affairs, the Department of Health) and research groups such as The Children's Sport Participation and Physical Activity Study (<https://www.sportireland.ie/research/csppa-2018>) and My World Survey: Study of Youth Mental Health in Ireland (<http://www.myworldsurvey.ie/>) were sourced from their respective websites.

5. The library at Dublin City University was used to source books on adolescent development and research methodologies.

Inclusion criteria used for peer reviewed literature were as follows:

- Exploratory, observational, experimental and review publications from the previous 18 years were favoured.
- Publications older than eighteen years of methodological or theoretical relevance were included.

## **2.2 The Adolescent Years**

The gap from childhood to adulthood is bridged by the important stage of life known as adolescence. Adolescence refers to the period from 10 to 19 years old (Benson & Scales, 2009). Adolescence can be further broken into three distinct phases – early adolescence or pre-pubescent (10 to 14 years), mid adolescence or pubescent (15 to 17 years) and late adolescence, post-pubescent or young adulthood (18 to 24 years) (Spano, 2004). The World Health Organisation (WHO) suggest that the adolescent years is a range in line with the 'teen' ages while acknowledging that significant differences exist in terms of development across cognitive, social, emotional and physical domains. These developmental differences continue into the early twenties and 'young people' or 'adolescents and young adults' are less formal terms that refer to people aged 10-24 years (Sawyer et al., 2012). Both the theoretical and contextual meanings of adolescence have changed in the past number of years. A child's journey into adolescence is starting earlier and finishing later than in previous generations. Young people are experiencing many of the personal and social pressures that adolescence brings at a much younger age, and taking longer to assume the responsibility of 'adulthood' (Arnett, 2000). Prior to the 20th century, children moved fairly rapidly into an adult lifestyle,

taking on adult roles of wage-earning in their early to mid-adolescence or even earlier in some cases. In many countries, it is still common today for many adolescents to be responsible for child-rearing, wage-earning or being part of the community survival effort (Aggleton, Hurry & Warwick, 2000). In the modern age they are entering marriage and parenthood later; education lasts longer, and many young people in their late adolescence and 20s explore a variety of activities and experiment with different careers in a way that was not possible for their parents (Bates, Illback, Scanlan, & Carroll, 2009). The implications of all these changes are still poorly understood. A brief background of adolescence and its changing nature will be outlined below to provide a context to the population in this study.

Research regarding distinct adolescent phases in childhood development began in the early 20th century and was first described in the scientific literature by G. Stanley Hall (Hall, 1904 described by Arnett, 1999). Hall (1904) proposed that adolescence is inherently a time of 'storm and stress'. This view continues to be addressed by modern psychologists although many reject the view that adolescent 'storm and stress' is universal and inevitable (Eccles et al., 1993; Steinberg & Levine, 1997). Taking historical and theoretical views into account along with contemporary research, the core principle of the storm and stress view appears to be that adolescence is a period of life that is *difficult* (Buchanan et al., 1990) and seemingly more difficult than other periods of life. While adolescence is difficult for the adolescent themselves, it is also a difficult period for those around them. The storm and stress concept is comprised of three key elements:

- i. *Conflict with parents* – Adolescents have a tendency to be rebellious and to resist adult authority. In particular, adolescence is a time when conflict with parents is especially high.
- ii. *Mood disruptions* – Adolescents tend to be more volatile emotionally than either children or adults. They experience more extremes of mood and more swings of mood from one extreme to the other. They also experience more frequent episodes of depressed mood.
- iii. *Risk behaviour* – Adolescents have higher rates of reckless, norm-breaking, and anti-social behaviour than either children or adults. Adolescents are more likely to cause disruptions of the social order and to engage in behaviour that carries the potential for harm to themselves and/or the people around them including smoking,

drug and alcohol use, careless driving, unprotected sexual behaviour and suicidal ideation (Michael & Ben-Zur, 2007; UNICEF, 2007).

The above three elements are widely accepted among psychologists although many others suggest including, albeit not universally, other elements such as school difficulties (Eccles et al., 1993) and self-image (Offer & Schonert-Reichl, 1992). Adolescents are more likely to engage in, and suffer from increased incidences of the above elements (Arnett, 1999), thus leading to greater difficulties during this time of transition.

A shift in expectations at the home and societal levels also impacts young adolescents. Traditional childhood behaviours are not tolerated any longer and increased cooperation is expected. Early adolescence, at 12-13 years, coincides with the move from primary to post-primary school in Ireland. These social changes, which occur during puberty, may have a stronger effect than if they happen before or after puberty (Kroger, 2006; Eccles et al., 1993). The rate of biological changes have begun to decline by mid-adolescence (15-17 years). The majority of males and females will have reached 98% of their maximum adult height. Mid-adolescents begin to have an acceptance of their biological transformations that stem from puberty and assimilate them into a revised sense of identity (Kroger, 2007). It is a time of ongoing negotiations at home as adolescents further distance themselves from the values and goals of their parents. Peer and one to one relationships take on more prominent roles in mid-adolescence as adolescents are most influenced by peers, compared to early and late adolescence (Steinberg & Morris, 2001). These social changes, occurring both inside and outside the family home, lead the adolescent on a quest for a sense of self and personal identity that is uniquely their own (Hornsey, 2008).

Adolescents can conceive various possibilities inherent in situations, in comparison to younger children, allowing them the capabilities to solve a variety of problems (Ginsburg & Oppen, 1988). However, the aforementioned heightened incidences of risk behaviour also associated with mid-adolescence like substance abuse and violence, may also manifest themselves in poor dietary practices, lack of physical activity and an increase in sedentary activities (Sawyer et al., 2012). Adolescents are more easily influenced by emotion, which has a functional role in terms of experimentation and autonomy development (Konrad, Firk & Uhlhaas, 2013). The influence of peers and the prospects of desired rewards play more significant roles in the behaviours of adolescents than more rational decision-making processes. Decision-making in

exciting or stressful situations seems to have more of an affective impact on adolescents than adults, especially when in the presence of peers (Konrad et al., 2013). Peer acceptance and reward appear to be more highly considered than the risk itself at this age (Konrad et al., 2013; Sawyer et al., 2012). The use of societal disapproval as a deterring factor in the prevention of risk-taking behaviour is wholly insufficient and any initiatives that aim to research or address health behaviours of adolescents need to place young people at the centre of their design to fully understand the complexities associated with such approaches in this population (Lerner, von Eye, Lerner & Lewin-Bizan, 2009).

## **2.3 Mental Health & Wellbeing**

### ***2.3.1 Defining Wellbeing***

Research on wellbeing has grown dramatically in recent decades although no universal definition (or even spelling) has yet been agreed upon (Dodge, Daly, Huyton & Sanders., 2012) with some suggesting that *'wellbeing is intangible, difficult to define and even harder to measure'* (Thomas, p. 11, 2009). Two approaches have emerged over time: The hedonic view which focuses on happiness, positive affect, low negative affect, satisfaction with life (Diener & Emmons, 1984; Kahnemann, Diener & Schwarz, 1999; Lyubomirsky & Lepper, 1999); and the eudemonic view which focuses on positive psychological functioning and human development (Rogers, 1961; Ryff, 1989; Waterman, 1993). Despite these two different approaches, most researchers now believe wellbeing to be a multi-dimensional construct (Diener, 2009; Dodge et al., 2012). There is conceptual overlap among common indicators of wellbeing, which commonly include constructs of global self-esteem, subjective wellbeing, quality of life, and psychological resilience (Lubans et al., 2016). The focus has recently shifted away from a lack of negative affect, or lack of mental ill-health, and instead toward a definition of optimal positive health.

#### Eudaimonia:

A Greek word commonly translated as 'happiness' or 'welfare'; although more accurate translations have been proposed, such as 'human flourishing, prosperity', and 'blessedness' (Nodelman, Allen & Perry, 1995). Aristotle believed eudaimonia was the overarching goal of all human activities and used it as the term for the highest human good. Defined as *"The good composed of all goods; an ability which suffices for living well; perfection in respect of virtue;*

*resources sufficient for a living creature*” (Ameriks & Clarke, 2000). The rise of *Positive Psychology*, which coincided with Martin Seligman’s tenure as President of the American Psychological Association led to the development of the “Questionnaire for Eudaimonic Well-Being” which focused on six key dimensions: Self-discovery; Perceived development of one’s best potentials; A sense of purpose and meaning in life; Investment of significant effort in pursuit of excellence; Intense involvement in activities; and Enjoyment of activities as personally expressive (Waterman et al., 2010).

#### Previous Definitions:

An early attempt to define wellbeing was Bradburn’s (1969) classic research on psychological wellbeing. His work moved away from the diagnosis of psychiatric cases to the study of psychological reactions of ordinary people in their daily lives. His discussion was based on an interest in how individuals coped with the daily difficulties they faced. The majority of Bradburn’s research focused on the distinction between positive and negative affect. His model specified that:

*“An individual will be high in psychological well-being in the degree to which he has an excess of positive over negative affect and will be low in well-being in the degree to which negative affect predominates over positive.”* (Bradburn, 1969)

This early description suggests a continuum along which individuals move; from positive to negative, although it does not necessarily define what constitutes wellbeing. Bradburn’s (1969) model led to a number of researchers trying not only to define what wellbeing is, but trying to define what contributes to and develops wellbeing. One of the first attempts at defining wellbeing stated it is *“a global assessment of a person’s quality of life according to his own chosen criteria”* (Shin & Johnson, 1978), although ‘quality of life’ can be difficult to define in and of itself. The World Health defined quality of life as:

*“An individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person’s physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment.”* (WHO, 1997)



Diener and Suh (1997) tried to incorporate quality of life into their description of what wellbeing is, although still incorporated both positive and negative affect:

*“Subjective wellbeing consists of three interrelated components: life satisfaction, pleasant affect, and unpleasant affect. Affect refers to pleasant and unpleasant moods and emotions, whereas life satisfaction refers to a cognitive sense of satisfaction with life.” (Diener and Suh, 1997)*

Towards the end of the 1980's and throughout the 1990's, researchers of wellbeing spoke about the need to move away from a continuum that ranged from positive affect to negative affect, but instead as two separate dimensions (Headey, Holmstrom & Wearing) with only moderate to strong associations between the two domains (Headey, 2006). One of the first attempts at identifying what constitutes wellbeing suggested autonomy; environmental mastery; positive relationships with others; purpose in life; realisation of potential and self-acceptance (Ryff, 1989). More recent research has placed different emphases on what wellbeing is, such as: the ability to fulfil goals (Goswami, 2008); happiness (Pollard & Lee, 2003); and life satisfaction (Diener & Suh, 1997; Seligman, 2004). The inclusion of goal achievement by both movements is interesting as other researchers have also believed that wellbeing stems from individuals' perception of their current situation and their aspirations (Emerson, 1985; Felce & Perry; 1995).

This sole emphasis on positive affect has enabled psychologists to 'de-medicalise' the concept of health (Stratham & Chase, 2010). Consequently, it is now possible to consider wellbeing separately from ideas of illness and as a construct in its' own right rather than an absence of negative affect or illbeing. Herzlich (1973) proposed that wellbeing should be viewed in a positive light in itself *“as a presence of which one is fully aware because of one's feelings of freedom and of bodily and functional wellbeing”*, although this belief was not widely accepted until the late 1980's and early 1990's. Herzlich (1973) also made another important point when highlighting the importance of defining *“what constitutes normality”* as without a widely accepted definition of normality then we are unable to identify deviations from normality, whether due to positive or negative affect.

Seminal work in regard to positive functioning, a precursor to wellbeing which dates back to writings of James in 1902, culminated in the work of Rogers (1957), who discussed wellbeing in terms of *“the good life”*. He believed that each individual strived towards becoming a *“fully*

*functioning person*” who is open to experience, is trusting in his/her own organism, and leads an increasingly existential life (Rogers, 1961). Ryff and Singer (2008) were influenced by Rogers’ early works when developing their core dimensions of psychological wellbeing (PWB): self-acceptance; purpose in life; environmental mastery; positive relationships; personal growth; and autonomy.

An interesting development is the way in which this area of wellbeing has impacted on clinical psychology with some calling for clinical psychology to adopt measures of positive functioning as they believe psychiatry has adopted a restricted view of wellbeing that focuses primarily on an absence of distress and dysfunction (Joseph & Wood, 2010). It is believed this natural broadening of the field would allow for prediction and treatment of distress and dysfunction through positive psychology. These measures of positive functioning have sometimes been identified as ‘wellbeing symptoms’ (Keyes, 2002; 2005). Keyes believes that mental health is created *“when an individual exhibits a high level on at least one symptom of hedonia and just over half the symptoms of eudaimonia, i.e., positive functioning in life”* (Keyes, 2009). In his 2002 research, Keyes asked adolescents to report the frequency of three symptoms of emotional wellbeing, four symptoms of psychological wellbeing and five symptoms of social wellbeing. He made a “diagnosis of flourishing” if the individual displayed a third of the emotional symptoms, four of the psychological symptoms and five of the nine symptoms of positive flourishing *“almost every day”* or *“every day”* in the past thirty days. Keyes work saw the adoption of the terms ‘flourishing’ and ‘languishing’ as scientific concepts, rather than as philosophical ideals, as they had been previously presented (e.g. Griffin 1986; Sumner, 1996; Hursthouse, 1999). The work of Keyes had a direct influence on Shah and Marks (2004) who, in their ‘wellbeing manifesto for a flourishing society’ described wellbeing as:

*“More than just happiness. As well as feeling satisfied and happy, wellbeing means developing as a person, being fulfilled, and making a contribution to the community.”*

The emergence of the term ‘flourishing’ has now become synonymous with the aforementioned positive psychology movement. Gable and Haidt (2005) explain that *“positive psychology is the study of the conditions and processes that contribute to the flourishing or optimal functioning of people, groups, and institutions”*. As the undeniable leader of the positive psychology movement, Martin Seligman stated on the opening day of his presidency of the American Psychological Association that:

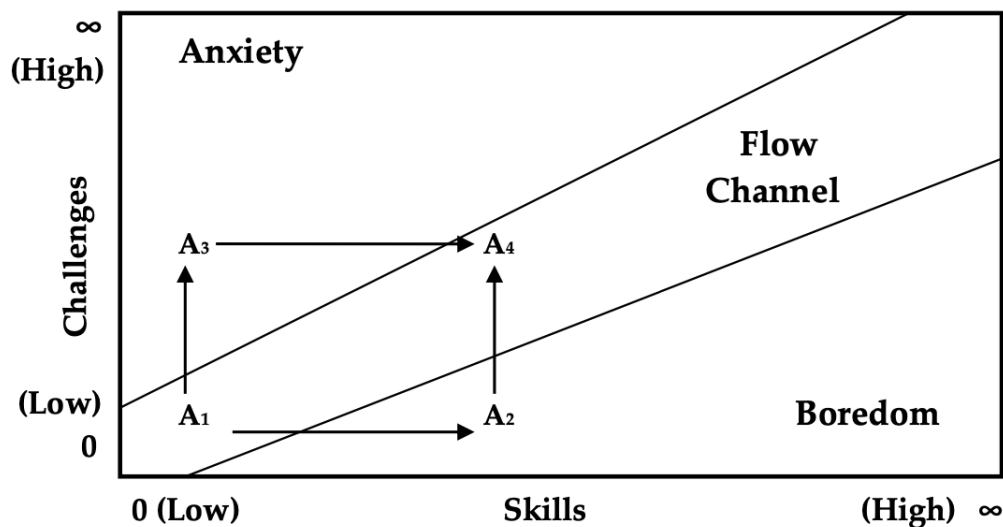
*“I realised that my profession was half-baked. It wasn’t enough for us to nullify disabling conditions and get to zero. We needed to ask, what are the enabling conditions that make*

*human beings flourish? How do we get from zero to plus five?” (Seligman, 1998, cited in Wallis, 2005, online)*

After his tenure as President, Seligman published his latest book entitled *Flourish* (Seligman, 2011), in which he outlines his new ‘dynamic’ concept of wellbeing, which moves away from theories based purely on happiness. The rationale behind this move is because the notion of ‘happiness’ is an awkward construct that hides the true, complex, nature of human flourishing. He sums this up by saying:

*“I used to think that the topic of positive psychology was happiness. I now think that the topic of positive psychology is wellbeing, that the gold standard for measuring wellbeing is flourishing, and that the goal of positive psychology is to increase flourishing.” (Seligman, 2011).*

In his 2011 book, Seligman outlines his new theory of wellbeing, which concentrates on elements that serve as a set of building blocks for a flourishing life: Positive Emotion, Engagement, Relationships, Meaning and Accomplishment, summed up by the acronym PERMA.



**Figure 3:** Demonstration of the relationship between challenges and skills (Csikszentmihalyi, 2002).

Renowned psychologist and researcher, Mihaly Csikszentmihalyi has spent his career focusing on the concept of ‘flow’ (1975) – “the state in which people are so involved in an activity that nothing else seems to matter” (Csikszentmihalyi, 2000), which in turn leads to happiness. His

theory is predicated on the notion that each individual develops relevant skills or resources to cope with the trials or challenges they might face. His original model assumed that enjoyment would happen when the strength of challenge and skills were both very low as well as when they were both high, as can be seen in figure 1. Csikszentmihalyi's model of flow has been proposed as a simplified model of wellbeing with some also suggesting the flow state is where true wellbeing occurs (Dodge et al., 2012).

Another model, the lifespan model development (Hendry & Kloep, 2002), is based on five key principles:

1. Individuals need challenge to stimulate development
2. Successfully solved challenges lead to development.
3. Unsolved challenges lead to problems when meeting challenges in the future.
4. This *"interactional, dialectical process"* of solving challenges leads to changes in the individual and/or the environment which accordingly stimulates development.
5. Individuals will have different levels of resources to meet the challenges.

Hendry and Kloep's (2002) model does not explicitly state a link to wellbeing, although it does reflect key elements of dynamic equilibrium theory in terms of the challenges an individual faces and in terms of how wellbeing is a fluctuating state. It also reflects the stages of physical development as proposed in Selye's (1950) model of general adaptation syndrome.

The most recent definition of wellbeing was proposed by Dodge et al., (2012). Their paper highlighted the undeniably complex task that defining wellbeing is while also recognising that previous research has been driven by dimensions and descriptions rather than definitions. Drawing upon the body of previous research, Dodge et al., (2012) focused on three key areas: the idea of a set-point for wellbeing; the inevitability of equilibrium/homeostasis; and the fluctuating stage between challenges and resources. Their proposal focused on a balance between an individual's resource pool and the challenges faced.



**Figure 4:** See-saw as a definition of wellbeing (Dodge et al., 2012).

The see-saw represents the drive of an individual to return to a set-point for wellbeing (Brickman & Campbell, 1971; Headey & Wearing, 1989, 1991, 1992) as well as the individual's need for equilibrium of homeostasis (Herzlich, 1973; Cummins, 2010). Dodge et al., (2012) have included a number of resources and challenges that make up either side of the see-saw, which tips from side to side based on the various resources an individual has at their disposal to meet the challenges placed upon them. This works just as Kloep, Handry and Saunders (2009) described:

*"Each time an individual meets a challenge, the system of challenges and resources comes into a state of imbalance, as the individual is forced to adapt his or her resources to meet this particular challenge."*

Dodge et al. (2012) describe stable wellbeing as when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge. When the challenges imposed on an individual exceed their available resources, the see-saw (in figure 2), dips, along with their wellbeing, and vice-versa. Dodge et al.'s (2012) definition supports Headey and Wearing's (1992) aim to *"understand how people cope with change and how their levels of wellbeing are affected"*. This is in contradiction to Cummins' (2010) proposal that wellbeing is static when individuals are not exposed to sufficient challenges which suggests that a lack of challenge will lead to *"stagnation"* (Hendry & Kloep, 2002; Dodge et al., 2012). The see-saw based definition of wellbeing also contains an element of dynamism whereby challenges and resources are constantly changing and while coping with the ever-changing balancing act between the two truly reflects wellbeing in an individual. Dynamism is important as previous definitions of wellbeing were based around purpose, engagement and meaning (Ryff & Singer, 2008), all of which require a level of movement or progression for an individual to consistently experience, or strive towards, wellbeing. Balancing resources against challenges is also important as resilience is often identified as a key contributor to wellbeing (Rutter, 2006). The concept of resilience is displayed when individuals have relatively high levels of wellbeing, despite exposure to acute or chronic stressors, or challenges, that are associated with negative outcomes (Rutter, 2006). The challenges proposed by Dodge et al. (2012) are then a necessary component in any model or definition of wellbeing and should be taken into consideration, alongside the resources deemed necessary to cope with said challenges, when planning any form of programme or intervention that targets wellbeing.

### **2.3.2 Mental Health of Young People**

Gore et al. (2011) conducted a systematic analysis on the Global burden of disease and found that mental health disorders account for nearly half (45%) of the disease burden in the world's adolescents and young adults. Mental health (or neuropsychiatric, as described in the study) disorders were the leading cause of disability throughout all regions of the world. Mental health disorders included major depression, anxiety disorders, substance abuse, schizophrenia and bipolar disorder (Gore et al., 2011). Data from several countries suggest that the number one health issue for young people is their mental health. About 70% of health problems and most mortality among the young arise as a result of mental health and substance-use disorders (McGorry, 2005). Ireland, Portugal, Germany, Finland and the United Kingdom have the highest rates of reported depression in Europe for those aged 15 years and over, all with greater than 10% prevalence rates for chronic depression (Biddle et al., 2018). This is concerning as almost 75% of all mental disorders first emerge between the ages of 15 and 25 (Hickie, 2004; Kessler et al., 2005; Kim-Cohen et al., 2005). The Mental Health Foundation reports 2014 data showing that 19.7% of people in the UK aged 16 years and over showed symptoms of anxiety or depression. This was a 1.5% increase from the previous year, and rates appear to be higher among females (Biddle et al., 2018). Lifetime prevalence of deliberate self-harm in Irish adolescents aged 15-17 years is between 8% and 12% (Dooley & Fitzgerald, 2012), while McMahon et al. (2017) also found it is three times more prevalent among females than males. A study was conducted by Madge et al. (2011) in over 30,000 adolescents aged 14-17 in seven European countries, including Ireland, examining reasons for self-harm and found that the most commonly reported reason was: 'to get relief from a terrible state of mind'.

Young people in Ireland are over-represented among those who die by suicide (Scoliers et al., 2009). Ireland has the fourth highest mortality rate from suicide in the EU among the 15-24 age group (Mental health Commission, 2010) and the third highest among young men aged 15-19. Suicidal behaviours have been shown to coincide with many psychological problems, including anxiety (D'Attilio & Campbell, 1990), depressive episodes (Hollis, 1996), psychotic manifestations (Nishida et al., 2010) and alcoholism (Buri, von Bonon, Strik & Moggi, 2009). Evidence also exists suggesting suicide behaviours are related to a range of risk behaviours including substance misuse (Schneider et al., 2011), risky sexual behaviour (Kim, Kim, Kawachi & Cho, 2011) and delinquency (Bjorkenstam, Bjorkenstam, Vinnerljung, Hallqvist & Ljung, 2011) which occur more frequently in adolescents, particularly during the stages of increased 'stress and storm' (Arnett, 1999). A strong relationship has been established between poor

mental health and many other health and development concerns for young people, including substance use and abuse, violence, educational achievements and reproductive and sexual health (Dooley & Fitzgerald, 2012).

### **2.3.2.1 Anxiety & Depression**

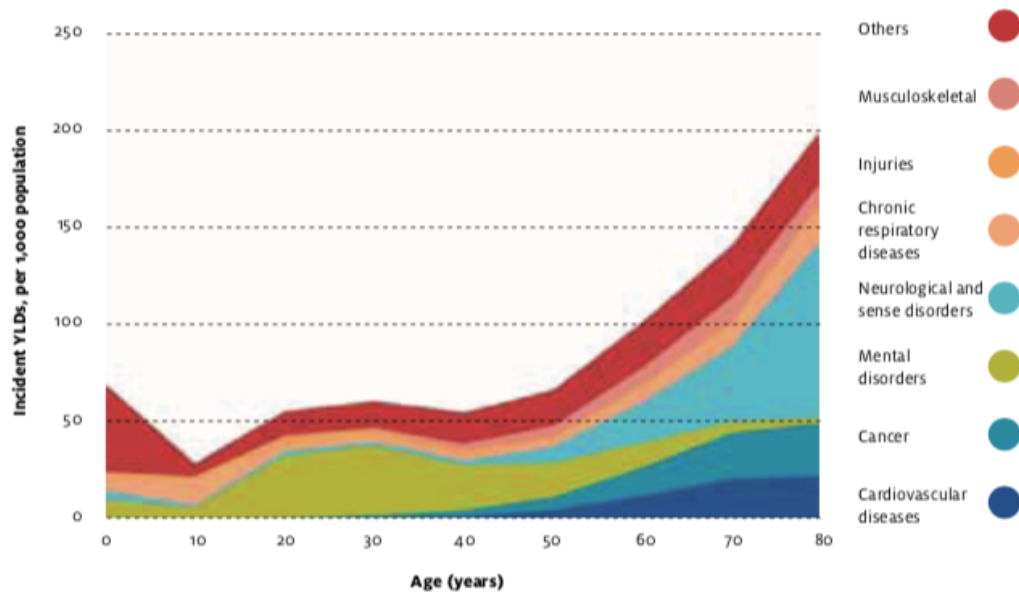
Depression: Depression is the leading cause of disability worldwide (WHO, 2017). It affects an estimated 322 million people worldwide and is more common among females than males (5.1% v 3.6%) (WHO, 2017). Clinically defined depression is a mood disorder known as major depressive disorder. In the Diagnostic and Statistical manual of Mental Disorders-5 (DSM-5) (Widiger et al., 1997). People have a major depressive episode what at least five of the following symptoms have been present during the same 2-week period, nearly every day, and represent a change from previous functioning: depressed mood, loss of interest or pleasure in normal activities, feelings of worthlessness, psychomotor agitation, abnormalities in weight, sleep or energy, or concentration and, often, suicidal thoughts. Additionally, at least one of the symptoms must be either depressed mood or loss of interest or pleasure in normal activities.

Anxiety: Anxiety disorders are the sixth leading cause of disability worldwide (WHO, 2017). They affect an estimated 264 million people worldwide and, like depression, are more common among females than males (4.6% v 2.6%). Anxiety is a normal adaptive response to stress that allows coping with adverse situations (Coutinho et al., 2010; Tallman et al., 1980), although when anxiety becomes excessive or disproportional in relation to the situation that evokes it, or when there is not any special object directed at it, such as an irrational dread of routine stimuli, it becomes a disabling disorder and is considered to be pathological (Coutinho et al., 2010). A distinction can be made between transient anxiety symptoms (i.e., state anxiety), and persistent symptoms (i.e. trait anxiety). When anxiety is experienced without an obvious danger, when the reaction is too strong in relation to the danger, or when the expectation of a potential anxiety reaction is very high and chronic, symptoms may be classified as an anxiety disorder. DSM-5 anxiety disorders include: separation anxiety disorder, selective mutism, specific phobia, panic disorder, agoraphobia, and generalised anxiety disorder.

### 2.3.3 Burden of Mental Health Disorders in Young People

The majority of research focusing on the mental health or ill-health of young people focuses on anxiety and depression, and their symptoms. An Australian study examining the burden of disease clearly displays the peak onset of mental health problems during the adolescent period. Figure 2.1 displays the overall burden of the Australian population and a marked rise can be seen in mental disorders from ages 10 to 20. Figure 2.1 clearly shows that mental disorders emerge during adolescence and are the most prevalent single group of disorders through adolescence into early adulthood (Vos & Begg, 1999).

**Figure 2.1:** Incidence of years lost to a disability rates per 1,000 by age and broad disease grouping, Victoria 1999 (Vos & Begg, 1999)



**Figure 5:** Incidence of years lost to a disability rates per 1,000 by age and broad disease grouping, Victoria 1999 (Vos & Begg, 1999).

There appears to have been a marked increase in prevalence of mental disorders among young people over the past fifty years although there is some dispute over this (Collishaw, 2009; Eckersley, 2008; 2009). Two meta-analyses reported an increase in symptoms of psychopathology among American college students between 1938 and 2007, and among high-school students between 1951 and 2002 as a 5-fold increase was observed in those now scoring above common cut-offs for psychopathology (Twenge et al., 2010). Twice as many young people reported frequent feelings of depression or anxiety in 2006 compared to 1986



(15% vs 7%; OR = 2.48 [1.65-3.72],  $p < .001$ ) in a UK examination of trends in adolescent emotional problems (Collishaw, Maughan, Natarajan & Pickles, 2010). They also found marked changes in some symptoms such as worry, fatigue and irritability.

#### **2.3.4 An Irish Context**

There is a limited body of research on the prevalence of mental health difficulties among adolescents in Ireland to date. Large-scale studies, such as those outlined below, that capture the health profile of adolescents help us to understand the experiences of young people so we can design interventions and supports in the future.

⇒ An epidemiological examination of 723 adolescents (aged 12-15) from 8 Dublin schools, involving a screening and interview phase, found that 19.4% of students were 'at risk' while 15.6% met the criteria for a current psychiatric disorder. Despite so many participants meeting the criteria for a current diagnosis, only a small minority (4%) had come to the attention of the appropriate Child and Adolescent Mental Health Services. The authors reported that psychiatric disorders and suicidal behaviours are similar in young Irish adolescents to those in other Western cultures. They concluded that mental health promotion should be given priority in schools (Lynch, Mills, Daly & Fitzpatrick, 2006).

⇒ A regionalised project sought to determine the prevalence of mental health problems among children and adolescents in the South East of Ireland and make recommendations for service development. The authors (Martin, Carr, Burke, Carroll & Byrne, 2006) found that 18.7% of the 3,374 participants screened met the criteria for at least one psychological disorder with 21% of 12-18 year olds meeting the same criteria. Anxiety disorders were the most common and accounted for 43% of all psychological disorders. Typically, individuals identified with clinical risk were from socially disadvantaged backgrounds and had more behavioural, physical health, family, life stress and coping problems than those not thus identified. Most of those identified as either being at risk or meeting the criteria for a psychological disorder were receiving no professional help, and fewer still had contact with the child and adolescent mental health services. The authors recommended that services for individuals with mental health disorders should be planned so as to take account of the fact that about 1 in 5 young people under 18 have significant psychological disorders. They also suggest that greater supports be put in place for both anxiety and disruptive behaviour disorders as they are more common than all others.

⇒ Another regionalised project screened 4,000 adolescents for mental health disorders in the Cork and Kerry region. 27% of participants reported serious personal, emotional, behavioural or mental health problems. Worryingly, only 18% of those who reported issues sought the help of a professional. A higher proportion of females displayed signs of depression (8%) and had an emotional disorder (13%) than males (5% and 6% respectively). 12% reported a lifetime history of deliberate self-harm while 46% of those had done so more than once. Females (14%) were three times as likely to harm themselves as males (4%) which is similar to findings by McMahon et al. (2010). When experiencing problems, a small minority responded that they would seek help from a healthcare professional with most preferring to talk to friends, followed by family (Sullivan, Keeley, Corcoran & Perry, 2004).

⇒ The My World Survey, A National Study of Youth Mental Health in Ireland (Dooley, Fitzgerald & Giollabhui, 2012) surveyed 6,085 adolescents (aged 12-19 years) from 72 post-primary schools. The researchers sought to identify key risk factors related to health and wellbeing among young people in Ireland and compare this sample to internationally published data on young people. Approximately one third of adolescents were found to experience elevated levels of depression (30%) and anxiety (32%) which is higher than the previous investigations mentioned above. Age, gender, maternal education, family composition, parental mental health as well as the experience of racism and bereavement were associated with elevated levels of depression and anxiety. Psychosocial factors associated with depression and anxiety included optimism, personal competence, life-satisfaction, self-esteem, anger, body dissatisfaction, experiencing the break-up of a romantic relationship, school, peer connectedness and the availability of one good adult. They also found that engaging in substance abuse was found to increase the likelihood of anxiety and depression. The authors concluded that a community-based approach to youth mental health would be most appropriate since factors protecting and putting adolescents at risk of anxiety and depression exist at every level of the adolescent's ecological system.

⇒ The My World Survey 2 (Dooley, O'Connor, Fitzgerald & O'Reilly, 2019) surveyed 10,459 adolescents from across the Republic of Ireland. Levels of depression and anxiety increased from 2012 to 2019 as adolescents were much less likely to be in the normal range for depression and anxiety, and much more likely to be in the moderate, severe or very severe ranges for depression and anxiety since 2012. Adolescents reporting symptoms of depression

outside the normal range increased 30% to 39% while adolescents experiencing symptoms of anxiety outside the normal range increased from 32% to 52%. Levels of protective factors related to mental health, such as self-esteem, optimism and resilience, were found to have decreased since 2012 such as self-esteem (28.6 v 26.4), optimism (13.8 v 12.8) and resilience (30.3 v 27.9). Females were more likely to report higher levels of depression (45% v 33%) and anxiety (54% v 41%), and lower levels of self-esteem (28.8 v 25.7), body esteem (24.2 v 19.3), and resilience (29.4 v 26.8) than males of the same age. Factors such as sleep, physical activity, social media use and pornography use were strongly associated with depression and anxiety. Adolescents did however demonstrate good insight into their mental health, where awareness of problems and help-seeking behaviour was linked to standardised measures of depression and anxiety.

Taken together, these studies suggest that approximately one in five young people in Ireland are experiencing some form of emotional distress or psychological disorder. Only a small minority experiencing psychological difficulties are in contact with some form of helping agency. There appears to be a hidden population of young people with mental health difficulties who are not coming to the attention of the health services as can be seen from the large discrepancy between those with difficulties and those actively seeking help. If only a minority of those experiencing difficult times are seeking professional support, many young people are struggling with the challenges of adolescence without help or access to adequate support systems. Overwhelming evidence exists suggesting that when appropriate support is provided at an early stage to young people with mental health issues, the majority either recover or develop coping strategies that aid in the effective management of stresses throughout the rest of their lives (Evans, Hawton & Rodham, 2005).

### ***2.3.5 Measurement of Mental Health Outcomes***

#### ***2.3.5.1 Beck Youth Inventory***

The Beck Youth Inventory (BYI) (Beck et al., 2001) includes five self-report inventories including anxiety, depression, anger, disruptive behaviour and self-concept. Each inventory contains 20 items, which are presented as brief self-statements. Each inventory yields a raw score that can be added together to give a cumulative score. None of the inventories contain subscales representing more specific item grouping. The internal consistency and the 1-week test-retest reliability of the BYI appear to be at least acceptable across most inventories and norm groups (Bose-Deakins & Floyd, 2004). The content of the inventories was developed

based on reviews of the Diagnostic and Statistical manual of Mental Disorders (DSM-5) (APA, 2013), research examining relevant child psychological disorders, and reviews of related assessment instruments for children (Bose-Deakins & Floyd, 2004). The BYI is made up of brief instruments that can be useful in screening young people who might be at risk for having or developing maladaptive thoughts and behaviours. As the inventories can be administered to individuals or groups, diagnostic screening and monitoring of young people's thoughts and behaviours can be conducted quickly. Reliability evidence supports the consistency of measurement across short periods of time in a sample of adolescents (Bose-Deakins & Floyd, 2004). The inventories have a strong theoretical and empirical base stemming from a well-established theory of psychopathology and associated treatments (Bose-Deakins & Floyd, 2004). As the proposed studies seek to focus on both positive and negative aspects of mental health, only the depression and anxiety sections of the BYI will be employed along with another established tool for measuring wellbeing, as outlined below.

#### ***2.3.5.2 Beck Depression Inventory***

The Beck Depression Inventory (BDI) (Beck et al., 1961) was derived from observations about the attitudes and symptoms displayed by depressed psychiatric patients. The observations were systematically reduced to 21 symptoms and attitudes which could be rated from 0 to 3 in terms of intensity. Importantly, the items were chosen to assess the intensity of depression and were not selected to reflect any developmental theory of depression. The symptoms and attitudes include mood, sense of failure, lack of satisfaction, self-dislike, sleep disturbance, and fatigability, among others. The BDI's first psychometric studies found an odd-even internal reliability coefficient of 0.86 while BDI total scores correlated 0.65 with clinicians' ratings of depression. Subsequent reviews of the BDI were found to mirror internal reliability coefficients and associations with clinical ratings reported in the initial reliability investigation (Steer et al., 1986).

#### ***2.3.5.3 Beck Anxiety Inventory***

The Beck Anxiety Inventory (BAI) (Beck et al., 1993) is a self-report inventory for measuring the severity of anxiety. An initial item pool of 86 items was drawn from three pre-existing scales: the Anxiety Checklist, the Physician's Desk Reference Checklist, and the Situational Anxiety Checklist. A series of analyses were used to reduce the item pool. The final scale consists of 21 items, each describing a common symptom of anxiety such as worrisome feelings, ability to concentrate, indigestion, hot or cold sweats, and ability to relax. The respondent is asked to rate how much he or she has been bothered by each symptom over

the past week on a 4-point scale. The BAI showed high internal consistency ( $\alpha = .92$ ) and test-retest reliability over 1 week ( $r = .81$ ) (Beck et al., 1993).

#### **2.3.5.4 Wellbeing**

Due to theoretical debate on the definition of wellbeing, measurement of wellbeing also faces much disagreement (Linton et al., 2016). Questionnaires are a useful means to gather data on wellbeing as they allow researchers to collect data on large samples of the population and quantify levels of wellbeing using wellbeing measurement tools (Michaelson et al., 2012). The Warwick-Edinburgh Mental Wellbeing scale (WEMWS) is research-informed and focuses entirely on positive aspects of mental health (Tennant et al., 2007). WEMWS was developed by an expert panel drawing on relevant academic literature, qualitative research with focus groups, and psychometric testing of an existing scale. It was validated on a student and representative population sample, and included aspects of both eudemonic and hedonic wellbeing. WEMWS has shown good internal reliability in population, student and adolescent samples (Stewart-Brown et al., 2011) with no ceiling effects across samples.

### **2.4 Physical Activity Behaviours**

#### **2.4.1 Physical Activity**

In the past 150 years, lifestyle changes of people in industrialised nations has resulted in the decline of people engaging in physical activity (Bouchard, Blair & Haskell, 2007). People participated in much more labour intensive activities as part of daily life prior to the industrial revolution (Hallal et al., 2012). Physical activity has gradually been engineered out of our lives with the increase in availability of new technological devices (Hallal et al., 2012). The introduction of steam, gas and electric engines, trains and cars have all had tremendously positive effects on productivity levels but adverse effect on the world's activity levels. Active daily commutes coupled with physically demanding jobs naturally embedded a lot of physical activity into daily lives while much of the technology which has been introduced in the workplace and home in the last few decades has specifically aimed to reduce the physical demands on the body and increase worker productivity (Hallal et al., 2012). The current generation of youth are extremely comfortable and engaged with technology such as smartphones, computers, games consoles and other handheld devices which has led to significant increases in screen-time (Bickham, Blood, Walls, Shrier & Rich, 2013; Biddle, Pearson, Ross & Braithwaite, 2010; Oliver, Duncan, Kuch, McPhee & Schofield, 2012). With the rise of "sedentariness" (Ray-Lopez, Vicente-Rodriguez, Biosca & Moreno, 2008) worldwide, we need to raise awareness that regular physical activity is an essential element

of a healthy lifestyle during childhood and adulthood (Fulton, Gard, Galuska, Rattay & Casperson, 2004; Lee et al., 2012; Corder et al., 2016). The meaning of physical activity has remained consistent among public health professionals over the past 30 years and a standardised definition has become accepted as: *“any bodily movement produced by the skeletal muscles that results in a substantial increase over resting energy expenditure”*

(Bouchard, Blair & Haskell, 2007; Caspersen, Powell & Christensen, 1985; Woods, Moyna & Quinlan, 2010). Energy expenditure resulting from physical activity can vary from low to high intensities (Caspersen et al., 1985) and is generally categorised as either light, moderate or vigorous. This broad and diverse definition encompasses leisure time physical activity, exercise, sport, transportation, occupational work and chores (Bouchard et al., 2007).

A solid base of evidence exists, both internationally and in an Irish context, demonstrating that the physical fitness and health status of children and adolescent youth are substantially enhanced by regular physical activity participation (Lavizzo-Mourey et al., 2012; Dobbins, Husson, De Corby & La Rocca, 2013; Coppinger, Lacey, O’Neill & Burns, 2016; Belton, O’Brien, Meegan, Woods & Issartel, 2014). These health benefits include lower rates of all-cause mortality, coronary heart disease, high blood pressure, stroke, metabolic syndrome, type II diabetes, breast cancer, colon cancer, depression, anxiety and falling (Warburton, Charlesworth, Ivey, Nettlefold & Bredin, 2010). Those who participate regularly in physical activity also demonstrate higher levels of cardio-respiratory fitness, muscular strength and endurance, healthier body mass and compositions, superior bone health and greater cognitive functioning (Warburton et al., 2010). Recent evidence also highlights that the amount of time spent being sedentary, or not engaged in physical activity, is an important risk factor for several aspects of ill health such as overweight and obesity and associated metabolic diseases (Biddle, O’Connell & Braithwaite, 2011; Pearson, Braithwaite, Biddle, van Sluijs & Atkin, 2014; Tanaka, Reilly & Huang, 2014). A study conducted by the American Cancer Society found that increased periods of sitting significantly reduced lifespan independent of physical activity and exercise levels (Kushi et al., 2012). A systematic review by Proper et al., (2011) identified a positive relationship ( $r = 0.76$ ,  $p = .02$ ) between time spent sitting and the risk for type II diabetes when investigating the relationship between sedentary behaviours and health outcomes in adults (Proper, Singh, Van Mechelen & Chinapaw, 2011). Thorp et al., (2011) identified a consistent relationship between sedentary behaviour, mortality and weight gain in a systematic review of longitudinal studies investigating sedentary behaviour and subsequent health outcomes (Thorp, Owen, Neuhaus & Dunstan, 2011).

A report by the American Physical Activity Guidelines Advisory Committee (2008) found that, when compared to inactive young people, physically active children and youth:

*“have higher levels of cardiorespiratory endurance and muscular strength, and well-documented health benefits include reduced body fatness, more favourable cardiovascular and metabolic disease profiles, enhanced bone health, and reduced symptoms of anxiety and depression”* (Physical Activity Guidelines Advisory Committee, 2008, p. A2-A3).

Tremblay et al. (2011) found that watching television for more than two hours per day negatively impacted a number of health related outcomes with an effect of  $-0.89 \text{ kg/m}^2$  (95% CI of  $-1.67$  to  $-0.11$ ,  $p = 0.03$ ) on unfavourable body composition as significant impacts were also found on lower self-esteem ( $p = 0.03$ ) and decreased academic achievement, especially when watching tv for more than three hours per day, in a systematic review of sedentary behaviour and health indicators among five to 17 year olds. Physical inactivity has been well established as one of the leading risk factors for non-communicable disease (Lee et al., 2012). Most recent evidence (Roth et al., 2017) suggests that over 60% of the burden of cardiovascular diseases can be attributed to the combination of all physical inactivity and dietary components. The World Health Organisation (2010) identified physical inactivity as the fourth leading risk factor for global mortality causing an estimated 6% of deaths globally while Lee et al. (2012) found that physical inactivity was attributed to 5.3 of the 57 million deaths worldwide in 2008. Girls are also more likely to reduce their physical activity participation as they enter adolescence (Owen, Curry, Kerner, Newson & Fairclough, 2017) with studies suggesting a 7% decrease in activity after the age of 10 (Dumith, Gigante & Domingues, 2011). Boys typically engage in more energetic play and sports than girls (46% v 22%) (Cooper et al., 2015), thus boosting their caloric needs.

On average 1% to 2.6% of total healthcare costs are due to physical inactivity (Pratt, Norris, Lobelo, Roux & Wang, 2014). The direct cost of cardiovascular disease as a result of inactivity was identified by Oldridge (2008) as between 1.5% and 3%. The indirect costs associated with inactivity, such as premature death and disability, should also be taken into account as they tend to be more burdensome on society than the direct costs (Pratt et al., 2014). The economic burden of physical inactivity was estimated to cost \$5.3 billion to the Canadian health service in 2001 which equated to \$1.6 billion in direct costs and almost double that in indirect costs at \$2.7 billion (Katzmarzyk & Janssen, 2004). Physical inactivity and obesity contributed to 2.6% and 2.2% respectively of total health care costs in Canada in 2001 (Katzmarzyk & Janssen, 2004). £1.06 billion was the estimated cost of the burden of physical activity-related ill health

to the UK's National Health Service in 2002 (Allender, Foster, Scarborough & Rayner, 2007) while physical inactivity was directly responsible for 3% of years life lost due to disability. The World Health Organisation has estimated that 3.3 million people around the world die due to physical inactivity each year (Bauman et al., 2009) which makes physical inactivity the fourth leading cause of death worldwide (Bauman et al., 2009). Of 57 million deaths in 2008, 5.3% were attributed to physical inactivity in more recent findings (Lee et al., 2012).

#### ***2.4.2 Physical Activity & Sedentary Guidelines***

Physical inactivity and sedentary behaviour have been recognised as predictors of illness and chronic disease among both adults and adolescents (Jago, Anderson, Baranowski & Watson, 2005; Riddoch et al., 2004; Tremblay et al., 2011; Troiano et al., 2008). Documenting the scientific evidence about the importance of regular participation in physical activity among adolescents is of little value if the target population cannot practically apply this behaviour to their lives. Over the past three decades extensive research has been conducted with a view to providing physical activity and sedentary behaviour guidelines (Haskel, 2007; Biddle, Cavill & Sallis, 1998; National Institutes of Health, 1996; Sallis & Patrick, 1994; Tremblay et al., 2011). Gradual and progressive development has been employed in the dissemination of information relating specifically to physical activity participation and sedentary guidelines in adolescents through public health messages known as physical activity guidelines for health (Bouchard et al., 2007) and can be seen in table 1.



**Table 1:** Summary of the WHO Guidelines on physical activity and sedentary behaviour (Bull et al., 2020).

Group	Physical Activity	Sedentary Behaviour
<b>Children and adolescents (aged 5-17 years), including those living with disability</b>	<p>In children and adolescents, physical activity confers benefits for the following health outcomes; physical fitness (cardiorespiratory and muscular fitness), cardiometabolic health (blood pressure, dyslipidaemia, glucose and insulin resistance), bone health, cognitive outcomes (academic performance, executive function) and mental health (reduced symptoms of depression) and reduced adiposity.</p> <p>It is recommended that:</p> <ul style="list-style-type: none"> <li>○ Children and adolescents should do at least an average of 60 min/day of moderate-to-vigorous intensity, mostly aerobic, physical activity, across the week;</li> <li>○ Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone should be incorporated at least 3 days a week.</li> </ul> <p><i>Strong recommendation</i></p>	<p>In children and adolescents, higher amounts of sedentary behaviour are associated with detrimental effects on the following health outcomes: fitness and cardiometabolic health, adiposity, behavioural conduct/pro-social behaviour and sleep duration.</p> <p>It is recommended that:</p> <ul style="list-style-type: none"> <li>○ Children and adolescents should limit the amount of time spent being sedentary, particularly the amount of recreational screen time.</li> </ul> <p><i>Strong recommendation</i></p>
<b>Adults (aged 18-64 years) including those with chronic conditions and those living with disability</b>	<p>In adults, physical activity confers benefits for the following health outcomes: all-cause mortality, cardiovascular disease mortality, incident hypertension, incident type 2 diabetes, incident site-specific cancers, mental health (reduced symptoms of anxiety and depression), cognitive health and sleep; measures of adiposity may also improve.</p> <p>It is recommended that:</p>	<p>In adults, higher amounts of sedentary behaviour are associated with detrimental effects on the following health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality and incidence of cardiovascular disease, type 2 diabetes and cancer.</p> <p>It is recommended that:</p>

	<ul style="list-style-type: none"> <li>○ All adults should undertake regular physical activity;</li> <li>○ Adults should do at least 150-300 min of moderate-intensity aerobic physical activity, or at least 75-150 min of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate-intensity and vigorous-intensity activity throughout the week for substantial health benefits;</li> <li>○ Adults should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.</li> </ul> <p><i>Strong recommendation</i></p> <ul style="list-style-type: none"> <li>○ Adults may increase moderate-intensity aerobic physical activity to &gt;300 min, or do &gt;150 min of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate-intensity and vigorous-intensity activity throughout the week for additional health benefits (when not contraindicated for those with chronic conditions).</li> </ul> <p><i>Conditional recommendation</i></p>	<ul style="list-style-type: none"> <li>○ Adults should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.</li> <li>○ To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults should aim to do more than the recommended levels of moderate-to-vigorous physical activity.</li> </ul> <p><i>Strong recommendation</i></p>
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Quantifying the amount and frequency of physical activity has been of utmost importance over the past thirty years given the health benefits associated with regular participation in physical activity. It was recommended that all children and youth obtain between 20 and 30 minutes of vigorous exercise each day by the American College of Sports Medicine in 1988. These recommendations have been constantly evolving since 1988. A collaborative effort with the International Consensus Conference on Physical Activity Guidelines for Adolescents recommend that adolescents aged 11 to 21 years should be physically active daily as part of

an active lifestyle and engage in moderate to vigorous activities lasting 20 minutes or greater on at least three occasions per week (Sallis & Patrick, 1994). The National Institutes of Health Consensus Development Panel on Physical Activity and Cardiovascular Health advised that all adolescents should accumulate 30 minutes of moderate physical activity on most or all days per week (National Institute of Health, 1996). These recommendations were deemed to be insufficient by the UK Health Education Authority in 1998 who recommended that children and adolescents should participate in physical activity, that is at least of moderate intensity, for 60 minutes per day (Biddle, Sallis & Cavill, 1998). Suggestions were also made at this time that children and adolescents should also participate in some form of muscular strengthening exercises for the trunk and upper arm girdle at least twice a week (Biddle, Sallis & Cavill, 1998). The Australian Department of Health and Ageing built on these recommendations of at least 60 minutes moderate to vigorous physical activity per day by also advocating for a reduction in screen-time to less than two hours per day in 1999. These guidelines continued to develop into the 2000s as the American Cancer Society (Byers et al., 2002) agreed with the Australian Department of Health's duration recommendations but disagreed on the frequency by suggesting that five days a week would be sufficient. There is now widespread agreement that accumulating 60 minutes of moderate to vigorous physical activity, on most or all days per week, is believed to be suitable levels of physical activity for children and adolescents (Strong et al., 2005; Centres for Disease Control and Prevention, 2008). The Canadian physical activity guidelines have built on this by providing suggestions as to how best to accumulate the aforementioned 60 minutes per day. Children and adolescents should be active daily through play, games, sports, transportation, recreation, physical education or planned exercise in order to accumulate physical activity through the course of daily living (Tremblay et al., 2011). Children and adolescents should participate in both vigorous physical activity and muscular strengthening exercises at least three times per week (Tremblay et al., 2011). Meeting the Canadian recommendations is reported to improve cholesterol levels, blood pressure, body composition, bone density, cardiorespiratory endurance, musculoskeletal fitness, and aspects of mental health in children and adolescents (Tremblay et al., 2011). The US and UK's most recent and widely accepted physical activity guidelines stipulate that children and adolescents should accumulate at least 60 minutes of moderate-to-vigorous physical activity per day in order to experience associated health and fitness benefits (British Heart Foundation, 2013; Kushi et al., 2012).

Irish guidelines are consistent with those in the UK and US suggesting that all Irish children and adolescents, aged 2-18, should aim to accumulate 60 minutes of moderate-to-vigorous

physical activity each day that incorporates muscle strengthening, flexibility and bone strengthening exercises at least three times per week (Department of Health & Children, 2009). The only major difference between the Irish guidelines and the updated UK guidelines (Department of Health, Physical Activity, Health Improvement and Protection, 2011) is the inclusion of recommendations on time spent in sedentary pursuits; suggesting the importance of children and young people minimising the amount of time spent sedentary for extended periods. Canadian guidelines have also raised the importance of reducing time spent in sedentary pursuits by children and adolescents by developing sedentary behaviour guidelines for both children, those aged 5 to 11 years, and adolescents, those aged 12 to 17 years (Tremblay et al., 2011). Canadian guidelines recommend that children and adolescents should limit recreational screen-time, such as television, computers, video games, mobile phones, tablets, etc., motorised transportation, time spent indoors, and time spent sitting within the context of the family, school and community. No more than two hours per day should be spent engaged in recreational screen-time (Tremblay et al., 2011).

To summarise the above, children and adolescents should accumulate 60 minutes of moderate-to-vigorous physical activity on a daily basis which includes exercises to develop muscular strength, bone strength and flexibility, while also aiming to keep time spent in sedentary activities under two hours per day. To effectively promote these guidelines, it is important that researchers and clinicians have access to precise and practical tools for the measurement of physical activity in children and adolescents (Trost, 2007).

#### ***2.4.3 Measurement of Physical Activity***

The worldwide physical activity and sedentary behaviour guidelines were outlined in the above section which suggest that physical activity promotion is a current public health priority (British Heart Foundation, 2013; Sallis et al., 2012; Woods et al., 2010). Previous research has identified varying methods to measure and assess the complex behaviour of physical activity in population surveillance (Bauman, Phongsavan, Schoeppe & Owen, 2006) as it is critical for researchers and clinicians to access practical tools that measure physical activity among children and adolescents. Measurement techniques of physical activity can be divided into one of two categories: self-report and objective (Kohl, Fulton & Caspersen, 2000; Trost, 2007). Both categories, and the specific methods within, have a number of individual strengths and weaknesses (Hands & Larkin, 2006; Kohl et al., 2000; Trost, 2007). This further adds to the debate in identifying the most appropriate tool for measuring physical activity in young people

(Corder et al., 2009; Ward, Evenson, Vaughn, Rodgers & Troiano, 2005) due to the multiple dimensions of physical activity, including frequency, intensity, type and time (Trost, 2007).

#### ***2.4.3.1 Self-Report Physical Activity Measurement***

The variety of self-report methods which have been used to assess physical activity in children and adolescents include self-administered recalls, interviewer administered recalls, diaries, and proxy reports completed by parents and teachers (Trost, 2007). The most widely used measure of physical activity are self-report techniques (Hands & Larkin, 2006; Murphy, 2009) with ease of administration, low cost and the ability to characterise activity historically cited as the main advantages. It was suggested that self-report methods are important for assessing aspects of physical activity which cannot be measured objectively, particularly different modalities of activity (Corder, Ekelund, Steele, Wareham & Brage, 2008). Self-report techniques are also commonly used in epidemiological research due to the impracticality and expense of objective measurement techniques in large sample sizes (Trost, 2007). The limitations of self-report physical activity measurement, despite the convenience, include participants' ability to accurately recall activities and difficulties associated with quantifying the duration of activity (Hands et al., 2006; Trost, 2007). It has been recommended that self-report recall methods should not be used among children younger than ten years of age by previous evidence that reviewed the reliability and validity of physical activity assessments (Kohl et al., 2000). Understanding the concept of physical activity is also difficult for children as was evidenced by Trost et al., (2000) who found that 60% of participants in an investigation of this concept had difficulty in differentiating between sedentary activities and active pursuits although Belton and MacDonncha (2010) have provided some support for the use of a validated self-report tool designed specifically for use by younger populations. This conflicting evidence suggests that care must be taken when using self-report instruments with younger children with particular emphasis on the use of valid and reliable instruments that are appropriate for this particular cohort.

Studies documenting the frequency and distribution of physical activity are dependent on valid and reliable measurement tools (Armstrong, 1998; Kohl et al., 2000) with a number of evidence based reviews for self-report in children and adolescents (Trost, 2007). An investigation into the possible assessment of free-living physical activity in young people by self-report (Corder et al., 2009) found evidence for the concurrent validity of the Youth Physical Activity Questionnaire (YPAQ). A moderate correlation ( $r = 0.42$ ) was found between accelerometry and the YPAQ questionnaire which suggests that it may be a valid instrument

for ranking moderate-to-vigorous physical activity. The YPAQ was also found to be the most reliable of four questionnaires assessed by Corder et al. (2009) as it showed excellent test-retest reliability coefficients for moderate-to-vigorous physical activity (0.92). Physical activity questionnaires have been found to be significantly stronger in adolescents than youth when correlated with accelerometry in a systematic review of physical activity questionnaires for youth (Chinapaw, Mokkink, van Poppel, van Mechelen & Terwee, 2010). The use of accelerometry has been recommended in either a full sample or subsample in conjunction with a valid self-report instrument to increase the strength of data gathered on physical activity levels in children and adolescents (Chinapaw et al., 2010).

#### **2.4.3.2 Objective Physical Activity Measurement**

Objective measurements of physical activity are suggested in younger populations due to the low validity coefficients observed for self-report instruments (Armstrong 1998; Kohl et al., 2000; Trost, 2007; Rowlands & Eston, 2005). Objective measures of physical activity are now considered most appropriate in overcoming the limitations associated with self-report measures (Murphy, 2009) and include direct observation, doubly labelled water, heart rate monitoring, pedometers and accelerometry. A brief description of all methods will be discussed below with greater detail afforded to accelerometry.

1. **Direct Observation:** Direct (systematic) observation is generally the formal observation (by trained individuals) typically consisting of observing a child at home or in school for extended periods of time and recording data into either a computer or coding form that provides an instantaneous rating of the child's levels of physical activity (Trost, 2007). Momentary time sample, such as intervals of five or ten seconds, up to a minute, are used to record activity patterns. Direct observation has been found to be a valid and reliable tool for classifying and quantifying physical activity behaviour and has the advantage of being able to describe what took place in the physical activity setting (Dale, Welk & Matthews, 2002). There are several direct observational systems in existence that can be used to contextualise, quantify and classify physical activity behaviours. Many consider direct observation as the gold standard of physical activity in that it will provide the most accurate quantitative and qualitative information about physical activity, particularly for those interested in assessing group physical activity in open environments (Sirard & Pate, 2001; McKenzie, 2010). Disadvantages of direct observation include the extensive time commitment required to train observers, the length of the observation period, the complexity of the data-coding process

and the large expense associated with a measurement method that is so labour intensive (Troost, 2007). Therefore, direct observation is generally confined to minor studies over shorter periods of time (Dale et al., 2002; Sirard & Pate, 2001). Some of the recognised systems of direct observation frequently used include the System for Observing Play and Leisure Activity in Youth (SOPLAY) (McKenzie, Marshall, Sallis & Conway, 2000), System for Observing Play and Recreation in Communities (SOPRAC) (McKenzie, Cohen, Sehgal, Williamson & Golinelli, 2006), the Behaviours of Eating and Activity for Children's Health: Evaluation (BEACHES) (McKenzie et al., 1991), the Children's Activity Rating Scale (CARS) (Puhl, Greaves, Hoyt & Baranowski, 1990), and the System for Observing Fitness Instruction Time (SOFIT) (McKenzie, Sallis & Nader, 1992). McKenzie (2002) compared nine different protocols for direct observation use in children. Strong concurrent validity with heart rate monitoring, accelerometry and indirect calorimetry was demonstrated by eight of the nine protocols. The recording of factors which influence and relate to physical activity such as availability of equipment, and peer or parental support are notable advantages that direct observation has over other objective measures (Troost, 2007).

2.      **Doubly Labelled Water:** Doubly labelled water is considered one of the most accurate means of measuring energy expenditure under free living conditions (Plasqui & Westerterp, 2007) and is both unobtrusive and non-invasive (Troost, 2007). Doubly labelled water is regarded as the gold standard technique when measuring energy expenditure over time (Murphy, 2009). Participants can maintain relative normality within their daily lives due to the low levels of researcher input required. Subjects consume isotope enriched water (generally deuterium and  $^{18}\text{O}$ ). A direct measure of carbon dioxide production is subsequently provided and an accurate estimate of energy expenditure during physical activity, calculated (Schoeller, 1999; Sirard & Pate, 2001, Troost, 2007). This technique has been validated in both adults and children against indirect calorimetry. It has been found to be accurate to within 5 to 10%. Cost is a major limitation of implementing the doubly labelled water technique in large groups (Troost, 2007).

3.      **Heart Rate Monitoring:** Heart rate monitoring is a measure of the relative stress being placed on the cardiopulmonary system by a specific activity as opposed to a direct measure of physical activity (Armstrong, 1998). Heart rate monitors collect and store objective information about the heart rate responses to physical activity (Kohl et al., 2000), are relatively inexpensive and provide multiple day storage capacity for minute-by-minute heart rates

(Trost, 2007). Heart rate monitors are considered a more feasible method of providing good information on frequency, intensity and duration but nothing on the type of activity (Dale et al., 2002; Kohl et al., 2000; Sirard & Pate, 2001). Heart rate monitors have been accepted as a validated and reliable measure of physical activity (Brage et al., 2006). Disadvantages of heart rate monitors include the discomfort to participants over prolonged periods of wear, loss of data through signal interruptions and external factors impacting on heart rate such as stress or fatigue (Dale et al., 2002; Sirard & Pate, 2001; Trost, 2007).

4. **Pedometers:** The electronic pedometer is a cost effective alternative to direct observation, doubly labelled water and heart rate monitoring (Trost, 2007) which counts the amount of times a specified acceleration threshold is exceeded. These counts are used to indicate an overall number of steps taken in a given period of time (Corder et al., 2008; Tudor-Locke, Williams, Reis & Pluto, 2004). A strong correlation ( $r = 0.90$ ) was found in a study comparing pedometers with direct observation (Hands & Larkin, 2006) which suggests that pedometers are a reliable and valid measurement tool that can be used to record child and adolescent physical activity levels for research purposes. Tudor-Locke et al. (2004) reviewed 25 articles and determined that pedometers are strongly correlated with accelerometers (median  $r = 0.86$ ) and time observed in activity (median  $r = 0.82$ ). The relatively low expense of pedometers make them a viable option for large-scale studies although they are unable to record certain movements, and only work in the uniaxial plane, which is a considerable limitation (Trost, 2007). The reliability and validity of mobile-phone based pedometer applications must also be assessed before being considered for use in research purposes (Leong & Wong, 2017).

5. **Accelerometers:** Accelerometers are motion sensor monitors that derive physical activity data pertaining to intensity, frequency, pattern and duration (Berlin, Storti & Brach, 2006). Accelerometers provide quantitative information regarding the vertical accelerations of the trunk and other body segments, at sampling time intervals specified by the researcher (Trost, 2007). The relatively modest cost, small size and robust design make accelerometry an appealing measurement tool of physical activity levels in children and adolescents (Welk, Corbin & Dale, 2000). Strong correlations have been reported between accelerometer output and energy expenditure and/or exercise intensity in previous studies (Freedson & Janz, 2005; Trost, 2007). A strong correlation ( $r = 0.77$ ) was found between accelerometry and the SOFIT



direct observation technique in a study observing moderate-to-vigorous physical activity in physical education classes (Scruggs, Beveridge & Clocksin, 2005).

The most widely used accelerometer in research involving children and adolescents is known as the ActiGraph, formerly known as the MTI and CSA 7164 (Freedson & Janz, 2005; Trost, 2007, Trost et al., 2002). The ActiGraph accelerometer has been validated extensively among children and adolescent populations (De Vries, Bakker, Hopman-Rock, Hirasing & van Mechelen, 2006; Engels & Garre, 2011; Trost, 2007) and has been in existence for over 20 years (Bassett & John, 2010). ActiGraph accelerometers are traditionally worn above the iliac crest of the right hip (Fairclough, Boddy, Mackintosh, Valencia-Peris & Ramirez-Rico, 2015; Puyau, Adolph, Vohra & Butte, 2002; Trost, Way & Okely, 2006) and should be as near as possible to the body's centre of mass. (Trost, McIver & Pate, 2005). There are several models of Actigraph monitors available (Sasaki, John & Freedson, 2011; Trost, 2007; Vanhelst et al., 2012) while multiple Actigraph models can often be used in the same study (Belton, O'Brien, Issartel, McGrane & Powell, 2016; O'Brien, Issartel & Belton, 2013). One of the more recent versions of ActiGraph accelerometer is the GT3X (John, Tyo & Bassett, 2010) which measures movement in three planes of motion (vertical, antero-posterior, and medio-lateral (Sasaki et al., 2011). These triaxial accelerometers gather more data in terms of the amount of activity performed when compared to older models, such as the GT1M, which only gathered uniaxial and biaxial activity (De Vries et al., 2006; Pamtly-Freedson & Janz, 2005). Sasaki et al. (2011) explored the differences between counts obtained from the multiple axes of the GT1M and GT3X during treadmill walking/running and found no significant inter-monitor differences from the vertical plane at any speed (Sasaki et al., 2011). High inter-monitor agreement was found for vertical activity counts which suggests that monitors are comparable when solely using the vertical plane (Sasaki et al., 2011). This suggests that both types of Actigraph accelerometer can be used together within the same field research.

#### ***2.4.3.2 Physical Activity Measurement Summary***

The above section identified the key features of the most commonly used measurement tools (self-report, direct observation, doubly labelled water, heart rate monitoring, pedometers and accelerometers) of free living physical activity among children and adolescents. A descriptive overview for each type of measurement was outlined by addressing the key concepts of validity, reliability, gold standards, feasibility and practicality. All methods were assessed on ability to measure frequency, intensity, type or time of activity. It should be noted that no single measurement is appropriate for all purposes as most recent evidence suggests that

objective and subjective measures may reflect different constructs and contexts of physical activity and sedentary behaviour (Syvaola et al., 2013). Each method serves its purpose in a given population and research design. Objective measures, such as accelerometers, provide valuable and reliable information on the quantification of physical activity behaviour and intensity (de Vries et al., 2011; de Vries et al., 2006; Trost, 2007). The use of a combination of both self-report physical activity measures, such as the Y-PAQ questionnaire (Corder et al., 2009) and objective accelerometry, provides much richer, accurate data on youth physical activity behaviour.

#### ***2.4.4 Levels of Physical Activity***

The evidence highlights the importance of regular PA in children and adolescents to promote lifelong health and fitness (Allender et al., 2007; Whitt-Glover et al., 2009). The current generation of youth are one of the first to develop risk factors of chronic diseases and illness due to leading predominantly inactive and sedentary lifestyles (Jago et al., 2005; Riddoch et al., 2007; Tremblay et al., 2011; Troiano et al., 2008). International research from both self-report and objectively measures PA suggests that the majority of youth are not meeting the recommended 60 minute daily MVPA guideline (Aibar et al., 2013; Belton et al., 2014; Ekelund et al., 2012) as only 10% of adolescents reported meeting physical activity guidelines in a recent Irish investigation (Woods et al., 2019). Given that PA levels track from childhood into adulthood, ensuring adolescents are meeting the PA guidelines is of utmost importance as active children are more likely to be active in adulthood (Telema et al., 2005). Understanding the extent of the problem and trends of inactivity is therefore essential in order to create targeted interventions.

The prevalence of low PA levels internationally is of cause for concern. Hallal et al., (2012) reported that 80% of adolescents self-reported not meeting the recommended PA guidelines as females reported lower levels of activity than males (53% v 95%). Objective measurements of PA in US children and adolescents found that children aged 6 to 11 years accumulated between 10 and 16 minutes of vigorous activity, and more than one hour of moderate activity per day (Troiano et al., 2008). A considerable drop in PA was noted as age increased 16 to 19 year old males achieving 30 minutes of total PA while females only achieved 20 minutes of total PA (Troiano et al., 2008) providing further evidence for an age related decline in physical activity. Of the entire sample, only 42% of children and 8% of adolescents met the physical activity recommendations (Troiano et al., 2008). These low levels of adherence to PA

guidelines are worrying and suggest that activity levels are insufficient across all age groups to best support health benefits.

Research on a Canadian population suggest similar patterns of activity, or inactivity, in children and adolescents as objectively measured PA found as little as 7% of Canadian children and youth met the 60 minute MVPA guideline on at least six days per week (Colley et al., 2011). A gender difference was also noted as 9% of males and 4% of females met recommendations. Less than 2% of children obtained at least 90 minutes of MVPA on a daily basis (Colley et al., 2011). Adherence rates were found to increase significantly when adherence to guidelines was measured on three days per week, with more than half of males (53%) and just over a third of females (35%) achieving said aforementioned levels of activity. Time spent on sedentary pursuits is also a cause for concern. On average, Canadian children and youth spent 8.6 hours (62% of waking hours), in sedentary behaviour (Colley et al., 2011). Females spent a larger volume of time in sedentary pursuits than males. The PA cut points in this study were more stringent and differed from those used by Troiano et al. (2008) when investigating US levels of PA, partly explaining the lower adherence to PA guidelines in Canadian youth when compared to their counterparts in the US.

Globally, these trends are being observed irrespective of the known benefits and necessity of PA for healthy living. Only 2.5% of children (aged 11) in the southwest of England were found to meet 60 minutes of MVPA per day (Riddoch et al., 2007) with participants averaging just 20 minutes MVPA per day. Once again males were found to have higher levels of activity than females as they achieved 25 minutes and 16 minutes per day respectively. Riddoch et al. (2004) sampled the activity levels of European children and adolescents (Denmark, Portugal, Estonia and Norway) aged 9 and 15 years and found the majority met PA guidelines. Males were more active than females at both 9 and 15 years of age (21% and 26% more active respectively), and 9 year olds were more active than 15 year old across all PA sub-groups. The higher levels of PA may be explained by the different cut points which were applied which differed by more than 2000 counts per minute (Riddoch et al., 2004, 2007).

Self-report research focusing solely on adolescents has found contrasting results across European countries as 13.6% of participants from a 10 country sample reported engaging in at least 60 minutes of physical activity every day with males again reporting higher levels of activity than females (17.9% v 10.7%) (McMahon et al., 2017). The highest proportion of adolescents meeting PA guidelines were in Slovenia (34.8% males, 23.6% females) while the lowest proportion was in Italy (7.7% males 1.5% females).

The above study also included a cohort from Ireland and suggested 11.9% of males and 5.6% of females met PA guidelines each day. This is similar to recent, and larger, examinations of PA levels in Ireland such as Health Behaviour in School-Aged Children (HBSC) study and the Children's Sport Participation and Physical Activity Study (CSPPA). The 2010 HBSC study found 25% of Irish children self-reported meeting the PA guidelines with gender differences observed once more (31% of males, 18% of females) (Kelly et al., 2012). Younger children were more likely to report obtaining sufficient PA on seven days per week compared to older children. Low levels of PA, age-related decline in PA, and gender differences are all consistent with findings in other countries and cohorts. PA levels also appear to be trending downwards according to most recent CSPPA data. The 2010 edition found 12% of adolescents met PA guidelines (Woods et al., 2010) while this had dropped to 10% in the 2018 edition. Similar to other studies, PA levels were lower in older children and adolescents and males reported higher levels of PA than females when matched for age and socioeconomic status. Although in line with other countries of similar demographics, these findings highlight the alarmingly low levels of PA in Irish youth.

## **2.5 Physical Activity & Wellbeing**

### ***2.5.1 Physical Activity & The Brain***

The importance of leading a physically active lifestyle has been well documented above however, in addition to the physical benefits a growing body of literature has linked physical activity with improvements in brain function and cognition (Hillman, Erickson & Kramer, 2008). Animal research has long shown that enriched environments, including access to exercise equipment (such as running wheels), has a positive effect on neuronal growth and on the neural systems that are involved in learning and memory which indicates that physically active behaviours influence cognitive function and the supporting brain structures (Vaynman & Gomez-Pinilla, 2006). Some of the recent advances in neuroimaging techniques, such as functional magnetic resonance imaging (fMRI), have shown that exercise leads to evident changes in brain structure and function. The earliest mention of a mind-body connection can be traced back to ancient Greek civilisations (Hillman et al., 2008) although scientific investigations of this relationship did not begin until the 1930s. The early scientific research focused mainly on reaction times and observed relationships between physical conditioning/fitness and quicker reaction times (Burpee & Stroll, 1936; Lawther, 1951; Pierson & Montoye, 1958). The first systematic examination took place during the 1970s and found that older adults who regularly participated in physical activity had faster psychomotor speed,

relative to their sedentary counterparts (Spiriduso, 1975) although no such relationship was observed in comparable groups of younger adults (Sherwood & Selder, 1979; Baylor & Spiriduso, 1988). This may have contributed to the paucity of research on the relationship between physical activity and the brain involving children and adolescents until the very recent past despite the fact that children in industrialised countries are growing increasingly unfit and unhealthy (Hillman et al., 2008). One of the more recent studies conducted a meta-analysis and determined a positive relationship between physical activity and cognitive performance in school-age children (4-18 years) across six measurement categories: (a) perceptual skills; (b) intelligence quotient; (c) academic achievement; (d) verbal tests; (e) mathematical tests; and (f) developmental level/academic readiness (Sibney & Etnier, 2003). This meta-analysis also found memory to be unrelated to physical activity behaviour. Sibney & Etnier (2003) observed effect sizes (+ 0.32) similar to another meta-analysis (+ 0.25) that examined the effects of physical activity on cognition across the lifespan (Etnier et al., 1997). These findings suggest that although physical activity might be beneficial at all stages of life, early intervention might be important for the improvement and/or maintenance of cognitive health and function throughout the adult lifespan (Hillman et al., 2008). More recent work by Snowden et al. (2011) has suggested that there is little evidence to suggest that exercise interventions are effective in improving cognitive function in older adults, although these studies assessed short-term effects of exercise on cognitive function and not chronic exercise participation. A key observation from all studies that examined the relationship between physical activity and cognition found that there are no negative effects from increased physical health-based activities in regard to cognitive health or academic performance (Hillman et al., 2008).

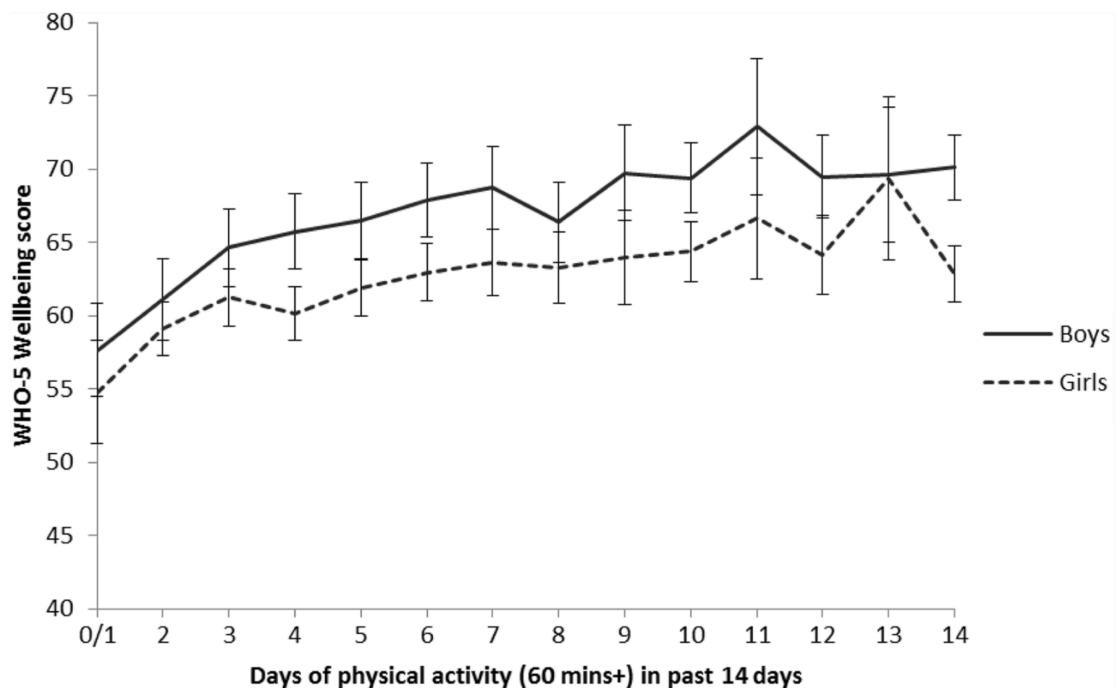
### ***2.5.2 Physical Activity & Wellbeing***

Physical activity can indirectly improve subjective wellbeing and quality of life by keeping disease and premature death at bay and recently there has been an increasing interest in its direct role in the prevention and treatment of mental health problems (Fox, 1999). This increase in interest began to grow during the 1990s as can be evidenced by Biddle's (1997) analysis of research trends in two sport and exercise psychology journals during the 1990s that showed the topic of 'exercise and mental health' had a 400% increase in frequency from the late 1980s to the mid 1990s (Faulkner & Biddle, 2001). Human suffering is high. Mental illness is socially debilitating and associated with suicidal ideation and attempts, drug and alcohol abuse and homelessness. There are also many more individuals who suffer a general malaise of low mental well-being characterised by emotional distress, low self-esteem, poor

body image, sense of hopelessness, chronic stress and anxiety for every serious case (Fox, 1999). The aforementioned conditions are often not clinically diagnosed and so their incidence is difficult to accurately assess yet often associate with other major problems such as heavy drinking, smoking, absenteeism from work/school, family breakdown, physical violence and abuse, and quality of life. One of the first review papers examining the link between physical activity and wellbeing found a moderate association and drew from several large-scale studies in a variety of countries (Fox, 1999). Care must be taken when interpreting these results as a variety methodologies and assessment tools were used for measuring both physical activity and wellbeing. Earlier experimental studies supported a positive effect on mood for moderate intensity exercise, although very few studies included specific exposure to vigorous exercise. Affective benefits were also reported as more likely to be experienced if participants focus on personal improvement goals which suggests that there may be a link between increases in wellbeing through physical activity and self-esteem/efficacy.

One of the most recent analyses of physical activity and wellbeing in adolescents was conducted in a European cohort ( $n = 11,072$ ) by McMahon et al. (2017). The cross-sectional analysis drew participants from 168 schools in ten European countries (Austria, Estonia, France, Germany, Hungary, Ireland, Italy, Romania, Slovenia and Spain). Physical activity was measured using the PACE+ questionnaire (Prochaska, Sallis & Long, 2001) which reports how many days a participant achieves 60 minutes or more of moderate-to-vigorous physical activity in the previous two weeks. Wellbeing was measured using the 'WHO-5' wellbeing questionnaire (Bech, 2004). They found a positive correlation between frequency of activity and well-being for both boys and girls (figure 6). Small increases in the number of days of activity were associated with greater well-being at lower levels of activity. Peak levels of well-being were found to be at 11 days for boys and at 13 days for girls. The association for girls was also curvilinear with those at 14 days of activity having reduced levels of well-being. It may be the case that the sub-group reporting very frequent or daily physical activity includes some adolescents who over-exercise and suffer from eating disorders or other psychopathology (Smith et al., 2013; Davis et al., 1997). The authors suggest, based on their findings, that moderately increasing activity in inactive adolescents could result in a meaningful improvement in well-being, as an increment of 10% on an individual's WHO-5 score may be clinically meaningful (Ware, 1995).

It has been suggested that previous small effect sizes found for associations between physical activity and wellbeing measures may be due to limitations in the measurement of types physical activity (Strong et al., 2005) although McMahon et al. (2017) examined participation in individual and team sports to identify the types of activity which may be particularly beneficial to mental health. The highest levels of wellbeing, in both boys and girls, were found among those participating in team sports with girls that participated in team sports differing significantly ( $P < .05$ ) from those participating in individual sport or other physical activities. This suggests that that team sports may confer particular mental health benefits, especially for girls. Multivariate analysis also showed that participating in any sport (individual or team) was associated with more positive mental health on all examined measures, independent of frequency of activity for both boys and girls. This suggests that regularly engaging in a challenging activity may lead to an increase in a young person's confidence and resilience which subsequently leads to an increase in wellbeing (Paluska & Schwenk, 2000) while the social relationships developed from regular participation in team sports may also impact positively on well-being (Monshouwer, ten Have, van Poppel, Kemper & Volleburch, 2013). These findings provide some support for the hypothesis that the mental health benefits of physical activity may be partly accounted for by the social interaction involved in team sports in particular, and confirm the importance of the psychological and social aspects of physical activity (McMahon et al., 2017).



**Figure 6:** Associations between frequency of physical activity and WHO-5 Well-being score (adjusted for clustering within school and country) (McMahon et al., 2017).

### **2.5.3 Physical Activity & Depression**

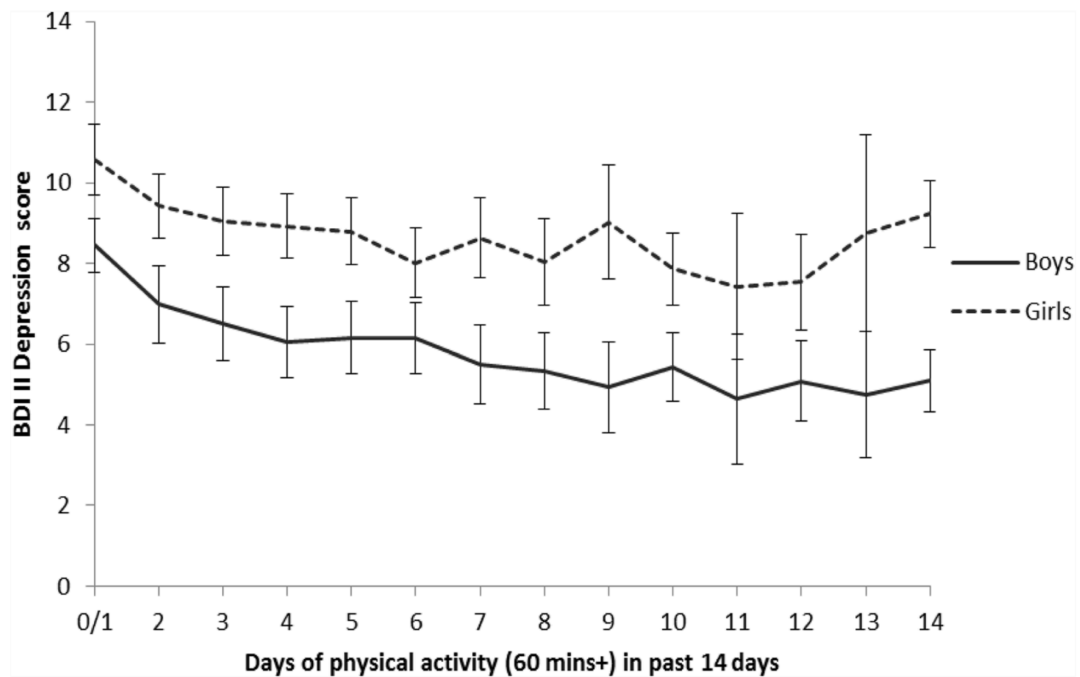
Depression is often seen as the mental health outcome most clearly associated with physical activity (Smith & Blumenthal, 2013). Some evidence exists for a similar association in young people although the links seem less consistent than for adults (Biddle et al., 2018). A 2011 review of reviews by Biddle & Asare found four reviews specifically addressing the relationship between physical activity and depression. They found that depression is inversely associated with symptoms of depression in adults (Craft & Landers, 1998; North, McCullagh & Tran, 1990) and there is some evidence that this relationship may be causal (Mutrie, 2003). No significant difference in effect was found between physical activity and psychosocial interventions in both children and adolescents which suggests that physical activity may be equally as effective as psychosocial interventions in youth, although no evidence was found for the effectiveness of physical activity interventions that lasted longer than 8 weeks. Most studies reviewed fail to specify the exact nature of the physical activity interventions in respect of frequency, intensity, duration and type of activity which make it difficult to make future recommendations for the reduction and management of depressive symptoms through physical activity. Group-based physical activity interventions often fail to control for the effects of social interaction which have already been mentioned as a contributor to increased mental health, and therefore reduced depression. The overall consensus from this review of reviews was that physical activity over no intervention seems to be potentially beneficial for reducing depressive symptoms, although the evidence base is limited. Many intervention designs are of low quality while many reviews consist of cross-sectional studies which may distort associations or fail to rule out reverse causality.

Since the 2011 review of reviews, a further ten systematic reviews have been conducted with eight of these synthesising evidence concerning interventions. Effects of interventions were moderate in strength for reducing depression in young people (effects mainly ranged from -0.41 to -0.61 in meta-analyses) and similar to effects reported in adults (Biddle, Ciacconi, Thomas & Vergeer, 2018). Effect sizes were greater in studies that included participants who were clinically diagnosed with depression (-0.43 to -0.61) than those from healthy or mixed samples (-0.26 to -0.52). This is possibly due to the larger potential for improvement in those



with greater levels of depression. Intervention effects tended to be greater over shorter time periods (Brown, Pearson, Braithwaite, Brown & Biddle, 2012) with interventions typically lasting three months, although this was poorly reported. There is partial support showing some causality between physical activity and lower levels of depression with support from interventions but not observational studies. There is biological plausibility (as is addressed in possible mechanisms below), but with a lack of definitive evidence in young people. There is consistency of findings between studies although there is no evidence to support temporal sequencing from longitudinal or prospective evidence (Korczak, Madigan & Colasanto, 2017) or a dose-response relationship (Bailey, Hetrick, Rosenbaum, Purcell & Parker, 2018; Carter, Morres, Meade & Callaghan, 2016). Intensity of physical activity is only reported in 4 of 11 randomised-controlled trials that were reviewed by Carter et al. (2016). Only one meta-analysis tested between levels of intensity (Bailey et al., 2018) and found similar effects. Bailey et al. (2018) also found similar effect sizes when conducting sub-group analyses between light, moderate and vigorous intensities of exercise. The lack of a dose-response relationship may be seen as a weakness for the efficacy of physical activity prescription, although there may be more complex associations between dose of physical activity and outcomes than have been assessed to date. The association may be linear, curvilinear, or contain a threshold, after which no further gains in mental health are made. A curvilinear relationship was found by McMahon et al. (2017) who conducted a cross-sectional examination of physical activity levels and depression in European adolescents (figure 7). Levels of depression were lowest in both boys and girls who were physically active for 11 out of the past 14 days with no decrease in levels of depression for boys who had higher frequencies of physical activity while levels of depression rose for girls with a higher frequency of physical activity. Although this was cross-sectional in design, it is interesting to note that increases in physical activity may not necessarily be beneficial for some adolescent who are already quite active, and may potentially prove harmful, particularly in the case of adolescent girls.

Further research is required in establishing the mechanisms that may lead to reduced levels of depression from physical activity in adolescents. This should help in identifying a dose-response relationship which may lead to specific recommendations being made for the reduction and management of depression in adolescents through the medium of physical activity.



**Figure 7:** Associations between frequency of physical activity and BDI-II depression score (adjusted for clustering within school and country) (McMahon et al., 2017).

#### 2.5.4 Physical Activity & Anxiety

Anxiety disorders rank among the most common mental health disorders in the developing world (Merom et al., 2008) with the lifetime prevalence rate of anxiety disorders in the USA estimated to be as high as 28.8%, almost 40 million people meeting the criteria for diagnosis (Kessler et al., 2005). Research has also shown that anxious patients have a higher risk of developing various co-morbid conditions such as depression, substance use disorders, and cardiovascular disease, while also not utilising more healthcare visits and resources than the general population (Merom et al., 2008; Strik, Denollet, Lousberg & Honig, 2003; Vogelzangs et al., 2010). Current clinical treatments for anxiety include pharmacotherapy, selective serotonin-reuptake-inhibitors (SSRIs) and cognitive behavioural therapy (CBT) while side effects of these treatment options include sexual dysfunction, sedation, insomnia, nausea, new-onset suicidal ideation, cardiac arrhythmias, and increased risk of bleeding disorders (Black, 2006; Corona et al., 2009). CBT has been shown to be an especially effective form of psychotherapy treatment for anxiety, although it takes several treatment sessions to achieve positive results with many patients reporting trouble in adhering to this schedule (Merom et

al., 2008) while up to a third of patients do not respond to SSRIs (Hofmann & Smits, 2008; De Vries, De Jonge, van den Heuvel, Turner & Roest, 2016). Physical activity, along with the widely known benefits for physical health, has been reported to help poor concentration, fatigue, and irritability along with other general symptoms and feeling of anxiety (Herring, Jacob, Suveg & O'Connor, 2011). As little as 20 minutes of acute exercise has been shown to improve anxiety levels in patients diagnosed with anxiety disorder (Knapen et al., 2009) with most of the earlier studies specifically focusing on the acute effects of aerobic exercise such as running (Fox, 1999).

One of the earliest meta-analyses examined the efficacy of aerobic exercise for reducing anxiety symptoms in healthy participants, but not in individuals with diagnosed anxiety disorders and found a small but significant benefit (Conn, 2010). These findings are in contrast to another meta-analysis who found no significant benefit of aerobic exercise for the treatment of anxiety disorders (Bartley, Hay & Bloch, 2013). Evidence based-treatments (SSRIs & CBT) outperformed aerobic exercise in the treatment of anxiety disorders in studies that compared both methods head-to-head although four of seven studies reported a significant benefit of aerobic exercise on anxiety symptoms as compared to a placebo or no treatment (Broocks et al., 1998; Herring et al., 2011; Jazaieri, Goldin, Werner, Ziv & Gross, 2012; Merom et al., 2008). This suggests that engaging in physical activity may be useful for those without access to clinical treatment options and that exercise, in conjunction with more recognised treatment options, may provide additional benefits although this requires further investigation.

The most recent meta-analytic examination of the anxiolytic effects of exercise for people with anxiety and stress-related disorders found that exercise significantly ( $p = 0.02$ ) reduced anxiety symptoms in people that have been diagnosed with anxiety and those with milder symptoms (Stubbs et al., 2017). The authors conclude that exercise should be considered an evidence-based option for anxiety symptoms among people with anxiety/stress related disorders having found that exercise has an effect in the medium range when compared to control conditions. The authors suggest that previous contradictory findings (by Bartley et al., 2013) may have reduced the effect size of exercise through a type ii error when suggesting that exercise is not an effective treatment for anxiety disorders (Stubbs et al., 2017). Another key difference was the inclusion by Bartley et al. (2013) of more clinical forms of aerobic exercise studies with stricter regimes while Stubbs et al. (2017) recommend three tips for adherence that were concluded from previous investigations: (a) a sense of autonomy (ie., experiencing a sense of psychological freedom when engaging in exercise); (b) individual competence (ie., ability to

attain desired outcomes following the exercise programme); and (c) need for relatedness (ie., being socially connected when being physically active) (Vancampfort, Stubbs, Venigalla & Probst, 2015). These recommendations are in line with those made by investigations into the effectiveness of physical activity on well-being and depression and will be discussed later in the section on potential mechanisms. In contrast to depression focused literature, baseline anxiety symptoms did not have any significant effect on treatment outcome from exercise which suggests that all populations may infer some potential positive effects from increased physical activity in relation to anxiety/stress related symptoms.

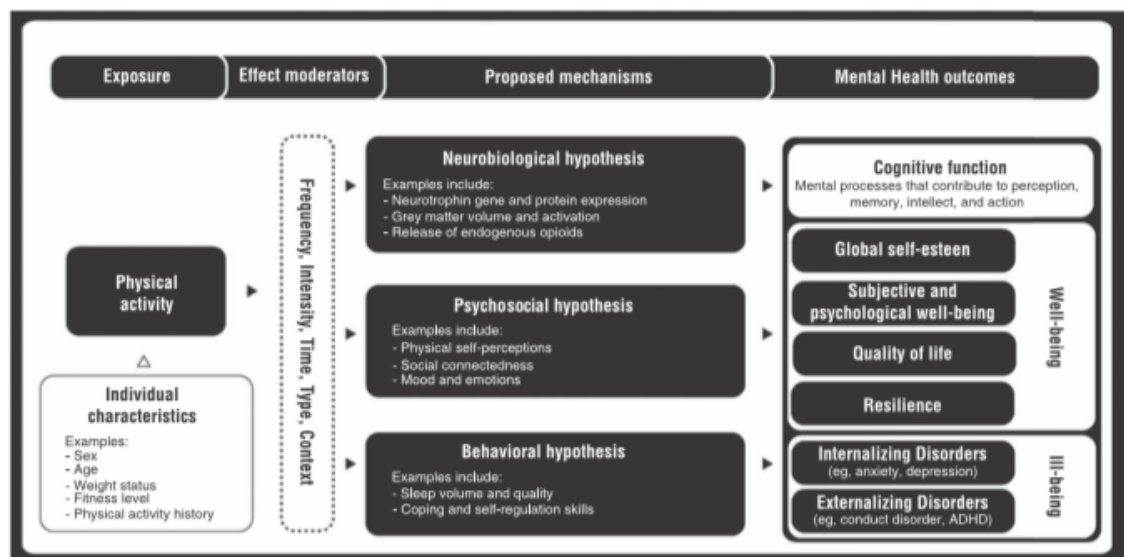
The aforementioned updated review of reviews on physical activity and mental health (Biddle et al., 2018) found that research regarding physical activity and anxiety, particularly in the adolescent population, has stalled in recent years. The small amount of up-to-date research does not allow any extensive or definitive conclusions to be drawn on the causality of reductions in anxiety from physical activity although it does appear that strength of association and experimental evidence does exist, but further work is required to elucidate other elements of causality.

#### ***2.5.5 Suggested Mechanisms of Physical Activity & Wellbeing***

Physical activity is well recognised as a key risk factor for the management and prevention of mental ill-health, including anxiety and depression (Teychenne et al., 2020). Physical activity guidelines have been developed and refined over several decades, since the late 1970s, by leading international experts in the field (Oia & Titze, 2011). The broad purpose of physical activity guidelines is to provide recommendations to improve overall health and wellbeing. The original guidelines were published with a view to reducing the onset of cardiovascular disease-related mortality, and, subsequently, were developed to encompass other prevalent chronic conditions such as diabetes and cancer (Piercy & Troiano, 2018). Recommendations for physical health detail the volume, intensity and type of activity that should be undertaken by both adults and young people but make no reference to other contextual factors that have been shown to play a contributory role in the support or development of optimal mental health. Contextual factors across the lifespan include the life-domain that physical activity occurs in, autonomous motivation, peer support, social interaction, access to green space, and progressions and achievements over time. The purpose of this section is to explore the associations between mental health and physical activity with a view to developing specific guidelines and recommendations to support optimal mental health through physical activity.

## Underlying Mechanisms

A clearer understanding of the bi-directional relationship between physical activity and mental health, or ill-health, may facilitate the delivery of successful interventions in future while also aiding the design and implementation of specific physical activity guidelines for mental health (Teychenne et al., 2020). The current evidence suggests there is a combination of both physiological and psychological factors involved in this relationship. The specific contribution of physiological and psychological factors is, as yet, unclear with a number of hypotheses currently proposed. A recent paper by Lubans et al. (2016) suggested three main interlinking components: the neurobiological processes, and the psychosocial processes, all of which are linked through behavioural processes.



**Figure 8:** Conceptual model for the effects of physical activity on mental health outcomes in children and adolescents (Lubans et al., 2016).

Neurobiological processes include the monoamine hypothesis which suggests that exercise improves the brain's aminergic synaptic transmission, affecting monoamines such as noradrenaline, dopamine brain-derived neurotrophic factor (BDNF), and serotonin, all of which have been implicated in depressive disorders (Ransford, 1982; Chen, 2013). The endorphin hypothesis has also been proposed, while often suggested as the primary reason in media sources, it suggests that endorphins produced by the pituitary gland as part of the parasympathetic system's response to exercise and help to reduce pain and induce a state of euphoria (North & McCullagh, 1990; Morgan 1985). Finally, the most recent suggested mechanism of how physical activity impacts processes in the brain is the anterior cingulate

cortex hypothesis which is developed through a higher frequency of moderate exercise and is believed to lead to an increase in grey matter volume (Lin et al., 2020; Lubans et al., 2016; Philips & Schwartz, 2014). The above neurobiological processes have mainly been studied in animals and is as yet, unclear if the “feel-good” effect of activity may be due to changes in 1 or more brain monoamines, with the strongest evidence available for dopamine, noradrenaline, and serotonin. It is unclear if these processes are the main contributor to changes in wellbeing, or illbeing, overtime.

Experimental studies looking at the neurobiological processes that contribute to changes in wellbeing from physical activity have been very difficult to measure, particularly in children and adolescents. As previously mentioned, the majority of studies have been conducted in animals although there has been an increase in the number conducted in younger humans in the past 8 years. A systematic review of 6 studies found significant interaction effects between neurobiological processes and improvements in cognitive function with minimal overlap for mental health outcomes. These existing studies have investigated different aspects of the brain using a variety of methods such as MRI, fMRI, and electroencephalography (EEG). Experimental studies suggest the effect of any specific brain-related mechanisms in improved cognitive function remains unclear (Lubans et al., 2016), although one recent paper found that a 12 week aerobic exercise intervention led to significant increases in grey matter volume of the anterior cingulate cortex in adolescents with subthreshold mood syndrome (Lin et al., 2020). Decreased anterior cingulate cortex volume has previously been found in adolescents and adults with subthreshold depression, hypomania and bipolar disorder (Phillips & Swartz, 2014; LeWinn et al., 2014; Drevets, Price & Furey, 2008).

Psychosocial approaches to the association between physical activity and wellbeing have largely focused on self-esteem or self-efficacy, physical self-perceptions, social connectedness, and mood and emotions. Many theoretical frameworks have proposed that wellbeing is achieved through satisfying basic psychological needs for social connectedness, autonomy, self-acceptance, environmental mastery, and purpose in life (Deci & Ryan, 2004; Ryff & Keyes, 1995). Any hypothesis based on psychosocial mechanisms recognises that physical activity provides an opportunity for social interaction (relatedness), mastery in the physical domain (self-efficacy and perceived competence), improvements in appearance self-perceptions (body image), and independence (autonomy) which suggests self-determination theory plays a significant role in contributing to the association between physical activity and

wellbeing. Participation in physical activity may lead to improved task self-efficacy, which generalises first to broader self-concept and then to global self-esteem, once it is framed within the correct structure and context (Sonstroem & Morgan, 1989; Shavelson, Hubner & Stanton, 1976). However, physical activity may also have a negative impact on mental health outcomes in adults (White et al., 2017), adolescents and children depending on the context and circumstances (Richards & Foster, 2013; Richards et al., 2014). A recent meta-analysis found that, although matched for physical activity levels, those who engaged in leisure time physical activity had higher levels of wellbeing and lower symptoms of ill-being than those who predominantly engaged in work-related physical activity (White et al., 2017). Mixed results were found for both physical education and active travel. Although active travel was positively associated with higher wellbeing in adults, it had null to negative associations in adolescents while mixed results in physical education stem from poorly designed lessons that may lower students' enjoyment and thus lead to decreases in perceived competence and global self-esteem. This suggests that neurobiological processes are not the only contributor to the association between physical activity and mental health. The life domain within which physical activity takes place significantly moderates the relationship between physical activity and mental health with a range of possible outcomes that vary from positive to negative (White et al., 2017). A recent review of 18 studies examining the effects of psychosocial based physical activity interventions on mental health outcomes found 12 studies had a significant effect for at least 1 potential mechanism, 11 of which also reported a significant effect for at least 1 mental health outcome (Lubans et al., 2016). The authors found evidence for a causal link between physical self-perceptions and indicators of wellbeing. Physical self-concept, perceived competence, and connectedness with others were the largest contributors to increases in and had the strongest associations with wellbeing.

Although the physical activity guidelines make reference to reducing the risk of depression and anxiety in adults and reducing the risk of depression in young people, the evidence behind these recommendations is nowhere near as strong as those for physical health (Biddle & Vergeer, 2020). It is also unclear if the same volume, type or intensity of activity is required for supporting positive mental health as for physical health. The next section will take a critical look at the current evidence that exists in regard to physical activity and mental health in terms of volume, type, and intensity.

### **2.5.5.1 Volume of Physical Activity**

A recent meta-analysis of 49 prospective cohort studies by Schuch et al. (2018) found those with higher volumes of physical activity had lower odds (adjusted odds ratio = 0.83, 95% CI = 0.79-0.88,  $p < 0.001$ ) of developing depression across all ages (young people, working-age adults and elderly people), and this was robust across geographical regions around the world. The risk of developing depression was reduced by 22% in adults who achieved the minimum recommendations of 150 minutes per week (Schuch et al., 2018), although a protective effect against depression was also observed in those who achieved less than 150 minutes per week when compared to largely inactive individuals. This is in agreement with a number of systematic reviews who have shown that even low doses of physical activity are associated with a reduced likelihood of developing depression (Mammen & Faulkner, 2013; Teychenne, Ball & Salmon, 2008). Another meta-analysis including 11 prospective cohort studies found that sedentary behaviour is associated with an increased risk of developing symptoms of depression at follow-up (relative risk = 1.14) (Zhai, Zhang & Zhang, 2015). This suggests the benefits of physical activity for the treatment and prevention of depression may be attainable at lower volumes of physical activity than the guidelines currently recommend, particularly when those most at risk are less likely to be sufficiently active (Hiles, Lamers, Milaneschi & Pennix, 2017; Vancampfort et al., 2017) and may prefer lighter forms of physical activity (Fraser, Chapman, Brown, Whiteford & Burton, 2015).

Similar findings have been reported for anxiety as for depression. A meta-analysis of 13 unique prospective cohort studies found that people with higher volumes of self-reported physical activity were at reduced odds (OR = 0.74, 95% CI = 0.62-0.88,  $p = 0.001$ ) of developing anxiety (Schuch et al., 2019). The protective effects for anxiety were evident in both young people and adults across Europe and Asia. A further systematic review and meta-analysis of 13 prospective cohort studies that focused solely on those with a clinical diagnosis also found that any anxiety disorder (OR = 0.66, 95% CI = 0.53-0.82,  $p = 0.025$ ) and generalised anxiety disorder (OR = 0.54, 95% CI = 0.32-0.91,  $p = 0.007$ ) were significantly lower after physical activity exposure when followed up at least 1 year later (McDowell, Dishman, Gordon & Herring, 2019). It must be noted, however, the most common study design included in both meta-analyses largely limited physical activity exposure to a single measure at baseline. No studies regularly tracked physical activity levels in a cohort across time while only six studies assessed physical activity more than once to permit an estimate of change in exposure across follow-up, and only three adequately controlled for putative confounders. Two of those three supported inverse associations between change in physical activity exposure and anxiety



(Hiles et al., 2017; Backmand, Kaprio, Kuiala & Sarna, 2009) although additional research is required to quantify the association between change in physical activity exposure and anxiety. It is also worth exploring the association between anxiety and cardiorespiratory endurance as increased higher volumes of physical activity are associated with higher levels of cardiorespiratory endurance and serve as an objective surrogate measure of physical activity (McDowell et al., 2019). The long term impact of maintaining or increasing fitness on anxiety is not well known and may help to clarify the volume of exposure required to support optimal mental health through physical activity.

It is clear that increased volumes of physical activity are associated with lower levels of depression and anxiety although exactly how much is currently unclear, although the available evidence suggests it is below the current guidelines for physical health as set out by the World Health Organisation (2010). It is acknowledged that there are likely multiple dose-response curves for various health outcomes (Warburton, Charlesworth, Ivey, Nettlefold & Bredin, 2010) although two studies found similar dose-response curves for depression and anxiety in adolescents (McMahon et al., 2017; Murphy, Sweeney & McGrane, 2020) however, neither matched the inverse curve for wellbeing. It certainly would not be conceivable to develop separate guidelines for each mental health outcome due to the likely confusion in public health messaging (Teychenne et al., 2020), although lowest symptoms of depression and anxiety were found in adolescents who met the physical activity guidelines on 8-10 days out of 14 (Murphy et al., 2020, McMahon et al., 2017). Given that more than a quarter of the global population do not currently meet physical activity guidelines (Guthold, Stevens, Riley & Bull, 2018), and those most at risk of poor mental health are among the least active (Hiles et al., 2017), it is important that guidelines are perceived as achievable by those who are starting from a low baseline. This has been argued previously in a critical review of existing guidelines in Canada where meeting half the current guidelines led to marked health improvements (Warburton & Bredin, 2016) while the largest difference in symptoms of anxiety and depression in a cohort of Irish adolescents was found between those who were currently least active and those classified as somewhat active (Murphy et al., 2020) suggesting even small increases in physical activity leads to significant increases in mental health for currently inactive individuals.

#### ***2.5.5.2 Type of Physical Activity***

As stated in the current guidelines for health, adults should perform muscle-strengthening activities involving major muscle groups on 2 or more days per week while children and

adolescents should perform vigorous-intensity activities that strengthen muscle and bone, at least 3 times per week (World Health Organisation, 2010). Most prospective studies investigating the impact physical activity has on mental health have largely focused on establishing a dose-response relationship although the exact dose required has not yet been determined. Little relevance has been paid to the type or mode of physical activity (Mammen & Faulkner, 2013; Schuch et al., 2013) until recently with the primary focus on aerobic type exercise. A meta-analysis of 16 studies found that resistance exercise significantly improves symptoms of anxiety in both healthy participants (Hedge's  $g = 0.50$ , 95% CI = 0.22-0.78,  $p < 0.001$ ) and participants with a physical or mental illness (Hedge's  $g = 0.19$ , 95% CI = 0.06-0.31,  $p < 0.04$ ) (Gordon, McDowell, Lyons & Herring, 2017). Another meta-analysis of 33 randomised controlled trials found that resistance exercise significantly reduced symptoms of depression in adults regardless of health status, total prescribed resistance training, or significant improvements in strength (Hedge's  $g = 0.66$ , 95% CI = 0.48-0.83,  $p < 0.001$ ) (Gordon et al., 2018). Comparisons between aerobic exercise only and resistance exercise only found no significant difference (Schuch et al., 2016) in the effect of reduced symptoms of depression in another meta-analysis of twenty five randomised controlled trials. Furthermore, an analysis of 17,839 adults who adhere to both the aerobic and muscle strengthening guidelines were at the lowest risk of developing symptoms of depression, compared to those who adhere to only one guideline (APR = 0.28-0.47 v 0.35 – 0.63) (either aerobic or muscle-strengthening activities) (Bennie, Teychenne, De Cocker & Biddle, 2019), while another analysis of 5,100 females found those who met the aerobic and resistance training guidelines had a stronger association with lowered risk of symptoms of both depression and anxiety than only meeting the aerobic recommendations (Ofstedal, Smith, Vandelanotte, Burton & Duncan, 2019). These studies suggest a synergistic relationship between aerobic physical activity and resistance training in terms of mental health benefits. It could be argued that those who engage in both aerobic physical activity and resistance training have a greater volume of total time in activity and thus accumulate more MET-minutes, although the effectiveness of resistance training in reducing symptoms of anxiety and depression has been demonstrated in experimental studies (Gordon, McDowell, Lyons & Herring, 2020; Sigh, Clements & Singh, 2001; Pilu et al., 2007; Herring, Jacob, Suveg & O'Connor, 2011). The majority of research focusing on resistance training and mental health outcomes has been conducted in adults and young males. Further research is required to understand the relationship between resistance training and young people, particularly young females.

In addition to aerobic exercise and resistance training, there is growing evidence supporting the use of yoga as an adjunct or combination therapy for the management of anxiety and depression (Butterfield, Schultz, Rasmussen & Proeye, 2017). The proposed mechanisms of how physical activity impacts mental health and wellbeing have been outlined above (Lubans et al., 2016), although those proposed for yoga are not well understood (Da Silva, Ravindran & Ravindran, 2009; Field, 2011). Sherman (2012) proposes that the physical postures, breath work, meditation, as well as relaxation, spiritual and mindfulness aspects of yoga may all contribute to improvements in anxiety and depression. Yoga is thought to have a positive effect on biochemical and neurobiological systems, including regulating the autonomic nervous system and stress response and thereby reduce symptoms of stress, anxiety and depression (Brown & Gerbarg, 2005; Salmon, Lush, Jablonski & Sephton, 2009). Physiologically, a stressor triggers the sympathetic nervous system to activate a chain of events, including an increase in blood pressure, heart rate and breath rate, and release of cortisol, called the “fight or flight” stress response. Regular yoga practice decreases the sympathetic nervous system stress response and activates the parasympathetic nervous system to reduce blood pressure, heart rate and breath rate, and is linked to a decrease in stress and anxiety levels (Brown & Gerbarg, 2005). Furthermore, the release of the “stress hormone” cortisol has been shown to reduce immediately following yoga practice (Michalsen et al., 2005; Yadav, Magan, Mehta, Sharma & Mahapatra, 2012).

Psychologically increased self-awareness (Arora & Bhattacharjee, 2008), coping mechanisms (Kinser, Bourguignon, Whaley, Hauenstein & Taylor, 2013), self-regulation (Gard et al., 2012), psychological flexibility (Dick, Niles, Street, Di Martino & Mitchell, 2014), positive attitude towards stress (Woodyard, 2011), and calmness (Sherman, 2012) have all been proposed as mechanisms for mental health benefits (Butterfield et al., 2017). Neuroplasticity, which are changes in neural pathways of the brain, are thought to occur through regular yoga practice (Brown & Gerbarg, 2005) and influence development and improvement in these psychological skills. This is a powerful connection suggesting that the brain, including thinking patterns and ability to cope with stress, can be trained and rewired much like a physical muscle of the body. It also suggests there is interaction between the neurobiological and psychological mechanisms outlined above when physical activity impacts on mental health and wellbeing. Systematic reviews have shown yoga to have positive effects on anxiety and depression although many of the reviewed studies were of poor quality and not enough statistical information as reported to conduct a relevant meta-analysis or meta-regression (Kirkwood,

Rampes, Tuffrey, Richardson & Pilkington, 2005; Hagen & Nayar, 2014; Butterfield et al., 2017).

#### ***2.5.5.3 Intensity of Physical Activity***

The three modes of exercise outlined in the previous section vary in intensity when compared to each other while cardiorespiratory endurance and resistance exercises can often be performed at a variety of intensities. The current guidelines for physical health can be met through either moderate or vigorous intensity exercise with vigorous intensity exercise appearing to be more time efficient. The effect that intensity of physical activity may play on mental health outcomes is, as yet, unclear although initial evidence shows both positive and null effects. While intensity is often either not reported, or reported through total MET-minutes, it is difficult to extrapolate cause and effect from intensity of physical activity. Studies involving high intensity interval training have shown some improvements in psychological wellbeing among adolescents (Costigan, Eather, Plotnikoff, Hillman & Lubans, 2016) although null effects were found for anxiety in young adults (Eather et al., 2019). Research on the efficacy of high intensity interval training for improving mental health outcomes should seek to compare to other intensities of exercise in future as the majority thus far have focused on comparisons with control groups. It may be possible that reported positive effects from high intensity physical activity may be due to increases in physical activity alone. There is currently no evidence to suggest that high intensity interval training has negative impacts on mental health, although it may be associated with more negative affective states during participation (Teychenne et al., 2020), compared to lower-intensity exercise, which can predict drop-out and therefore reduce the likelihood of meeting physical activity guidelines (Biddle & Batterham, 2015). The strenuous nature of high intensity interval training may also undermine competence (Biddle & Batterham, 2015), particularly for people in the lowest activity groups, and thus have negative knock-on psychological effects to those already in a high risk category. Perceived competence not only predicts sustained participation in physical activity (Biddle & Mutrie, 2007), but is also associated with increased positive affect and reduced negative affect (Teixeira, Marques & Palmeira, 2018).

#### ***2.5.5.4 Context of Physical Activity***

When examining the roles of volume, intensity, and type of exercise on mental health there is inconclusive evidence regarding any one specific recommendation that can be made. More exercise is better but we may not need to meet the current physical activity guidelines for physical health. Benefits were found when engaging in aerobic exercise, resistance exercise,

and yoga, with some of the largest benefits observed in those who engaged in a combination of more than one form of exercise (Oftedal et al., 2019). Varying intensities also showed inconsistent results with both high and low levels of intensity conferring similar benefits, although high intensity interval training still warrants further research due to the potentially increased levels of drop out. Recent research has shifted from volume, intensity and type of physical activity to the context or life-domain through which it is engaged in. The guidelines for health do not distinguish between where physical activity is undertaken and state that *“physical activity includes recreational or leisure-time physical activity, transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities”*. The variety of life-domains outlined suggest the context of physical activity is largely irrelevant and benefits to physical health from physical activity are predominantly physiological. As the aforementioned mechanisms of physical activity and wellbeing suggest combinations of both physiological and psychological processes, it gives us reason to believe the domain of physical activity plays a significant role for the prevention of mental ill-health and the promotion of positive mental health. A meta-analysis of domain-specific physical activity and associations with mental health in 98 independent studies found leisure-time physical (r = .11, 95% CI = .07 to 0.17, p < 0.001) and active travel (r = 0.13, 95% CI = .02 to .23, p < 0.01) to be positively associated with mental health while leisure-time physical activity (r = -.11, 95% CI = -.16 to -.06, p = 0.007) and school sport (r = -.09, 95% CI = -.11 to -.07, p < 0.01) were inversely associated with mental ill-health (White et al., 2017). However, physical activity was not consistently associated with lower mental ill-health across domains as work-related physical activity was positively associated with mental ill-health (r = .09, 95% CI = .03 to .15, p = < 0.001) while household chores and physical education had no relationship with mental health or mental ill-health (White et al., 2017). Interestingly, the positive association observed between active travel and mental health was primarily in adults while studies involving adolescents showed null and negative associations between active travel and mental health (White et al., 2018). Life-domain was found to significantly moderate the strength of the relationship between physical activity and mental ill-health (p < 0.001) and explained 46% of the variance, thus highlighting the need to investigate the most appropriate contexts of physical activity that best support mental health and wellbeing.

A sub-domain of leisure-time physical activity, with a growing body of research, is the impact of sport on mental health outcomes. Azstalos et al., (2009) found that participation in sports, and no other form of physical activity, was consistently associated with significantly less stress

(OR = 0.375, 95% CI = 0.2 to 0.7,  $p < 0.001$ ) and distress (OR = 0.48, 95% CI = 0.25 to 0.91,  $p < 0.001$ ). Similarly, Wijndaele et al., (2007) found that participation in sport and no other form of physical activity could discriminate between three meaningful clusters of perceived stress, social support and coping behaviour. A random-effects meta-analysis of 29 studies, including 122,056 participants, also found that symptoms of anxiety and depression were significantly lower among sport-involved adolescents than in those not involved in sport (Panza et al., 2020). A small negative correlation was found between sport participation and anxiety ( $\rho = -0.12$ , 95% CI = -0.15 to -0.10). A small negative correlation was also found between sport participation and depression ( $\rho = -0.08$ , 95% CI = -0.10 to -0.06). Recent cross-sectional analyses found sport to have a significant ( $p < 0.01$ ) protective effect against symptoms of depression and anxiety in adolescents (McMahon et al., 2017). It is therefore arguable that sports participation may represent effective preventive and intervention strategies against stress and distress, both leading causes of symptoms of anxiety and depression. The main reason for less stress/distress may be that sports participation usually represents a chosen leisure-time activity that includes recreation, enjoyment and social interaction (Azstalos et al., 2009). These attributes are associated with enhanced psychological wellbeing, but they rarely can be attributed to types of physical activity that imply compulsion to a certain extent, such as housework or active transportation.

We have established that both physiological and psychological processes interact as mental health outcomes are improved through physical activity. Current evidence supports a number of psychosocial mechanisms that have been suggested although the role these mechanisms play in each domain of physical activity is unclear. Physical activity enhances self-efficacy and exposes individuals to challenges that offer opportunities to develop confidence and a sense of mastery (Craft & Perna, 2004; Paluska & Schwenk, 2000). Work-related and household physical activity often consist primarily of walking, and so give little opportunity to experience a sense of mastery when compared to leisure-time physical activity (Sohn, Hasnain & Sinacore, 2007). The social interaction hypothesis suggests that participating in physical activity with other people may influence mental health outcomes (Bailey & McLaren, 2005). Transport related physical activity may be engaged in with others or alone so social interaction may explain some of the variance within this domain. The distraction hypothesis suggests that physical activity diverts individuals attention from stressful life events which leads to improved mental wellbeing (Leith, 2000) which suggests that leisure-time physical activity provides a distraction from stress while physical activity during domains such as work do not; and may often be a source of stress.

A potentially important factor in framing the context of physical activity is motivation. Leisure time physical activity is generally chosen by the performer for enjoyment or the perceived physical, mental, and social benefits (Seippel, 2006; McCarthy, Jones & Clark-Carter, 2008). Choosing to participate for enjoyment is central to autonomous motivation (Ryan & Deci, 2000). Work-related physical activity is often construed as a compulsory task and may be enforced by either another person, or for the purpose of receiving an external reward (Azstalos et al., 2009) and so ends up with motivation being controlled (Ryan & Deci, 2000). Self-determination theory posits that behaviours which are undertaken due to autonomous motivation are more likely to be associated with the satisfaction of psychological needs, namely autonomy, competence, and relatedness, and that wellbeing is enhanced when an individual's psychological needs are satisfied (Weinsten & Ryan, 2010). As such autonomously motivated behaviours are expected to yield more positive psychological outcomes than behaviours undertaken due to controlled motivation (Ryan & Deci, 2000; Deci & Ryan, 2008a; Deci & Ryan, 2008b). Further to this, exercise involving choice has shown positive associations with increased positive affect and enjoyment, compared to exercise with no choice (Parfitt, Rose & Burgess, 2006). Self-determined motivation may also explain some of the variation within each domain of physical activity (Catten, 2009). While transport related physical activity is positively associated with mental health among adults, no such relationship was found for adolescents (White et al., 2017). It is possible that this finding reflects the mental health benefits experienced when adults personally choose to walk to work because it is enjoyable or important, while young people who are forced to walk to school do not experience the same benefit. Furthermore, Azstalos et al., (2009) reported that transport physical activity was associated with increased stress among blue collar workers but not among white collar workers. Financial factors may force some blue collar workers to cycle to work (controlled motivation), while white collar workers are more likely to own a car, yet choose to walk or cycle to work autonomously for health or enjoyment benefits (Azstalos et al., 2009). Autonomous motivation has been found to increase activity levels in adolescents (Gillison, Standage & Skevington, 2006) and the chances of long-term involvement in sport (Hagger & Chatzisarantis, 2007).

Increasing physical activity in and of itself is not likely to be worthwhile in terms of reducing the prevalence of mental ill-health, as individuals with occupations that involve higher amounts of physical activity, such as blue collar jobs, are more likely to experience mental ill-health. This suggests physical activity is not automatically associated with greater mental health and reduced mental ill-health, and that contextual factors are crucial to such

relationships (White et al., 2017). Current evidence suggests that leisure-time physical activity is likely to be an optimal domain to promote mental health and prevent mental ill-health. Gaining knowledge of the specific factors that mediate or moderate the relationship between physical activity and mental health, particularly through the leisure-time domain, will help lead to the development of contextually tailored interventions and physical activity guidelines, and improve the effectiveness of physical activity as a prevention and treatment method.

## **2.6 School-Based Physical Activity Interventions**

As the volume of theoretical research on the benefits of PA in adolescents increases, there are much fewer investigations with quasi-experimental designs compared to cross-sectional designs (Vaquero-Solis et al., 2020). There are even fewer that refer to the psychosocial benefits compared to those referring to physical benefits (Vaquero-Solis et al., 2020). As the intervention process is characterised by the manipulation of independent variables over time, this provides us with more information about the results of intentional manipulation to improve PA and psychosocial outcomes (Sallis et al., 2015). Intervention studies help to better understand the causal relationships between physical and psychological variables that lead to favourable changes in outcomes of health, whether they be physical or mental (Sallis et al., 2015).

### **2.6.1 Impact on Physical Activity**

Early reviews of school-based PA interventions found mixed effects in terms of increased PA and associated health benefits such as increased physical fitness, attitudes towards PA and self-efficacy (Cale & Harris, 2006). Interventions targeting sedentary behaviours such as television watching and video game playing were successful in reducing these behaviours but unsuccessful in increasing physical activity (Cale & Harris, 2006). Early reviews suggested that school-based PA interventions and programmes are largely successful in increasing physical activity within the intervention delivery component itself but do not necessarily transfer to increased PA outside of the intervention or lead to effects lasting after the intervention (Cale & Harris, 2006).

Recent reviews and meta-analyses have also found mixed levels of success in terms of increasing PA through school-based interventions. Some individual studies showed positive results and the subgroup analyses revealed promise for approaches underpinned by theory and multi-component interventions (Owen et al., 2017). Although school-based interventions have been suggested as the most promising setting to intervene with adolescents, particularly females (Camacho-Minano et al., 2011), the observed small effects illustrate the difficulties



and challenges of positively impacting adolescents PA behaviours through the school setting. Several factors have been suggested as contributing to these difficulties such as social or cultural norms, difficulties in providing a range of PA opportunities, length of intervention periods, and small sample sizes. Interventions that were successful at increasing PA had some commonalities such as focusing solely on one gender, uniquely addressing the PA needs of the target population, being underpinned by theory, focusing on younger adolescents (12-15), and utilising a multi-component design (Owen et al., 2017). School-based interventions were reported as more effective when enjoyment of PA was prioritised and participants are given freedom of choice of activities (Owen et al., 2017).

Interventions targeting other components of health, such as health-related physical fitness have also shown mixed results. Improvements to body composition were documented across a number of school-based interventions included in a systematic review, although participants were predominantly classified as overweight or obese at the outset (Duncombe et al., 2022). Interventions incorporating high intensity interval training have been shown to increase cardiorespiratory fitness in adolescents although enjoyment levels were significantly lower when performing exercise alone than compared to team sports (Duncombe et al., 2022).

### ***2.6.2 Impact on Mental Health & Wellbeing***

As school-based interventions focusing on PA have provided mixed results due to variations in sample sizes, underpinning theories, participant characteristics and length of intervention, researchers have begun to include other variables and outcomes for measurement. The growing popularity in research on physical activity and mental health has led to an increase in focus on the impact of physical activity interventions on mental health outcomes, such as anxiety, depression, and wellbeing (Biddle et al., 2019). A systematic review and meta-analysis of school-related physical activity interventions on mental health in young people found beneficial effects on positive mental health, wellbeing, anxiety and resilience (Andermo et al., 2020). These findings must be taken with caution as the authors noted effect sizes were small and found mixed results across studies. These mixed results can be attributed to a number of factors, many of which have been outlined above, but also include the intensity of the intervention. Relatively intensive interventions reported negative effects on mental health in younger adolescents and children (Andermo et al., 2020), which highlights the potential differences that PA interventions can have on separate outcomes as higher intensity interventions reported more favourable results in terms of physical fitness outcomes (Duncombe et al., 2022). Mixed results may also be impacted by large variation in the activities

that were included as it is difficult to disentangle the effects of different components of each programme.

For internalising mental health problems the authors found that age appeared to moderate programme effects as adolescents experienced favourable or no effects and younger children experienced negative or no effects. Considering that the average age of onset of anxiety disorders is 11 years (Kessler et al., 2005) and 11-13 years for depressive disorders (Merikangas et al., 2009), prevention effectiveness may vary depending on not only the type of intervention, but also the age or developmental stage of the participant (Johnstone et al., 2018). Except for age, the authors found no other systematic pattern in effectiveness regarding the type of intervention, sex of the participants, socioeconomic status, implementation reach, study quality or the type of control group on internalising mental health problems. Authors of previous reviews examining the effect of PA interventions on anxiety and depression in young people have shown varying results (Johnstone et al., 2018; Larun et al., 2006) with some studies focusing on both outcomes showing positive effects on anxiety but not on depression and others showing positive effects on depression but not on anxiety (Larun et al., 2005). This supports previous literature suggesting the context within which physical activity is experienced has a significant bearing on outcomes of mental health (Teychenne et al., 2020).

Less attention has been dedicated to the effect of physical activity interventions on positive mental health in young people. The concept of positive mental health is a multidimensional construct (Scheid & Horwitz, 1999). Factors that have been shown to be positively correlated to positive mental health include male sex, younger age, higher education, higher income and social relations (Barry, 2009). A key component of positive mental health is resilience and refers to a dynamic process encompassing positive adaptation within the context of significant adversity (Luthar et al., 2000). Meta-analytic evidence found beneficial effects on resilience suggesting that physical activity interventions in the school context may be important to help young people cope with the adversities (Andermo et al., 2020).

### ***2.6.3 Underpinning Theories***

Subgroup analysis in meta-analyses (Owen et al., 2017; Andermo et al., 2020; Mears & Jago, 2016) inferred a significant effect for interventions underpinned by behaviour change theory suggesting interventions underpinned by theory are more effective than those with no specified theory. Two of the most commonly utilised motivational theories in physical activity interventions in the educational context are Self-Determination Theory and Achievement Goal Theory (Vaquero-Solis et al., 2020).

### **2.6.3.1 Self-Determination Theory**

Self Determination Theory (SDT) (Ryan & Deci, 2000) is based on motivation and the innate inclinations toward personal growth that are either satisfied or prevented by their immediate environment. It has been widely used for the development of intervention strategies to improve student motivation during PA practice (Amado et al., 2014; Cheon et al., 2016). It is a macro-theory of personality and motivation which proposes that context can influence the reasons for performing certain activities. It also focuses on the extent to which behaviours are voluntary or self-determined, maintaining that motivation is a continuum of self-determination, differentiating autonomous motivation (intrinsic, integrated, and identified regulation), controlled motivation (introjected and external regulation) and amotivation (Ryan & Deci, 2000). According to SDT, the type of motivation shown by individuals depends on the satisfaction of their basic psychological needs: autonomy, competence, and relatedness. The satisfaction of these basic psychological needs, or its lack of, will influence wellbeing (Ryan & Deci, 2017). The need for competence is defined as the feeling of effectiveness while engaging in an optimally challenging task. The need for autonomy is characterised by the sense of initiative felt by the participants when voluntarily participating in the proposed activities. The need for relatedness is defined by the individual's feeling of integration and acceptance in the context in which he or she interacts.

### **2.6.3.2 Achievement Goal Theory**

Achievement Goal Theory (AGT) (Ames, 1992) considers that people are directed by the goals they hope to achieve and that they act rationally in accordance with these goals (Nicholls, 1984). In this sense, the success or failure of an action depends on the individual's interpretation, therefore what some people interpret as success is interpreted by others as failure (reference 28). According to AGT, achievement goal orientations refer to the cognitive representations through which participants are involved in certain tasks (Treasure & Roberts, 1995). In this line, in achievement contexts, there are two predominant types of involvement: ego-involvement, in which success is perceived when one's performance is better than that of others; and mastery involvement, in which the term goal implies the improvement of one's personal competence. Therefore, the type of participation that a student plays for a given activity will be the result of the motivational climate and the goal orientations presented by that individual (Jaakkola et al., 2016).

### ***2.6.3.3 Interventions Underpinned by SDT & AGT***

The majority of intervention studies in educational contexts are based on SDT (Vaquero-Solis et al., 2020), which may be due to the amount of constructs concerning human behaviour that may be included as variables in interventions although some (Kokkonen et al., 2019; Lonsdale et al., 2019) have utilised both SDT and AGT. This suggests both methodological approaches can complement each other to give a more complex view of motivation independently of an educational, sporting, or PA sense. A recent review of interventions in educational contexts that were embedded in theory found only three based solely on AGT (Vaquero-Solis et al., 2020). This review found changes in motivation to be active are mostly predicted by the support and satisfaction of the basic psychological need which may be due to the fact that in many of the interventions they base their strategies on the support of autonomy (How et al., 2013; Sevil et al., 2015), relegating the need for competence to a secondary level. The programmes included in the review revealed further effects on fun, boredom, and usefulness for the improvement in levels of motivation and PA in educational settings. Several studies agreed on the positive effects on PA in supporting autonomy or another basic psychological need (Franco & Coteron, 2017). Increases in motivation to be active and fun while being active were also found in interventions developed around the TARGET area (Ames, 1992) through support for autonomy (Rokka et al., 2019). Teixeira et al. (2012) demonstrated that the most autonomous forms of behavioural regulation and PA can be important in the context of promoting an active lifestyle through the choice of optimal challenge that promote compromise and enjoyment. Alongside improvements in PA, studies have also shown the behavioural effects derived from intervention programmes such as the intention to be active (Franco & Coteron, 2017), reductions in sedentary behaviour (Lonsdale et al., 2017), attitude towards PA (Fu et al., 2015), and perceived effort when engaging in PA (Bechter et al., 2019). Changes to psychosocial variables have also been found such as wellbeing (Babic et al., 2016), self-efficacy (Bronikowska et al., 2018), subjective norms (Grasten et al., 2015), and prosocial and antisocial behaviour (Cheon et al., 2018). The changes in the psychosocial variables could be due to the intervention procedure developed by the different researchers where the results can guide the theoretical developments and improvements, which then influence the subsequent research and practice in a significant way (Walton, 2014). It's worth noting the effects on PA after an intervention as in many of the investigations, it was the means to improve the psychosocial variables (Bronikowska et al., 2018; Fu et al., 2015; Shannon et al., 2018). The impact on motivation to be active, largely due to the satisfaction of basic psychological needs, appears to be a significant factor in interventions underpinned by theory

although no qualitative, or mixed-, methodologies were employed to provide us with potentially richer details as to the underlying mechanism. It is clear that interventions underpinned by theory are more successful in increasing PA but also many of the behavioural and psychosocial variables that interact with PA although the direction, and magnitude, of causality is still unclear.

### **Link from Chapter 2 to Chapter 3**

Chapter 2 highlighted relevant literature suggesting a link between physical activity and mental health and wellbeing, although there is a lack of up to date research on these associations in Irish adolescents. Research in one field has highlighted the declining levels of physical activity in Irish adolescents (Woods et al., 2010; Woods et al., 2019) while research in another field has highlighted the increasing prevalence of symptoms of anxiety and depression (Dooley et al., 2012; Dooley et al., 2019). Associations between these trends are currently available in a European cohort (McMahon et al., 2017) although none currently exist for Irish adolescents. Chapter 3 provides the researcher with a picture of the current levels of physical activity, participation in sports, wellbeing, and symptoms of anxiety and depression amongst adolescents in the Republic of Ireland. It is a baseline study using self-report tools to examine associations between physical activity and sports participation, with wellbeing, and symptoms of anxiety and depression. The researcher conducted this study to establish baseline data across year groups, genders, frequency of activity and sub-categories of physical activity, such as the number and type of sports played.

## **Chapter 3:**

# **Physical activity and sports participation in Irish adolescents and associations with anxiety, depression and mental wellbeing. Findings from the physical activity and wellbeing (PAWS) study.**

### **Manuscript submitted as:**

Murphy, J., Sweeney, M. R., & McGrane, B. (2020). Physical activity and sports participation in Irish adolescents and associations with anxiety, depression and mental wellbeing. Findings from the physical activity and wellbeing (PAWS) study. *Physical activity and health*, 4(1).

### **3.1 Abstract**

A cross-sectional study design was used to examine associations between frequency of physical activity and participation in sports with mental wellbeing, and symptoms of depression and anxiety. Surveys were completed in post-primary schools by 5,661 adolescents from the Republic of Ireland. Validated instruments were used to assess frequency of physical activity, participation in sports, mental wellbeing (WEMWS), depressive symptoms (BDI) and anxiety (BAI). A minority of the sample (11.5% of males and 5.3% of females) were found to meet WHO's physical activity guidelines (60 minutes or more each day). Frequency of activity were found to decline with age. Frequency of activity was positively associated with wellbeing and negatively associated with symptoms of anxiety and depression. Males had higher levels of wellbeing and lower levels of anxiety and depressive symptoms across all sub-groups. Adolescents who engaged in sports were found to have higher levels of wellbeing and lower symptoms of anxiety and depression with team sport conferring an additional benefit. Future physical activity recommendations for children and adolescents should include mental as well as physical health benefits.

### **3.2 Introduction**

It is important to participate regularly in physical activity to improve the likelihood of living a healthy life. To assist people living a healthy life, there are specific physical activity guidelines (Hallal et al., 2006). Children and adolescents aged 5-17 years should accumulate 60 minutes of moderate-to-vigorous physical activity (MVPA) each day according to international recommendations (World Health Organisation, 2010). It has been reported however, that up to 80% of younger adolescents (13-15 years) do not meet the recommendations (Hallal et al., 2012), while only 13% of European adolescents (McMahon et al., 2017), and 10% of Irish adolescents meet the recommendations (Woods et al., 2019). Internationally, physical activity levels have decreased with age across adolescence, with females reporting significantly lower



engagement in physical activity than their male counterparts in the majority of countries (Currie et al., 2009).

Conclusive evidence has demonstrated that the physical health of adolescents is enhanced through a higher frequency of physical activity (Jansen & Leblanc, 2010; Strong et al., 2005), there is also widespread belief that physical activity is inherently good for young people in respect of varied psychosocial outcomes, such as self-esteem and cognitive functioning (Biddle & Asare, 2011), with the most evidence about depression and anxiety (Abu-Omar et al., 2004; Dinas et al., 2011; Sieverdes et al., 2011). Suicide, depression, eating disorders and anxiety are some of the conditions that affect young people in disproportionate rates in comparison to many other population groups (Viner & Booy, 2005). McPhie & Rawana (2015) found greater levels of resiliency against symptoms of depression in adolescents who engaged in higher frequencies of physical activity in a longitudinal study. Regular physical activity also appears to be protective against anxiety disorders (Carek et al., 2011; Strohle, 2009) while reduced levels of suicidal ideation has been associated with engagement in sporting activities.

A recent review of reviews on physical activity and mental wellbeing in adolescents (Biddle, Ciacconi, Thomas & Vergeer, 2019) found that those who are physically active seem less likely to suffer from mental health problems and may have enhanced cognitive functioning with greater effects more likely in those with poorer mental health at baseline. A European wide study (McMahon et al., 2017) on the associations of physical activity with anxiety, depression and mental wellbeing found that lower levels of depression and anxiety in adolescents were associated with higher frequencies of physical activity as well as greater levels of wellbeing. They also found that participation in sport provided additional benefits to mental health regardless of frequency of activity with girls who play team sport, in particular, having significantly lower levels of depression and anxiety. These findings go some way to support

the hypothesis that psychosocial interactions are significant contributors to the mental health benefits provided by physical activity (McMahon et al., 2017; Lubans et al., 2016).

The *My World Survey, A National Study of Youth Mental Health in Ireland* (Dooley, Fitzgerald & Giollabhui, 2012) found approximately one third of adolescents to be suffering from elevated levels of depression and anxiety. A follow up study, *Jigsaw My World Health Survey 2* reported that 40% of participants suffered from mild to very severe depression and 49% suffered from mild to very severe anxiety (Dooley, O'Connor, Fitzgerald & O'Reilly, 2019). This increase highlights the growing, and worrying, upward trend of mental health difficulties experienced by Irish adolescents.

While mental health difficulties have increased among Irish adolescents, physical activity levels have decreased. The *Children's Sport and Physical Activity Study* (CSPPA) (Woods, Moyna & Quinlan, 2010) found that 12% of adolescents met the physical activity requirements in 2010 while this had decreased to 10% in the 2019 follow-up study (Woods et al., 2019). The relationship between this increase in mental health difficulties and decrease in physical activity levels has been previously unexplored in an Irish context. The current study sought to explore the associations between physical activity and mental health and wellbeing indicators to further understand the bi-directional relationship between physical activity and mental health in adolescents. Our objectives were to describe the frequency of physical activity and engagement in sport among males and females aged 11 to 20 and to examine associations between frequency of physical activity and engagement in sport with wellbeing, and symptoms of depression and anxiety. We hypothesised that the majority of adolescents would not meet WHO physical activity recommendations, that females would have lower frequencies of physical activity than males and that more frequent exposures to physical activity would be associated with higher levels of wellbeing and lower symptoms of depression and anxiety.

### **3.3 Methods**

A cross-sectional study design was employed in the post-primary school setting. Invitations to participate were circulated via the University's social media platforms where interested principals/teachers could register via an online form. Data collection took place during September and October 2019.

#### **Data Collection**

Written consent from each school's Principal was sought prior to the distribution of questionnaires. Parental consent forms and plain language statements were given to all students prior to the questionnaire being issued. Participants were informed that their responses would be treated in strictest confidence and that all responses were entirely anonymous. They were encouraged to take time, reflect on their answers, and to be as honest as possible. All questionnaires were administered through an online form and could be completed via desktop computer, laptop, tablet or mobile phone. An option to contact the National Education Psychologists Service (NEPS) was offered to participants after completion of the questionnaire if they wished to discuss anything from the questionnaire with a suitably qualified professional. The means of administering the questionnaire was at the discretion of each participating school.

#### **Physical activity**

Habitual physical activity was assessed via a modified version of the Take PART questionnaire by measuring the number of days during the past 14 that participants had accumulated 60 minutes of moderate-to-vigorous physical activity (MVPA) which was previously validated in an Irish adolescent population (Woods et al., 2009). The survey item assessing physical activity was as follows: "During a typical 2-week period, on how many days were you physically active for a total of at least 60 minutes? For

each day, add up all the time you spent in physical activity like walking, riding a bicycle etc. Count up the days with at least 60 minutes of physical activity in a typical 2-week period.” A graphic summarising moderate-to-vigorous physical activity, with examples, was also included in the questionnaire to aid participants in gauging the intensity of their exercise. Responses ranged from 0 to 14 days.

### **Participation in sport**

A further survey item asked about regular (at least one time per week) engagement in one or more sports during the past 6 months, with possible responses “Yes” or “No” (McMahon et al., 2017). Participants could list the sports they engaged in, with the options to provide up to three sports. The study team counted all sports that were listed, and coded participants based on “0”, “1”, “2” or “3+” sports. Listed sports were later coded by the study team as either individual/fitness activity or team sport. The working definition of team sport was *“those that typically involved three or more players on each side who compete concurrently”* (Zhou, Heim & O’Brien, 2015). Participants who listed at least one sport that was classified as *“team sport”* were assigned to that category. Participants who listed individual sports or fitness activities were assigned to the, but no team sports were assigned to the *“individual sport/fitness activity”* category.

### **Mental health**

Depressive symptoms: Depressive symptoms were measured using the Beck Depression Inventory (BDI) (Beck, Steer & Carbin, 1988). The BDI assesses specific symptoms of depression experienced by participants over the previous two weeks. One question pertaining to loss of libido was excluded from the current questionnaire as it is deemed inappropriate for an adolescent population (Kendall, Hollon, Beck, Hammen & Ingram, 1987). Question responses are scored from 0 to 3, with 3 indicating higher severity of a symptom. Total scores on the BDI range from 0 to 60 with higher scores indicating higher severity of symptoms. Responses

demonstrated excellent internal reliability with a Cronbach's Alpha of 0.94 (Beck & Steer, 1984). The BDI has demonstrated very good reliability and validity in both clinical and community samples of adolescents (Teri, 1982; Steer, Kumar, Ranieri & Beck, 1998).

Anxiety symptoms: Anxiety symptoms were measured using the Beck Anxiety Inventory (BAI) (Steer & Beck, 1997), a 21-item self-report questionnaire. Question responses are scored from 0 to 3, with 3 indicating higher severity of a symptom. Total scores on the BAI range from 0 to 63 with higher scores indicating higher severity of symptoms. Responses demonstrated excellent internal reliability with a Cronbach's Alpha of 0.93 (Ulusoy, Sahin & Erkmen, 1998). The BAI has previously shown good reliability and validity in adolescent samples (Fydrich, Dowdall & Chambless, 1992; Steer, Kumar, Ranieri & Beck, 1995).

Wellbeing: Wellbeing was assessed using the Warwick Edinburgh Mental Wellbeing Scale (WEMWS) (Stewart-Brown & Janmohamed, 2008), which measures positive psychological wellbeing through a 14 item self-report questionnaire. Each question is scored from 1 to 5 with total possible scores ranging from 14 to 70. Higher scores (maximum 70) represent highest possible levels of wellbeing. Good internal reliability was demonstrated through a Cronbach's Alpha of 0.83. The WEMWS has been psychometrically confirmed for use in adolescent samples (Clarke et al., 2011).

Age and year group were also recorded and have been included as covariates as previous work has shown associations between increases in age and lower frequencies of physical activity (Currie et al., 2009).

### **Statistical analyses**

Based on their reported frequency of physical activity, participants were categorised as Least Active (60 minutes or more of activity on 0-3 days in the past 14), Somewhat Active (60 minutes or more of activity on 4-7 days in past 14), or Most Active (60 minutes or more of

activity on 8-14 days of the past 14). A further sub-group was also created who reported meeting the daily physical activity guidelines on all 14 days in a typical 2-week period (Sufficiently Active according to WHO guidelines). T-tests were used to compare mean frequency of physical activity between males and females.

Mean scores on the psychological variables (BDI, BAI, WEMWS) between the three physical activity sub-groups were compared using two-way ANOVA. Mean scores on the psychological variables (BDI, BAI, WEMWS) between females, males and other were also compared using two-way ANOVA. Tukey's HSD with Bonferroni correction was used for post hoc between-groups comparisons.

Analyses were carried out separately for males and females due to the significant differences in prevalence of mental health problems and frequency of physical activity. Analyses were conducted in R (R Core Team, 2014) and figures were produced using the package ggplot2 (Wickham, 2009).

## **Research Ethics**

The study was approved by the DCU Ethics Committee (DCUREC/2019/107)

## **3.4 Results**

### **Participant characteristics**

144 schools initially registered interest in taking part. 65 schools were unable to participate fully due to either: commitments to other research; availability of time; or lack of Principal consent. The remaining 79 schools who registered interest represent 11% of the post-primary schools in Ireland. 5661 participants were recruited from these 79 schools throughout the Republic of Ireland with a minimum of one school from each of the 26 counties in Ireland giving a very good geographical spread. The number of student responses in each school ranged from 24 to 232.

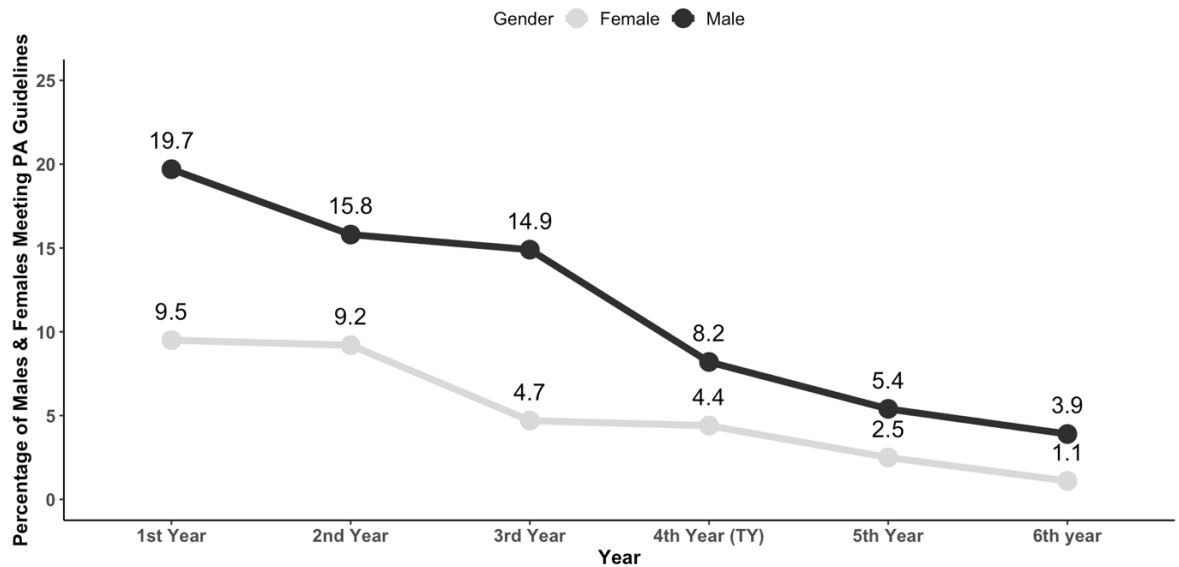
In total, 5661 adolescents participated in the questionnaire. 3247 (57%) females, 2386 (42%) males and 28 (0.5%) who identified as neither female nor male (referred to as “other” for the purposes of reporting). Transition year had the most participants (n = 1411, 25%) followed by 3<sup>rd</sup> year (n = 1011, 18%), 5<sup>th</sup> year (n = 983, 17%), 2<sup>nd</sup> year (n = 894, 16%), 1<sup>st</sup> year (n = 872, 15%) and the least participants from 6<sup>th</sup> year (n = 490, 9%). Ages ranged from 11 to 20 years. The mean age of the sample was 14.8 (sd = 1.5).

**Table 2:** Participants by year.

Year	Female	Male	Other	Total
1 <sup>st</sup> Year	495	375	2	872
2 <sup>nd</sup> Year	499	387	8	894
3 <sup>rd</sup> Year	601	402	8	1011
4 <sup>th</sup> Year	781	625	5	1411
5 <sup>th</sup> Year	591	390	2	983
6 <sup>th</sup> year	280	207	3	490
<b>Total</b>	<b>3247</b>	<b>2386</b>	<b>28</b>	<b>5661</b>

#### **Frequency of physical activity and sports participation**

The current study found that, 275 (12%) males and 173 (5%) females engaged in at least 60 minutes of physical activity every day. 8% of the entire sample reported meeting physical activity guidelines. The percentage of adolescents meeting physical activity guidelines declined through post-primary school from 1<sup>st</sup> year (13.9%) through 2<sup>nd</sup> (12.2%), 3<sup>rd</sup> (8.8%), 4<sup>th</sup> (6%) and 5<sup>th</sup> year (3.7%) with the lowest percentage in 6<sup>th</sup> year (2.2%).



**Figure 9:** Percentage of students meeting PA guidelines by year and gender.

Significant differences were found in the proportion of young people in each of the three physical activity subgroups; with more females than males in the least active (22.8% of females, 12.1% of males) and somewhat active group (39.7% of females, 32.9% of males), and more males than females in the most active group (55% of males, 37.5% of females). The percentage of adolescents in the somewhat active group also declined through post-primary school from 1<sup>st</sup> year (54.1%) through 2<sup>nd</sup> (49.8%), 3<sup>rd</sup> (45%), 4<sup>th</sup> (42%) and 5<sup>th</sup> year (40.7%) with the lowest percentage in 6<sup>th</sup> year (35.6%).

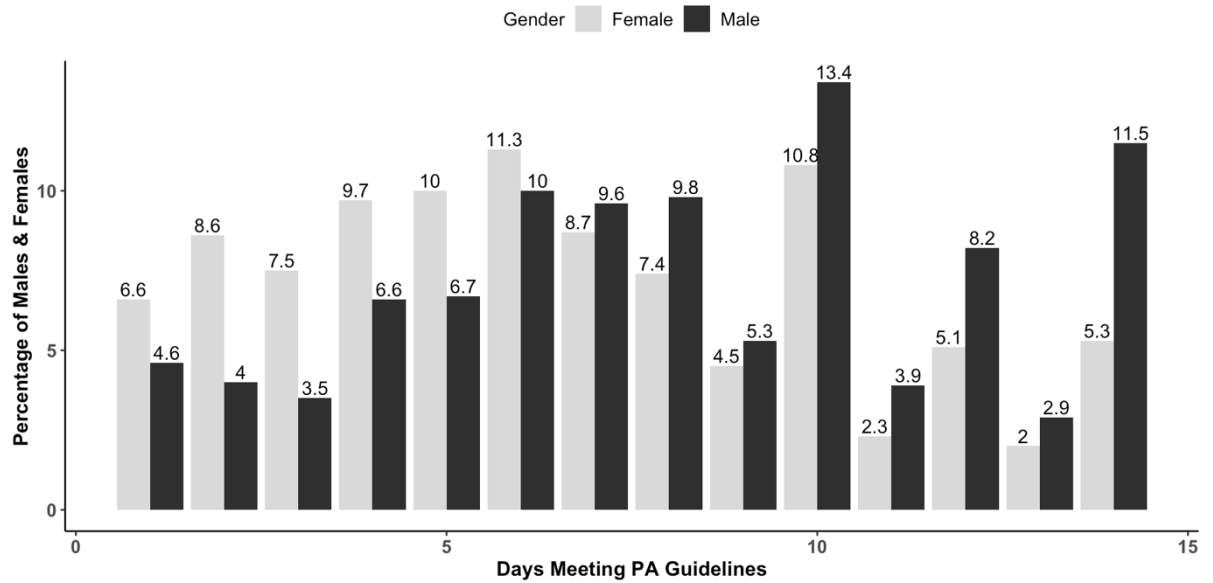


**Table 3:** Frequency of physical activity among males and females by year.

	Least Active (0-3 days) (% within sex)		Somewhat Active (4-7 days) (% within sex)		Most Active (8-14 days) (% within sex)		Sufficiently Active (% within sex)	
	Male	Female	Male	Female	Male	Female	Male	Female
<b>1<sup>st</sup> Year</b>	8.8%	17.6%	26.9%	36.0%	64.3%	46.5%	19.7%	9.5%
<b>2<sup>nd</sup> Year</b>	11.1%	19.6%	31.0%	36.7%	57.9%	43.7%	15.8%	9.2%
<b>3<sup>rd</sup> Year</b>	11.9%	22.8%	29.9%	40.9%	58.2%	36.3%	14.9%	4.7%
<b>4<sup>th</sup> Year</b>	13.0%	24.1%	35.7%	41.4%	51.4%	34.6%	8.2%	4.4%
<b>5<sup>th</sup> Year</b>	14.4%	25.0%	33.6%	41.6%	52.1%	33.3%	5.4%	2.5%
<b>6<sup>th</sup> Year</b>	13.0%	29.0%	43.5%	40.9%	43.5%	30.1%	3.9%	1.1%
<b>Mean</b>	12.1%	22.8%	32.9%	39.7%	55.0%	37.5%	11.5%	5.3%

In the total sample, 80% of adolescents reported playing at least one sport while 66% reported engaging in team sport with large sex differences (58% of females, 76% of males). 20% of adolescents reported no participation in sport, either team or individual. The percentage of adolescents engaging in team sport declined from 1<sup>st</sup> year (76.7%) through 2<sup>nd</sup> (74.3%) and 3<sup>rd</sup> (66.7%) year before levelling off in 4<sup>th</sup> (58.4%), 5<sup>th</sup> (59.9%) and 6<sup>th</sup> year (59.8%).

The most frequently reported number of days where physical activity guidelines were met for boys was 10 (n = 320, 13%) followed by 14 (n = 275, 12%). The most frequently reported number of days in girls were 6 (n = 367, 11%) followed by 10 (n = 351, 11%).



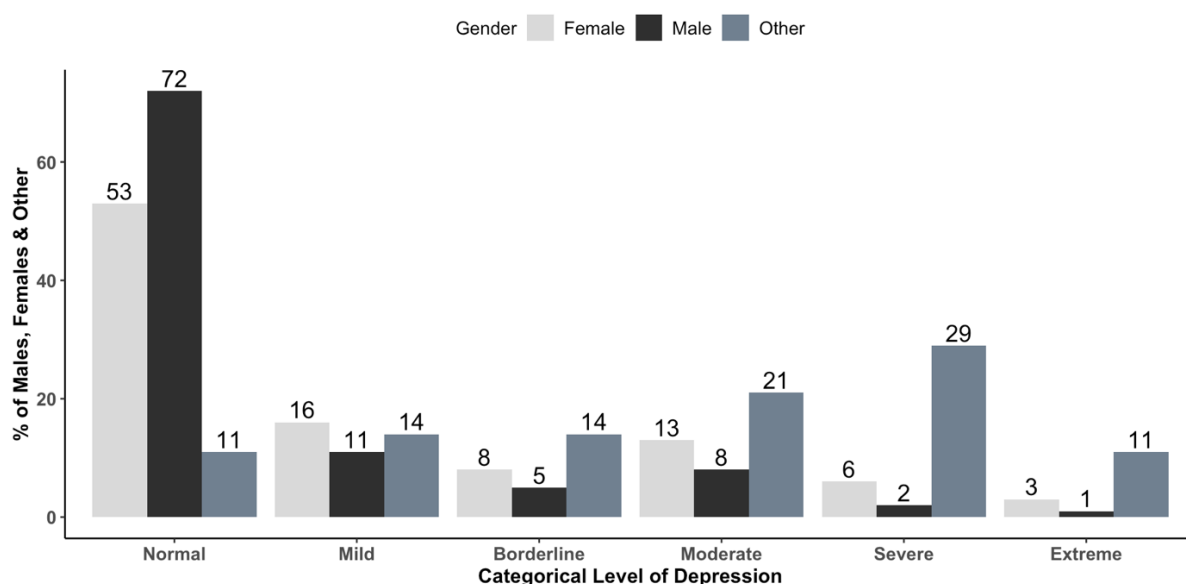
**Figure 10:** Days of physical activity 60+ min during past 2 weeks.

## Mental health outcomes

### *Depressive symptoms: BDI*

Of the total sample, 39% of participants reported suffering mild to extreme forms of depression with 7% reporting either severe or extreme depression. 28% of males were in the mild to extreme ranges with 3% reporting as either severe or extreme. 47% of females were in the mild to extreme ranges with 9% reporting as either severe or extreme. 89% of other were in the mild to extreme ranges with 40% reporting as either severe or extreme. 26% of 1<sup>st</sup> year students were in the mild to extreme range with 5% reporting as either severe or extreme. 37% of 2<sup>nd</sup> year students were in the mild to extreme ranges with 7% reporting as either severe or extreme. 44% of 3<sup>rd</sup> year students were in the mild to extreme ranges with 10% reporting as either severe or extreme. 39% of 4<sup>th</sup> year students were in the mild to extreme ranges with 7% reporting as either severe or extreme. 44% of 5<sup>th</sup> year students were in the mild to extreme ranges with 8% reporting as either severe or extreme. 46% of 6<sup>th</sup> year students were in the mild to extreme ranges with 7% reporting as either severe or extreme. Significant differences ( $p < 0.001$ ) were found between 1<sup>st</sup> years and all other year groups in

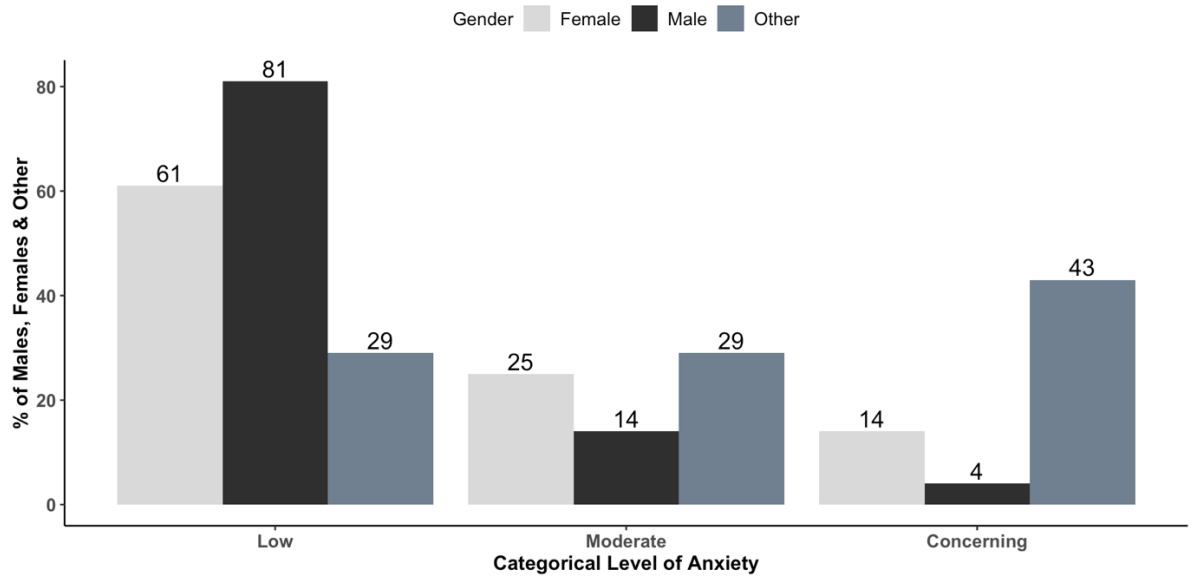
mean depression scores. Significant differences ( $p = 0.002$ ) were also found between 2<sup>nd</sup> years and 3<sup>rd</sup> years, and 3<sup>rd</sup> years and 4<sup>th</sup> years. Significant differences ( $p < 0.001$ ) in mean depression scores were also found between all categories of gender: male, female, and other.



**Figure 11:** Participants by category of depression and gender.

#### *Anxiety symptoms: BAI*

31% of participants reported suffering moderate to concerning levels of anxiety. 19% of males were in the moderate to concerning categories. 39% of females were in the moderate to concerning categories while 71% of other were in the moderate to concerning categories. 22% of 1<sup>st</sup> year; 32% of 2<sup>nd</sup> year; 36% of third year; 31% of 4<sup>th</sup> year; 31% of 5<sup>th</sup> year; and 33% of 6<sup>th</sup> year students reported moderate to concerning levels of anxiety. Significant differences ( $p < 0.001$ ) in mean anxiety scores were found between 1<sup>st</sup> years and all other year groups. No other significant differences were found between year groups. Significant differences ( $P < 0.001$ ) in mean anxiety scores were also found between all categories of gender: male, female, and other.



**Figure 12:** Participants by category of anxiety and gender.

#### Wellbeing: WEMWS

The mean wellbeing score of participants was  $46.9 \pm 9.3$  out of 70. Significant differences ( $p = 0.0002$ ) in mean wellbeing score were found between 1<sup>st</sup> years and all other year groups and between 2<sup>nd</sup> and 3<sup>rd</sup> years ( $p = 0.0005$ ), 2<sup>nd</sup> and 5<sup>th</sup> years ( $p = 0.0001$ ), 2<sup>nd</sup> and 6<sup>th</sup> years ( $p = 0.0001$ ), 3<sup>rd</sup> and 4<sup>th</sup> years ( $p = 0.0005$ ), 4<sup>th</sup> and 5<sup>th</sup> years ( $p = 0.001$ ), and 4<sup>th</sup> and 6<sup>th</sup> years ( $p = 0.0002$ ). Significant differences ( $p < 0.001$ ) in mean wellbeing score were also found between all categories of gender: male ( $49.4 \pm 8.6$ ), female ( $45.3 \pm 9.3$ ), and other ( $36.6 \pm 8.7$ ).

A significant, strong positive relationship ( $p < 0.001$ ,  $r = 0.69$ ) was found between depression and anxiety. A significant, strong negative relationship ( $p < 0.001$ ,  $r = -0.67$ ) was found between depression and wellbeing. A significant, moderate negative relationship ( $p < 0.001$ ,  $r = -0.51$ ) was found between anxiety and wellbeing.

**Table 4:** Mental health outcomes by year and gender.

Year	Depression			Anxiety			Wellbeing		
	Mean (SD)			Mean (SD)			Mean (SD)		
	Male	Female	Other	Male	Female	Other	Male	Female	Other
1 <sup>st</sup>	6.5(8.6)	7.9(9.2)	19.5(00.7)	11.3(11.3)	14.7(12.4)	26.5(17.7)	51.1(8.1)	48.2(8.6)	36.5(3.5)
2 <sup>nd</sup>	8.7(10.5)	12.6(11.7)	25.1(16.3)	13.9(11.3)	19.5(13.8)	28.5(19.6)	49.4(9.3)	46.3(9.7)	35.4(5.2)
3 <sup>rd</sup>	9.1(10.2)	14.8(12.2)	23.0(13.8)	13.7(10.9)	21.2(13.8)	30.1(17.9)	48.5(8.8)	44.1(9.3)	40.6(5.9)
4 <sup>th</sup>	7.6(8.9)	13.5(11.2)	23.6(9.6)	12.5(10.6)	20.1(12.6)	28.0(9.9)	49.8(8.2)	45.5(9.1)	44.2(9.2)
5 <sup>th</sup>	8.4(9.7)	14.2(11.5)	38.0(4.2)	12.3(10.5)	20.2(13.1)	36.0(8.5)	49.0(9.1)	43.9(9.2)	24.5(6.4)
6 <sup>th</sup>	9.3(9.2)	14.1(11.4)	41.0(18.1)	12.6(10.5)	21.1(14.0)	47.0(14.7)	47.2(7.9)	43.3(9.3)	24.3(5.5)
Mean	8.4(9.6)	13.6(11.4)	26.7(14.2)	13.3(10.8)	19.1(13.4)	31.4(16.2)	49.4(8.6)	45.3(9.3)	36.6(8.7)

#### **Associations between frequency of physical activity, sport participation and mental health measures**

Significant differences were found between physical activity sub-groups on all of the mental health outcomes examined ( $p < 0.005$  for both males and females on BDI, BAI, WEMWS after Bonferroni correction). Lower symptoms of depression and anxiety, and higher levels of wellbeing were associated higher frequencies of physical activity.

Post hoc sub-group comparisons showed significant differences between the Least Active and Somewhat Active subgroups in terms of scores on all examined measures for both boys and girls, with the Somewhat Active group having lower depression and anxiety levels and higher wellbeing than the Least Active group. Comparisons between the Somewhat Active and Most Active subgroups showed significant differences among boys and girls for depression and anxiety (Most Active group having lower scores) and for wellbeing (Most Active group having higher scores).

Participation in sport was associated with significantly higher levels of wellbeing and lower levels of anxiety and depression ( $p < 0.001$  for both males and females on BDI, BAI, WEMWS after Bonferroni correction) with more sports leading to significantly greater levels of wellbeing and lower levels of anxiety and depression.

Posthoc analyses showed significant differences in wellbeing between males and females who played no sports and 1, 2 or 3+ sports, those who played 1 and 2, and 1 and 3+, but not between males or females who played 2 and 3+. Significant differences in anxiety were found between males who played no sport and those who played 1, 2 or 3+ sports but no significant difference between those who play 1 and 2, 1 and 3+, and 2 and 3+. Significant differences were shown in anxiety between females who played no sport and those who played 1, 2 or 3+ sports and in females who played 1 and 2 sports, and 1 and 3+ sports but no significant difference between those who play 2 and 3+. Significant differences in depression were found between males and females who played no sports and those who played 1, 2 or 3+. Significant differences were also found between males who played 1 and 3+ but not between males who played 1 and 2 or 2 and 3+. Significant differences were found between females who played 1 and 2, and 1 and 3+ but not between females who played 2 and 3+.

**Table 5:** Number of sports played and associations with wellbeing, depression and anxiety by gender

	Percentage of		Wellbeing		Depression		Anxiety	
	Male	Female	Male	Female	Male	Female	Male	Female
Physical Activity Subgroup								
Least Active (0-3 days)	12.1%	22.8%	45.9(9.3)	42.0(9.9)	10.9(10.7)	16.3(12.9)	15.5(11.3)	22.5(14.0)
Somewhat Active (4-7 days)	32.9%	39.7%	48.9(8.2)	45.1(8.7)	8.6(9.4)	12.9(11.0)	13.2(11.4)	20.0(13.2)
Most Active (8-14 days)	55.0%	37.5%	50.4(8.5)	47.6(9.0)	7.3(9.2)	10.9(10.6)	11.8(10.3)	17.2(12.7)
Number of Sports Played	Male	Female	Male	Female	Male	Female	Male	Female
0	14%	24%	45.6(9.8)	41.9(9.7)	11.6(11.2)	17.0(12.7)	15.9(12.5)	23.1(14.1)
1	24%	32%	48.9(8.8)	44.8(9.1)	8.6(10.2)	13.2(11.2)	12.7(10.7)	20.2(13.3)
2	31%	27%	50.2(7.7)	47.0(8.6)	7.7(8.6)	10.9(10.3)	12.6(10.7)	17.4(12.6)
3+	31%	18%	50.5(8.4)	48.3(8.6)	6.8(8.7)	9.9(10.1)	11.5(10.2)	16.5(12.2)
Team Sport	Male	Female	Male	Female	Male	Female	Male	Female
Yes	76%	58%	50.1(8.2)	46.9(8.8)	7.3(8.8)	11.0(10.3)	11.8(10.1)	17.4(12.5)
No	24%	42%	47.1(9.6)	43.1(9.6)	10.7(11.1)	15.7(12.5)	15.7(12.5)	22.4(13.9)

Team sport was associated with significantly higher levels of wellbeing and lower levels of anxiety and depression ( $p < 0.001$  for both males and females on BDI, BAI, WEMWS after Bonferroni correction).

### 3.5 Discussion

A small minority (8%) of participants met physical activity recommendations (at least 60 minutes of MVPA each day) (WHO, 2010). Females were less likely to be active than males with only 5% of females meeting the WHO's physical activity guidelines in contrast to 12% of males, and decreased with age. This finding is similar to other national (Woods et al., 2019) and European wide studies of activity levels in adolescents (Currie et al., 2010; McMahon et al., 2017). The percentage of adolescents meeting physical activity guidelines (8%) is well below previous European studies (14%) (McMahon et al., 2017). These findings are also slightly below previous nationwide studies where it was found that only 12% and 10% of adolescents met physical activity guidelines respectively (Woods, Moyna & Quinlan, 2010; Woods et al., 2019). Significantly more boys (86%) engaged in sport than girls (77%) although both were much higher than previously recorded European levels (77% and 61% respectively). We found a larger disparity between males and females in terms of participation in team sport as 76% of males reported participating in at least one team sport as opposed to 58% of females. Previous work suggests that opportunities to participate in sport, and team sport in particular, may be biased in favour of boys (Currie et al., 2012). With so few adolescents meeting physical activity recommendations, despite the large proportion engaging in team sport, it would appear that there is a growing need for individual sports or fitness-based activities, particularly for adolescent females. We also found that physical activity levels reduced as adolescents progressed through school with the largest reduction from 2<sup>nd</sup> to 3<sup>rd</sup> year (14-15 years old) in females and from 3<sup>rd</sup> year to 4<sup>th</sup> year in males (15-16 years old) which is consistent with previous investigations of reductions in physical activity levels (Kimm et al., 2000; O'Donovan et al., 2010). This suggests physical activity interventions should target these at-risk groups in the future (Belton, O'Brien, Meegan, Woods & Issartel, 2014).



Our findings suggest two fifths of Irish adolescents are experiencing elevated levels of depression with one third experiencing elevated levels of anxiety. While concerning, this is in line with recent investigations of mental health issues in Ireland (Dooley et al., 2019), which appears to be moving in an upward trend over the past ten years (Lynch, Mills, Daly & Fitzpatrick, 2006; Martin, Carr, Burke, Carroll & Byrne, 2006; Sullivan, Keeley, Corcoran & Perry, 2004; Dooley, Fitzgerald & Giollabhui, 2012). Lowest levels of depression and anxiety were found in 1<sup>st</sup> years and moved in an upward trend with highest levels in 3<sup>rd</sup>, 5<sup>th</sup> and 6<sup>th</sup> year. This suggests the pressures associated with state exams in 3<sup>rd</sup> and 6<sup>th</sup> year may be contributory factors to elevated levels of depression and anxiety. A sharper rise in depression and anxiety was also found from 1<sup>st</sup> to 3<sup>rd</sup> year in females when compared to males. This is when the greatest reduction in levels of physical activity were also found in females which suggests a link between the two although it is difficult to identify cause and effect. The higher prevalence of depression and anxiety in females is consistent with Irish (Dooley et al., 2019) and international (Kieling et al., 2011) research, although the alarmingly elevated levels of depression and anxiety in those who identify as neither male nor female is particularly concerning and not previously reported in an Irish context. Higher levels of wellbeing were associated with higher frequencies of physical activity as were lower symptoms of depression and anxiety.

Previous examinations of physical activity and mental health found statistically significant but small differences between more and less active adolescents, particularly for depression and anxiety (McMahon et al., 2017) that may not be clinically meaningful. Our findings, however, suggest more meaningful differences in depression and anxiety from increases in physical activity for both males and females, particularly as they move from the Least Active to Somewhat Active groups. These findings are consistent with longitudinal research on the

association between increases in wellbeing and frequency (Wand et al., 2012). Outside of gender and team sport, the Least Active and Somewhat Active groups accounted for the largest differences in mental health outcomes. This is consistent with previous findings in both adolescents (McMahon et al., 2017) and adults (de Souto Barreto, 2015). These findings suggest that even a slight increase in physical activity may confer significant benefits for mental health while also emphasising the message that key policy aims should be targeted at those who are fully inactive, or least active, with a view to improving the mental health of those most in need (Vancampfort, Stubbs, Ward, Teadale & Rosenbaum, 2015).

The greatest difference in terms of all mental health outcomes was between those who played sport, either 1, 2 or 3+, and those who didn't. Participation in team sport conferred an additional mental health benefit. Previous investigations into physical activity and mental health measures failed to take into account the nature or type of activity which may account for the smaller effect sizes (Strong et al., 2005; Biddle & Asare, 2011; Biddle et al., 2019). Our findings on team and individual sport, and the number of sports played, helped to identify the context of activity which may provide the greatest support to improvements in mental health. Highest levels of wellbeing and lowest levels of depression and anxiety were found in those who played team sport compared to individual or no sport. Highest levels of wellbeing and lowest levels of depression and anxiety were also found in those who played 3+ sports, with wellbeing increasing, and depression and anxiety decreasing, the more sports that are played. McMahon et al., (2017) also found significant differences in wellbeing, depression and anxiety for females although not in males. Our findings suggest that team sport confers significant mental health benefits for males and females, regardless of frequency of activity. Vella et al. (2020) have suggested that high levels of self-determination and enhanced social identification among youth sport players could provide extra benefits for mental health.

Investigations involving adult populations found associations between greater mental health outcomes and higher frequencies of physical activity, with particularly low and particularly high thresholds of activity associated with lower levels of mental health, especially in females (Kim et al., 2012). It has previously been suggested that some sub-groups engaging in high frequency or daily activity may include adolescents who over-exercise or suffer from potential eating disorders (Smith et al., 2013; Davis et al., 1997). This does not appear to be the case among our particular cohort as wellbeing continued to increase with a higher frequency of activity in both males and females, while anxiety and depression continued to decrease for females and reached a plateau in males from 10-14 days for depression, and 8-14 days for anxiety. This suggests there may be an optimal range of physical activity for mental health benefits, although with no major negative effects of going above this in terms of mental health outcomes.

A number of mechanisms have been suggested to explain the positive relationship between wellbeing and physical activity, and the inverse relationship between physical activity and anxiety and depression (Stavrakis, de Jonge, Ormel & Oldehinkel, 2012). Most recent evidence suggests a combination of physiological and psychosocial processes. Proposed physiological mechanisms, such as the *monoamine hypothesis* (exercise improves brain aminergic synaptic transmission, affecting monoamines such as noradrenaline, dopamine, BDNF, and serotonin, all of which have been implicated in depressive disorders) (Ransford, 1982; Chen, 2013); the *endorphin hypothesis* (endorphins are produced as a result of exercise, which help to reduce pain and induce a state of euphoria) (North & McCullagh, 1990; Morgan, 1985); and the *anterior cingulate cortex hypothesis* (which can be developed through a higher frequency of moderate exercise and is believed to lead to an increase in grey matter volume) (Lin et al., 2020; Lubans et al., 2016; Philips & Schwartz, 2014) cannot entirely account for physical

activity induced changes in mental health. Meta-analytic evidence has shown a positive association between leisure-time physical activity and mental health. Positive associations between transport-related physical activity and mental health in adults have also been found, although the relationship is less clear in adolescents (White et al., 2017). Work-related or occupational-based physical activity is associated with negative mental health outcomes (White et al., 2017). These domain-specific differences in the association with mental health suggests that the association between physical activity and mental health is not purely because of physiological mechanisms (Teychenne et al., 2020). Therefore, other factors relating to physical activity experience, such as psychosocial mechanisms, need to be considered. These other factors include mastery of goals/skills, autonomous motivation, enjoyment, choice, a sense of belonging, and social interaction (Biddle & Mutrie, 2007; White et al., 2018); all of which are associated with playing sport, and team sport in particular. Physical activity performed outdoors has also been associated with lower incidences of mental ill-health than exercise performed indoors. As the most popular sports in Ireland (gaelic football, hurling and soccer) are performed outdoors, this may also explain the higher levels of wellbeing in adolescents who participate in team sport. Based on the proposed mechanisms by which physical activity improves mental health, our findings support recent recommendations that guidelines for mental health benefits should also include a context as well as frequency, intensity, type and time (Teychenne et al., 2020).

Limitations of this study include the use of a self-report questionnaire to measure frequency of physical activity, which may be prone to recall bias and varying interpretations of physical activity in different genders and ages (Hallal et al., 2012). Cross-sectional studies of this nature do not allow for the investigation of any causal or temporal relationships between mental health outcomes and the frequency or context of physical activity. Further research could include longitudinal examinations of how mental health outcomes track throughout post-primary school and into young adulthood and the impact of physical activity on later mental

health. The use of previously validated measurement tools and a large sample of Irish adolescents are strengths of the study.

### **3.6 Conclusion**

Approximately one third of adolescents fall outside the normal range for depression and anxiety with females and other having a higher prevalence than males. Depression and anxiety levels increase in adolescents after 1<sup>st</sup> year and are at their highest in the years that conclude with state exams. Regular engagement in physical activity is associated with greater wellbeing, and lower depression and anxiety in young people. These findings emphasise the importance of increasing physical activity levels among adolescents who are least active. Engagement in sport, and team sport in particular, confers additional benefits over and above that provided by activity alone. Future physical activity recommendations for children and adolescents should include mental as well as physical health benefits. The provision of a wider variety of physical activities and sports through school and community organisations should be a priority for the optimal development of physical and mental health among adolescents. Future school and community-based interventions should focus on increasing the frequency of exposures to physical activity and increasing engagement and retention of young people in individual or team sports to promote wellbeing and positive mental health in adolescents.

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### **Link from Chapter 3 to Chapter 4**

Chapter 3 addressed a gap in the literature, particularly in an Irish context, in identifying current associations between physical activity and sports participation, with wellbeing, and symptoms of anxiety and depression. There have been other studies exploring these associations in a European cohort (McMahon et al., 2017) although this included a small sample of Irish adolescents. The results shown in chapter 3 allow the researcher to give an accurate depiction of the current associations between categories of PA and mental health and wellbeing in Irish adolescents. The low number of adolescents meeting PA guidelines is a cause for concern, although in line with previous investigations in the same cohort (Woods et al., 2019). Elevated symptoms of anxiety and depression are also of concern, and once again, in line with previous investigations of a similar cohort (Dooley et al., 2019). Higher levels of wellbeing and lower symptoms of anxiety and depression were associated with a higher frequency of physical activity, engagement in a number of sports, and engagement in team sport. Males reported higher levels of wellbeing and lower symptoms of anxiety and depression than females across all sub-groups of PA. The findings of this study are in line with previous investigations suggesting higher frequencies are associated with increased mental health and wellbeing, up to a certain point, as some adolescents have reported higher symptoms of anxiety and depression when meeting the PA guidelines every day (McMahon et al., 2017). Engagement in team sport, and a number of sports, have previously been highlighted as supporting higher levels of mental health and wellbeing in adolescents (Panza et al. 2020), although the specific psycho-social mechanisms, as suggested by Lubans et al. (2016), that contribute to this, have yet to be confirmed.

The aforementioned mechanisms as proposed by Lubans et al (2016) suggest both neurobiological and psychosocial processes contribute to enhance wellbeing through physical activity. Psychosocial processes include increased physical self-perceptions and increased social connectedness, both of which may be developed through engagement in organised sports. Two tenets of self-determination theory, namely competence and relatedness, may contribute to enhanced self-perceptions and increased social connectedness and were used in the design of the intervention. Chapter 4 aims to measure the impact of a games-based physical activity intervention, informed by self-determination theory, on wellbeing, and symptoms of depression and anxiety in Irish adolescent girls. Self-efficacy and components of health-related fitness will be included as secondary measures to assess any changes in associations between mental health outcomes and secondary measures. Chapter 2 highlighted the significant effect of interventions that are underpinned by behaviour change

theory (Owen et al., 2017; Andermo et al., 2020; Mears & Jago, 2016). A number of behaviour change theories and frameworks have been utilised in physical activity intervention such as the Behaviour Change Wheel (COM-B), Achievement Goal Theory (AGT) and SDT. The COM-B model focuses on specific changes in behaviour such as greater adherence to medication, reduced tobacco use or increased physical activity and has proven successful in a variety of contexts. AGT and SDT are the two most commonly utilised motivational theories in physical activity interventions in the educational context (Vaquero-Solis et al., 2020). Self Determination Theory (SDT) (Ryan & Deci, 2000) is based on motivation and the innate inclinations toward personal growth that are either satisfied or prevented by their immediate environment. It has been widely used for the development of intervention strategies to improve student motivation during PA practice (Amado et al., 2014; Cheon et al., 2016). It is a macro-theory of personality and motivation which proposes that context can influence the reasons for performing certain activities. As this thesis seeks to explore the contexts of physical activity that are associated with wellbeing, theory impacting upon contexts was deemed the most appropriate. According to SDT, the type of motivation shown by individuals depends on the satisfaction of their basic psychological needs: autonomy, competence, and relatedness. The satisfaction of these basic psychological needs, or its lack of, will influence wellbeing (Ryan & Deci, 2017) therefore being suitable as the underpinning theory of the intervention in Chapter 4.

## Chapter 4:

# **The Effect of a Games-Based Intervention on Wellbeing in Adolescent Girls**

### **Manuscript submitted as:**

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#### 4.1 Abstract

**Objective:** To examine the impact of a self-determination theory informed school-based lunchtime games intervention on wellbeing and symptoms of anxiety and depression among Irish adolescent girls

**Design:** Non-randomised controlled intervention design.

**Method:** This self-determination theory informed intervention, consisted of lunchtime games for girls aged  $13 \pm 0.7$  years 3 days a week. After a one week 'sampling' period, students self-selected to either 0, 1, 2 or 3 days of lunchtime games. Intervention and control groups were compared by pre- and post-testing. Participants were included in the intervention design via a survey to ascertain the most popular games and activities at the outset.

**Results:** Participating in games twice a week led to significant decreases ( $p < 0.01$ ) in symptoms of anxiety and depression while the control group showed significant increases ( $p < 0.01$ ) in symptoms of anxiety and depression. Mental wellbeing significantly ( $p < 0.01$ ) increased among those who participated two and three times a week. Increases in mental wellbeing were similar in effect size to increases in self-efficacy.

**Conclusion:** Higher frequencies of physical activity led to increased mental health. Self-efficacy may act as an underlying mechanism for increases in mental health through physical activity.

#### Keywords:

Exercise; Self-determination theory; Motivation; Physical health; Mental health; Depression; Anxiety

#### 4.2 Introduction

A number of lifestyle-related health problems have increased among children and adolescents over the past 20 years in high-income countries, especially in Northern Europe (Potrebny, Wiium & Lundegard, 2017), with symptoms of anxiety, depression and stress being the most common (National Collaborating Centre for Mental Health, 2011; Rehn & Shield, 2019). Together, these issues account for 10-14% of the global burden of disease (Schofield et al., 2019; World Health Organisation, 2018) with further evidence indicating that mental health issues account for 183.9 million disability adjusted life years (Schofield et al., 2019;). The Global Burden of Disease study (James et al., 2017) reported that anxiety and depressive disorders are among the top four leading causes of the disease burden among young people

in Western Europe. Internationally, a larger proportion of young women report mental health issues when compared to young men although both follow a similar pattern of increase over time (Dooley, O'Connor, Fitzgerald & O'Reilly, 2019; Murphy, Sweeney & McGrane, 2020). Ireland has among the highest reported rates of depression among adolescents in Europe (Eurostats Statistics Explained, 2018). One third of Irish young people aged 12-19 years were found to be suffering from either depression and/or anxiety with girls reporting higher levels of mental health difficulties than their male counterparts (Dooley, O'Connor, Fitzgerald & O'Reilly, 2019; Murphy et al., 2020). In a positive sense, wellbeing is a key indicator of health and refers to an individual's optimal psychological functioning (Deci & Ryan, 2008; Dodge, Daly, Huyton & Sanders, 2012).

Evidence to support the positive physiological benefits of physical activity is well established. A body of evidence is also growing to support the benefits of physical activity for positive mental health outcomes, such as wellbeing, and the prevention of negative mental health outcomes such as depression and anxiety (Biddle, Ciacconi, Thomas & Vergeer, 2019; Murphy et al., 2020). Many children and adolescents fail to meet recommended levels of physical activity internationally and specifically in high-income countries (WHO, 2011; Hallal et al., 2012) with Ireland being no exception (Woods et al., 2019; Murphy et al., 2020). Recent cross-sectional analyses found 10% and 8% of Irish young people aged 12-19 years achieved the recommended levels of physical activity (Woods et al., 2019; Murphy et al., 2020). Physical activity levels were also found to decline with age in both boys and girls as symptoms of anxiety and depression increased (Dooley, O'Connor, Fitzgerald & O'Reilly, 2019; Murphy, Sweeney & McGrane, 2020) suggesting an association between increased levels of physical activity and increased mental health as has been previously identified in cross-sectional (McMahon et al., 2017) and experimental (Gordon, McDowell, Lyons & Herring, 2021; Goldfield et al., 2015) studies. Internationally, and in Ireland, women have consistently reported higher symptoms of depression and anxiety, and lower levels of wellbeing and physical activity (Dooley et al., 2019, Murphy et al., 2020, Woods et al., 2019). Reductions in physical activity throughout adolescence is also more common in girls than boys (Bradley et al., 2011; Woods et al., 2010). Suggested factors for this reduction in physical activity are a lack of enjoyment, lack of purpose or meaning in the activity, and unfair treatment or negative relationships with coaches (Farmer et al., 2018) all of which may lead to lowered self-esteem therefore negatively impacting mental health outcomes psycho-socially as well as behaviourally. Consistent findings of lower physical activity participation by girls, coupled with a lower proficiency of movement skills (O'Brien, Belton & Issartel, 2016) and poorer mental



health outcomes suggest there is a need for more and specifically tailored physical activity interventions for Irish adolescent girls.

Interventions to improve physical activity levels have been trialled across a variety of contexts with varying degrees of success. One of the most promising areas, due to the ease of recruitment and controlled environment, is the school setting. A key area of school-based physical activity research that has gained momentum is the implementation of strategies during school breaks (Hyndman, Telford, Finch & Benson, 2012; Hyndman, Benson, Ullah, Finch & Telford, 2014). A number of interventions targeting school breaks have successfully attempted to counteract declining physical activity by implementing active supervision (Sallis et al., 2003), school break periods with a weekly activity theme (Stellino, Sinclair, Partridge & King, 2010), and the provision of sports or games (Verstraeta, Cardon, De Clercq & Bourdeaudhuij, 2006). These interventions have generally fostered structured physical activity with specified locations, time schedules, adult supervision and the facilitation of sport and fitness (Sener, 2006).

Limited information currently exists as to the psychosocial mechanisms responsible for improving wellbeing and physical activity levels among children and adolescents (Michie et al., 2018) although one meta-analysis has identified the potential importance of self-perceptions, social connectedness and emotions experienced while participating in physical activity (Lubans et al., 2016). To advance wellbeing and physical activity promotion it has been proposed that psychosocial variables be included in all aspects of the design of interventions (Michie et al., 2018; Van Sluijs & Kriemler, 2016). One model encompassing psychosocial variables that has been previously used to aid in the design of physical activity interventions is self-determination theory (Deci & Ryan, 2004). Collectively, sub-theories within self-determination theory specify that the satisfaction of human's psychological needs for competence, autonomy and relatedness is essential for optimal motivation and wellbeing. In support of self-determination theory, adolescent's physical activity has consistently been predicted by autonomous motivation (Owen, Smith, Lubans, Ng & Lonsdale, 2014). The aim of self-determination theory informed interventions is to engender needs-supportive social conditions wherein the enhancement of physical activity and wellbeing is realised indirectly through needs-support and satisfaction, and autonomous motivation (Ryan & Deci, 2017; Fortier, Duda, Guerin & Teixeira, 2012).

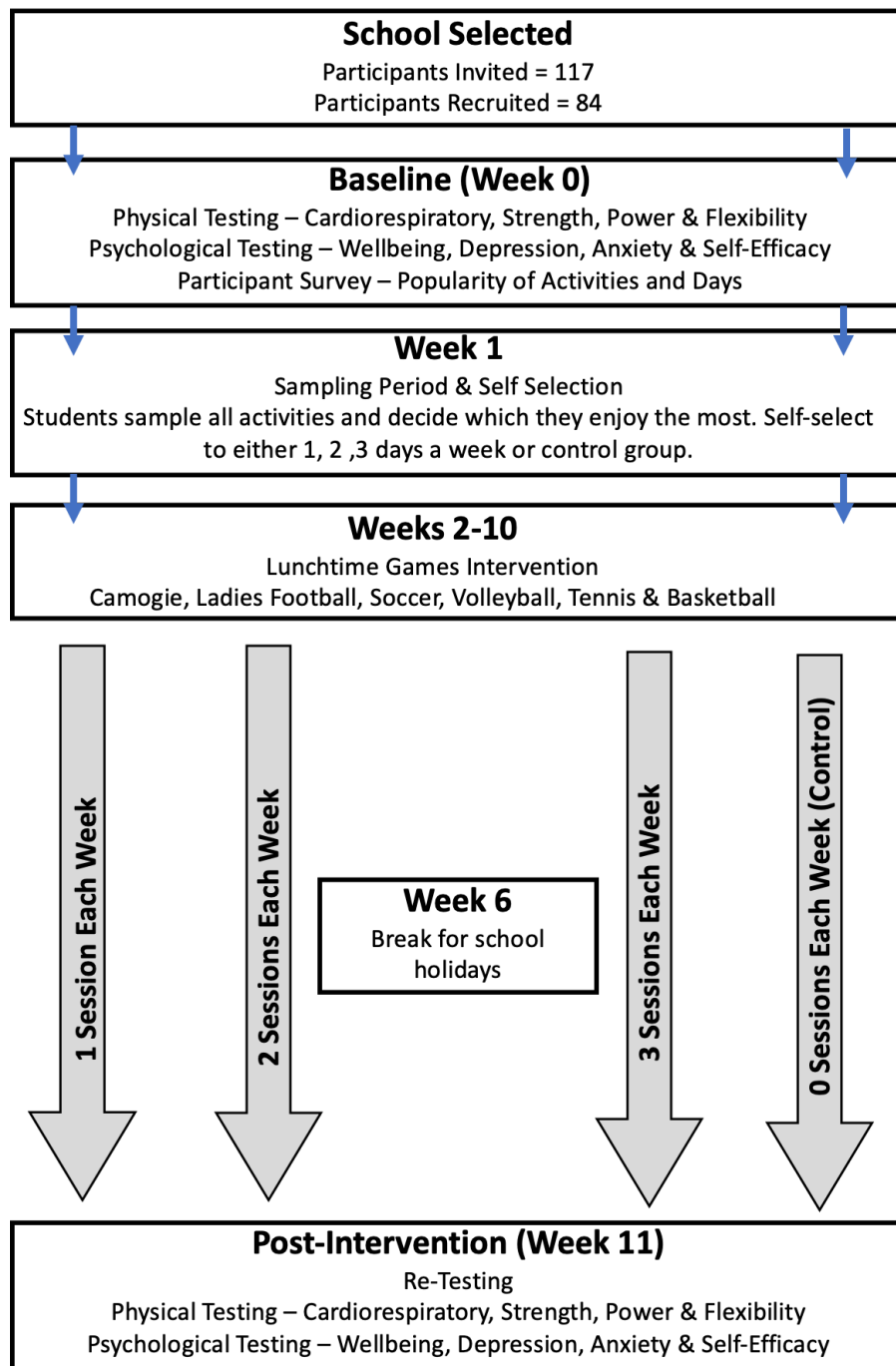
The primary aim of this study was to examine the impact of self-determination theory informed school-based lunchtime-games intervention on the wellbeing and symptoms of anxiety and depression of Irish adolescent females. Secondary aims were to examine the impact of frequency of physical activity on both physical and psychological markers of health while also examining some of the potential changes in secondary outcomes that may lead to changes in mental health and wellbeing.

### **4.3 Methods**

#### ***Study design***

This study took the form of a non-randomised, exploratory, controlled before-and-after design. The study took place from September 2019 to December 2019. The design, conduct and reporting of the trial adheres to the Transparent Reporting of Evaluations with Non-randomised Designs statement (TREND) (Des Jarlais, Lyles, Crepaz & Trend Group, 2004). This non-randomised trial was designed to examine the impact that frequency of physical activity has on positive and negative mental health outcomes. The intervention consisted of lunchtime games 3 days a week for 40 minutes. The intervention lasted for 10 weeks as previous reviews have found interventions lasting 8-12 weeks to be the most effective (Biddle & Asare, 2011; Biddle, Ciacconi, Thomas & Vergeer, 2019) and fit into the current school calendar. The 10 weeks included a one week 'sampling' period at the beginning and a 'free-week' due to school holidays in the middle as can be seen in figure 13. After the 'sampling' period, students aged  $13 \pm 0.7$  years self-selected to either 0, 1, 2 or 3 days of lunchtime games. Those who self-selected to 0 acted as the control group. Intervention and control groups were compared through pre- and post-testing. The control group had lunchtime as normal which consisted of remaining in their 'base' classroom while eating lunch. There were no options for further physical activity at lunchtime.

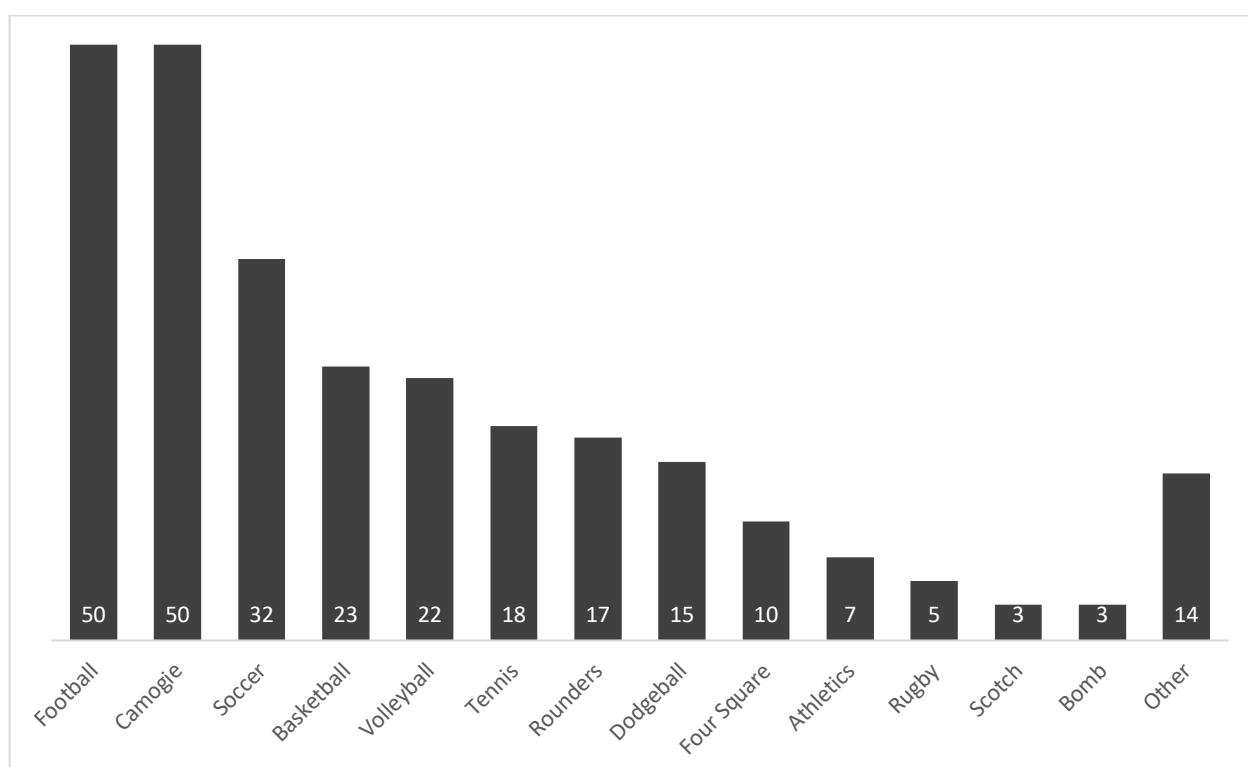
## Intervention Timeline



**Figure 13:** Intervention timeline

### ***Intervention Overview***

Autonomy was provided by including participants in the intervention design via a survey to ascertain the most popular games and activities at the outset. A breakdown of choices can be seen in figure 14. The activities offered were camogie (an indigenous sport to women in Ireland that is similar to field hockey), football, soccer, tennis, volleyball and badminton. Two activities were offered at each lunchtime and participants could select whichever one they preferred. Lunchtime-games were based on small-group activities of 4-6 participants per group to allow for connections to develop between participants. Each lunchtime session included a 5-10 minute period in the middle where participants focused on developing a skill that was relevant to the game being played that day. This allowed participants to develop a level of competence. Activities were led by the first author, a physical education teacher at the school, and two other teachers who were experienced coaches. Transition year “assistants” (fourth year students participating in a voluntary coach education module) also aided in the delivery of activities with at least two assistants involved in each activity. Transition year assistants had completed an introduction to coaching course prior to their involvement in the intervention activities.



***Figure 14: Survey of most popular activities and days of the week.***

### ***Selection and recruitment***

Convenience sampling was used to identify an all-girls Catholic secondary school located in the south-east of Ireland close to where the lead researcher was based there as a physical education teacher. An approach was made to the school principal by the research team through a phone-call and subsequent on-site meeting. All first year students received a plain language statement outlining the purpose of the research, along with a participant and parental consent form. A total of 84 students (72% response rate) returned signed informed parental consent forms along with their own assent to participate in the study (Figure 2).

### ***Intervention Outcome Measures***

Pre- and post-tests included physical, psychological and behavioural measurements. The primary outcome variables of the lunchtime games intervention were wellbeing, symptoms of depression and symptoms of anxiety. The secondary outcome variables were self-efficacy and health-related physical fitness.

### ***Psychological***

Participants completed a self-report questionnaire, which included well established and validated instruments all of which are outlined below. All questionnaires were administered through an online form and could be completed via tablet or mobile phone. The majority of participants chose to use their mobile phone. Participants filled in the questionnaire during a timetabled wellbeing class which is a mandatory 40-60 minute period that all students from 1<sup>st</sup> to 3<sup>rd</sup> year in Ireland participate in to become more aware of their physical and mental wellbeing. The lead researcher was present throughout to answer any potential questions that might arise. Questionnaires were completed between three and five days after physical testing depending on when wellbeing classes were timetabled. The psychological variables measured consisted of positive psychological domains (wellbeing and self-efficacy) and negative psychological domains (depression and anxiety).

### ***Wellbeing***

Wellbeing was assessed using the Warwick Edinburgh Mental Wellbeing Scale (WEMWS) (Tennant et al., 2007), which measures positive psychological wellbeing through a 14 item self-report questionnaire. Responses to each item range from 1 to 5 with overall scores ranging from 14 to 70 where 70 represents the best possible level

of wellbeing. Cronbach's alpha in our sample was 0.83, indicating good internal reliability. The psychometric properties of the WEMWS have been confirmed in both adult (Tennant et al., 2007) and adolescent samples (Clarke et al., 2011).

### *Self-Efficacy*

Self-efficacy was measured using the general self-efficacy scale (Chen, Gully & Eden, 2001) which seeks to measure differences among individuals in their tendency to view themselves as capable of meeting task demands in a broad array of contexts (Chen et al., 2001). Cronbach's Alpha in our sample was 0.86, indicating good internal reliability. The general self-efficacy scale has been shown to have very good test-retest reliability and validity in both adult populations and among adolescents (Luszczynska, Scholz & Schwarzer, 2005).

### *Depressive symptoms*

Severity of depressive symptoms was measured the Beck Depression Inventory (BDI) (Beck, Steer & Carbin, 1988). Items of this instrument assess specific symptoms of depression experienced over the preceding two weeks. The BDI includes an item measuring loss of libido which was excluded from the questionnaire as it is considered inappropriate for use in school (Kendall, Hollon, Beck, Hammen & Ingram, 1987). Each question was scored from 0 to 3, indicating the severity of the symptom, with total scores ranging from 0 to 60. Cronbach's Alpha in our sample was 0.94, indicating excellent internal reliability (Beck & Steer, 1984). The reliability and validity of the BDI have been confirmed in clinical and community samples of adolescents (Teri, 1982; Steer, Kumar, Ranieri & Beck, 1998).

### *Anxiety symptoms*

Symptoms of anxiety were assessed using the Beck Anxiety Inventory (BAI) (Steer & Beck, 1997), a 21-item self-report questionnaire. Responses to each item range from 0 to 3 with scores ranging from 0 to 63 with higher scores indicating increased levels of anxiety. Cronbach's Alpha in our sample was 0.93, indicating excellent internal reliability (Ulusoy, Sahin & Erkmen, 1998). The BDI has been shown to have good

reliability and validity in adolescent samples (Fydrich, Dowdall & Chambless, 1992; Steer, Kumar, Ranieri & Beck, 1995).

### ***Physical fitness***

Health-related physical fitness comprises multiple components including cardiorespiratory endurance (CRE), musculoskeletal fitness (muscular strength, endurance, and power), flexibility and body composition, which have been identified as powerful markers of future health among children and adolescents (Ortega, Ruiz, Castillo & Sjostrom, 2008; Ruiz, et al., 2009). There is a consistent body of evidence supporting the favourable effects of moderate to high levels of physical fitness on health-related outcomes, including cognitive abilities in childhood and adolescence (Bezold et al., 2014). The health-related physical fitness measurements used were based on recent guidelines for fitness testing in adolescents in Irish schools (O’Keeffe, MacDonncha, Purtill & Donnelly, 2020). Cardiorespiratory endurance was measured using the 20 metre multi stage test (beep test); muscular strength using a hand grip dynamometer; muscular endurance using the front plank; lower body power using the standing long jump; flexibility using the sit and reach test. All tests were carried out during physical education class by the lead researcher. Participants had a minimum of three attempts at each test to practice the movement and their best score went forward for analysis.

### ***Physical Activity***

Habitual physical activity was assessed via a modified version of the Take PART questionnaire by measuring the number of days during the past 14 that participants had accumulated 60 minutes of moderate-to-vigorous physical activity (MVPA) which was previously validated in an Irish adolescent population (Woods, Nelson, O’Gorman, Foley & Moyna, 2009). The original Take PART questionnaire measured the number of days in the past 7 that participants were active. This was modified to 14 as previous investigations of associations between mental health outcomes and frequency of physical activity have been based on 14-day scales (McMahon et al., 2017; Murphy et al., 2020). The survey item was as follows: “During a typical 2-week period, on how many days were you physically active for a total of at least 60 minutes? For each day, add up all the time you spent in physical activity like walking, riding a bicycle, etc. Count up the days with at least 60 minutes of physical activity in a typical 2-week

period.” A graphic summarising moderate-to-vigorous physical activity, with examples, was also included in the questionnaire to aid participants in gauging the intensity of their exercise. Responses ranged from 0 to 14 days.

### ***Data Analysis***

Mean scores on the psychological variables (BDI, BAI, SE, WEMWS) in the four groups (0, 1, 2 or 3 times per week) were compared using two-way repeated measures multivariate analysis of covariance (MANCOVA) to control for the effects of initial psychological variables and groupings at the outset. Mean scores on the physical fitness measures in the four groups were also compared using two-way repeated measures MANCOVA to control for initial physical fitness measures at the outset. Post hoc between-groups comparisons were carried out using Tukey’s HSD and Bonferroni correction to account for multiple testing. Cohen’s D was used for calculating and reporting effect sizes. Confidence intervals were set at 95%. Linear models with fixed effects for ‘days meeting physical activity recommendations’ were conducted to assess the impact of the intervention on each psychological variable. Linear regression was used to test for the moderating effects of initial wellbeing, depression, anxiety and self-efficacy on the impact of the intervention.

Analyses were conducted in R (R Core Team, 2014) and Figures were produced using the package ggplot2 (Wickham, 2009).

The study was approved by the Dublin City University Ethics Committee (DCUREC/2019/107)

### **4.4 Results**

In total, 8 students participated in the study. 24 attended games 1 time per week, 22 attended 2 times per week, 18 attended 3 times per week and 21 attended 0 days per week, thus acting as the control group (Table 6).

### ***Psychological Variables***

No significant differences were found between sub-groups in terms of symptoms of depression, symptoms of anxiety, self-efficacy or wellbeing at the outset (table 6).



**Table 6:** Mental health outcomes pre- and post-intervention.

Group (Frequency)  N	Days Meeting PA Guidelines Mean		Depression Mean (SD)		Anxiety Mean (SD)		Wellbeing Mean (SD)		Self-Efficacy Mean (SD)	
	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-
<b>Grand Mean</b> 84			7.0 (4.2)	6.5 (3.7)	12.5 (6.2)	11.1 (5.2)	47.9 (8.3)	50.9 (8.7)	27.0 (5.6)	28.2 (4.8)
<b>0 (Control)</b> 21	5	6	7.5 (4.2)*	13.3 (4.7)*	13.8 (6.7)*	18.6 (5.7)*	48.1 (7.5)	45.5 (5.7)	26.1 (5.6)	25.2 (4.5)
<b>1</b> 24	9	7	6.9 (2.5)	4.8 (2.2)	10.2 (4.2)	9.5 (4.4)	49.2 (7.2)	52.3 (7.6)	28.9 (4.4)	28.5 (4.7)
<b>2</b> 22	7	8	10.2 (5.3)*	2.6 (1.8)*	15.1 (6.8)*	6.3 (3.6)*	47.5 (6.9)*	53.7 (8.2)*	26.0 (5.5)*	30.0 (5.0)*
<b>3</b> 17	8	9	6.4 (2.5)	3.7 (2.4)	9.8 (5.0)	6.7 (4.6)	49.2 (9.4)*	55.1 (7.7)*	27.0 (3.4)*	31.9 (3.4)*
<b>*significant difference (<math>p \leq 0.05</math>)</b>										

### *Depression*

A significant increase in symptoms of depression was observed in the control group ( $p = 0.01$ ). No significant differences were observed in those who participated on either 1 ( $p = 0.02$ ) or 3 ( $p = 0.05$ ) days per week. A significant decrease was observed in those who participated on 2 days per week ( $p = 0.001$ ).

### *Anxiety*

A significant increase in symptoms of anxiety was observed in the control group ( $p = 0.009$ ). No significant differences were observed in those who participated on either 1 ( $p = 0.7$ ) or 3 ( $p = 0.3$ ) days per week. A significant increase was observed in those who participated on 2 days per week ( $p = 0.003$ ).

### *Wellbeing*

No significant differences were observed in either the control group ( $p = 0.1$ ) or among those who participated once per week ( $p = 0.06$ ) for wellbeing. Significant differences were observed

in those who participated both twice ( $p = 0.01$ ,  $d = 0.67 \pm 0.54$ ; medium) and three times ( $p = 0.001$ ,  $d = 0.8 \pm 0.50$ ; large) per week for wellbeing.

#### *Self-efficacy*

No significant differences were observed in either the control group ( $p = 0.4$ ) or among those who participated once per week ( $p = 0.7$ ) for self-efficacy. Significant differences were observed in those who participated both twice ( $p = 0.002$ ,  $d = 0.76 \pm 0.51$ ; medium) and three times ( $p = 0.001$ ,  $d = 0.9 \pm 0.61$ ; large) per week for self-efficacy.

A linear model with fixed effects for 'days meeting physical activity recommendations' found that the impacts of the intervention remained significant ( $p < 0.001$ ) even when controlling for frequency of physical activity in all of the psychological variables. A further linear model controlling for wellbeing, depression, anxiety and self-efficacy at the outset of the intervention found that the impact of the intervention remained significant ( $p < 0.001$ ).

#### ***Physical Fitness***

Pearson's product moment was used to examine the association between physical fitness measures and psychological variables at the outset. A significant moderate association was found between symptoms of depression and body mass index ( $p = 0.006$ ,  $r = 0.3$ ) while a significant weak inverse association was found between symptoms of depression and muscular endurance ( $p = 0.04$ ,  $r = -0.22$ ). A significant weak inverse association was found between symptoms of anxiety and lower body power ( $p = 0.04$ ,  $r = -0.22$ ). A significant weak inverse association was found between wellbeing and body mass index ( $p = 0.01$ ,  $r = -0.27$ ) while a significant weak association was found between wellbeing and muscular endurance ( $p = 0.02$ ,  $r = 0.25$ ). No significant associations were found between any physical fitness measures and self-efficacy (Table 7).

**Table 7:** Associations between mental health outcomes and components of physical fitness.

	Anxiety	Depression	Wellbeing	Self-Efficacy
<b>Cardiorespiratory Endurance (20MST)</b>	-0.25 (±0.186)	-0.19 (±0.198)	0.14 (±0.140)	0.002 (±0.132)
<b>Muscular Endurance (Plank)</b>	-0.19 (±0.181)	-0.22 (±0.221)*	0.25 (±0.191)*	-0.04 (±0.211)
<b>Muscular Strength (Handgrip)</b>	-0.02 (±0.212)	-0.22 (±0.194)	0.12 (±0.121)	-0.16 (±0.201)
<b>Power (Vertical Jump)</b>	-0.22 (±0.194)*	-0.18 (±0.199)	0.11 (±0.206)	0.02 (±0.212)
<b>Flexibility (Sit &amp; Reach)</b>	0.06 (±0.211)	-0.06 (±0.209)	-0.05 (±0.211)	0.05 (±0.211)
<b>Body Mass Index</b>	0.19 (±0.197)	0.3 (±0.184)*	-0.27 (±0.188)*	-0.2 (±0.195)
<b>r (± 95% Confidence Interval)</b>				
<b>*significant correlation (p ≤ 0.05)</b>				

Significant differences in cardiorespiratory endurance and muscular endurance were found between sub-groups at the outset, with the control group scoring significantly lower on both measures while the group that participated 3 times per week scored significantly higher on both. Significant reductions in muscular endurance were found in all groups post-intervention while the control group showed significantly higher cardiorespiratory endurance. The control group and those who participated 1 time per week also showed a significant increase in body mass index. Those who participated 1, 2 and 3 times per week had significant increases in flexibility while those who participated 3 times per week had a significant decrease in muscular strength (table 8).

**Table 8:** Changes in physical fitness.

Group	Physical Fitness Measure	Pre-	Post-	Change	Cohen's (d = )	Significance (p = )
<b>0</b>	Cardiorespiratory Endurance (shuttles)	36.9	41.0	+ 4.1	0.27 (small)	0.02*
	Muscular Endurance (seconds)	87.7	70.7	- 17.0	0.48 (small)	0.006*
	Muscular Strength ((kg)	25.1	25.2	- 0.1	0.02 (negligible)	0.8
	Power ((cm)	33.6	33.7	- 0.12	0.02 (negligible)	0.8
	Flexibility (cm)	23.7	25.3	- 1.7	0.3 (small)	0.06
	Body Mass Index	19.6	19.9	- 0.3	0.13 (negligible)	0.01*
<b>1</b>	Cardiorespiratory Endurance (shuttles)	46.9	48.7	+ 1.9	0.13 (negligible)	0.3
	Muscular Endurance (seconds)	100.2	80.9	- 19.2	0.54 (medium)	0.006*
	Muscular Strength ((kg)	24.1	24.3	+ 0.2	0.05 (negligible)	0.7
	Power ((cm)	33.6	33.9	+ 0.3	0.04 (negligible)	0.7
	Flexibility (cm)	19.5	22.4	+ 2.9	0.41 (small)	0.002*
	Body Mass Index	19.6	20.0	+ 0.4	0.16 (negligible)	0.005*
<b>2</b>	Cardiorespiratory Endurance (shuttles)	43.3	46.0	+ 2.7	0.18 (negligible)	0.05
	Muscular Endurance (seconds)	103.2	86.5	- 16.7	0.43 (small)	0.001*
	Muscular Strength ((kg)	25.1	24.8	+ 0.3	0.08 (negligible)	0.4
	Power ((cm)	32.9	33.4	+ 0.5	0.12 (negligible)	0.5
	Flexibility (cm)	19.1	20.9	+ 1.8	0.28 (small)	0.02*
	Body Mass Index	20.1	20.2	+ 0.1	0.02 (negligible)	0.4
<b>3</b>	Cardiorespiratory Endurance (shuttles)	59.9	63.6	+ 3.7	0.35 (small)	0.1
	Muscular Endurance (seconds)	109.0	94.1	- 14.9	0.42 (small)	0.02*
	Muscular Strength ((kg)	27.8	26.3	- 1.5	0.32 (small)	0.01*
	Power ((cm)	35.3	35.7	+ 0.4	0.06 (negligible)	0.57
	Flexibility (cm)	19.7	21.3	+ 1.6	0.45 (small)	0.001*
	Body Mass Index	20.0	19.7	- 0.3	0.11 (negligible)	0.2
<b>*significant difference (p ≤ 0.05)</b>						

## 4.5 Discussion

The current study took the form of a non-randomised exploratory trial looking at the impact of a self-determination theory-informed lunchtime-games based intervention on mental health and wellbeing outcomes in Irish adolescent girls. Overall, the intervention had significant positive impacts on mental health and wellbeing indicators with little-to-no effect on components of physical fitness.

Participants who attended lunchtime games 2 times per week had significant reductions in symptoms of anxiety and depression while those who attended three times did not. This suggests there is a ceiling effect or 'sweet spot' in terms of the frequency of activity that is required to protect against anxiety and depression, in line with previous findings from European and Irish adolescent cohorts (McMahon et al., 2017; Murphy et al., 2020). Dose-response curves suggest symptoms of anxiety and depression reach their lowest in adolescents when meeting physical activity recommendations on 8-9 days out of every 14 with no benefits being found in those with a higher frequency (McMahon et al., 2017; Murphy et al., 2020).

Elsewhere, it has been suggested that meeting physical activity recommendations on 14 days out of 14 may be associated with neurotic or compulsive behaviours and potential eating disorders, particularly in young women (Smith et al., 2013; Davis et al., 1997) therefore leading to elevated symptoms of anxiety. Controlled motivation has also been suggested as having a negative impact on the mental health benefits that can be derived from physical activity (White et al., 2018) such as when forced to engage in activity, through the use of negative consequences or as punishment, on a higher frequency of days by a coach or parent. Participants in the group that attended three times per week were meeting physical activity recommendations 9 days out of every 14 and so may not have benefited from the increased activity through the intervention. Ceiling effects of physical activity on wellbeing have not been found for European adolescent boys (McMahon et al., 2017) or Irish adolescent boys or girls (Murphy et al., 2020) in terms of wellbeing, which is in line with the current findings of increases in those who attended two and three times per week regardless of external frequency of activity.

Previous adolescent-focused physical activity interventions have shown inconsistent findings with respect to mental health outcomes. A recent meta-analysis of interventions with physical activity components showed no overall impact on anxiety or depression directly post-intervention or at follow-up (Neill, Lloyd, Best & Tully, 2020). These findings must be taken

with caution however as most participants had pre-existing known comorbidities such as previous traumatic experiences or obesity. One such intervention showing a reduction in symptoms of anxiety and depression involved a physical activity programme that was delivered through a cognitive behavioural skills programme (Melnik et al., 2009) which had an impact on the context of physical activity. Other interventions have focused solely on the type and intensity of physical activity, including both aerobic and resistance training (Goldfield et al., 2018) and found neither to have a significant impact. The authors suggested that exercise interventions for adolescents should include higher levels of cognitive engagement when being physically active (Goldfield et al., 2018).

A review of the mechanisms underpinning changes in mental health and wellbeing through physical activity was conducted by Lubans et al (2016). They suggested three interlinking hypotheses including neurobiological processes, psychosocial processes and behavioural processes. Most neurobiological explanations have focused on brain-derived neurotrophic factor (BDNF). While BDNF was not measured in the current study, a recent randomised controlled trial found no significant changes in BDNF after a 22-week intervention that looked at various types of exercise (Goldfield et al., 2018). This suggests there may be another neurobiological process responsible for potential changes, or that psychosocial and behavioural processes play a more significant role than hitherto documented in this relationship, as was highlighted in a previous meta-analysis (White et al., 2017).

The similarity in effect size between improvements in wellbeing and self-efficacy highlights the potential psychosocial processes that underlie the mechanisms of physical activity and wellbeing promotion. Previous meta-analytic evidence found that when controlling for total physical activity, the life domain within which physical activity took place had a significant effect on mental health outcomes with leisure-time physical activity having the largest positive association (White et al., 2017). This suggests psychosocial processes such as choice of activity (autonomy), a sense of belonging (relatedness), and increases in self-confidence or esteem (competence), play a significant role in the development of mental health and wellbeing through physical activity. A systematic review and meta-analysis of the association between self-determined motivation and physical activity in adolescents found a moderate positive association between autonomous forms of motivation and physical activity whereas controlled forms of motivation had weak, negative associations with physical activity (Owen, Smith, Lubans, Ng & Lonsdale, 2014). This is in agreement with Lubans et al. (2016) who suggested that increases in self-perceptions and social connectedness were key psychosocial

contributors to global self-esteem, resilience and subjective wellbeing, and therefore increased mental health.

Another school-based physical activity intervention has been found to have indirect effects through autonomy-support and needs satisfaction indicating that needs satisfaction at a domain level (such as physical activity) may transfer its effects to wellbeing at a global day-to-day level (Shannon et al., 2018). Increases in self-esteem through physical activity may be an underlying mechanism for increases in wellbeing as previous qualitative evidence has demonstrated that positive affect and physical activity was associated with feelings of achievement and progress (White et al., 2018). Meaningful experiences in physical activity have previously been attributed to young people's perceptions of their own high motor competence (Gray et al., 2008), suggesting improvements, accomplishments and learning all contribute to greater enjoyment of physical activity experiences. This aligns with Scanlan and Lewthwaite's (1986) model of sport enjoyment based on the two continua of intrinsic-extrinsic and achievement-non-achievement. Increasing task-specific self-esteem through increased movement competence may lead to enhanced overall self-esteem thus developing higher levels of subjective wellbeing in adolescents.

### **Limitations**

As participants voluntarily assigned themselves to groups, or to act as controls, motivation to participate must be considered as a potential confounding variable it is an important correlate and potential determinant of engaging in and sustaining physical activity (Ng et al., 2012). Those who selected 0 days per week had significantly lower levels of cardiorespiratory endurance and met physical activity guidelines on fewer days than those in other groups indicating they were already less active and fit than other participants. This study sought to include autonomy and intrinsic motivation by allowing participants to choose what activities were included in the intervention. As the intervention was based on the most popular games, this may have led to the exclusion of potential participants who are most in need of extra physical activity as they would prefer to engage in less popular or less-accessible activities. Future interventions should look to target potentially 'at-risk' sub-groups who may have lower levels of physical activity and/or wellbeing by tailoring the activities to their specific interests instead of popular choices of the group at large. The design of the current study was specific to adolescents in a particular setting. Therefore, adaptation would be necessary for use with alternative populations or in different contexts. It was not possible to conduct a follow-up to test whether the effects reported maintained longitudinally due to restrictions in place for

Covid-19. While every effort was made to reduce the potential for contamination, the design of this study would have been improved through the use of a clustered randomised control trial including additional participants.

#### **4.6 Conclusion**

In conclusion, this non-randomised study shows that a self-determination theory informed lunchtime-games based programme can decrease symptoms of anxiety and depression in girls while also increasing their wellbeing. It also suggests the school setting provides opportunities to intervene with children and adolescents and have a positive effect on both physical activity and wellbeing. Similar effect sizes for both self-efficacy and wellbeing suggest that increased self-efficacy may be an important underlying mechanism for increasing wellbeing through physical activity. The lack of change in physical fitness also suggests that lower intensities of physical activity, coupled with the right contextual factors may be enough to elicit change in markers of mental health in adolescents. Future research should look to embed self-determination theory in interventions so the impact of autonomy, competence and relatedness can be further explored to determine the contextual factors that best support wellbeing in adolescents through physical activity.

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### **Link from Chapter 4 to Chapter 5**

Chapter 4 sought to examine the impact of a self-determination theory-informed school-based lunchtime games intervention on wellbeing, and symptoms of anxiety and depression among adolescent girls in Ireland. Results suggest a games-based physical activity intervention is successful in improving wellbeing, and symptoms of anxiety and depression in adolescent girls. A higher frequency of physical activity has been consistently associated with increased wellbeing (McMahon et al., 2017) although there appears to be diminishing returns, and perhaps even negative consequences, from higher frequencies of physical activity for symptoms of anxiety and depression (McMahon et al., 2017). The similarity in effect sizes between wellbeing and self-efficacy suggest increases in self-efficacy may be a key contributor to enhancing wellbeing through physical activity and are in line with proposed underlying mechanisms of increases in wellbeing through physical activity (Lubans et al., 2016).

Chapter 5 seeks to build on the quantitative results from chapters 3 and 4 by qualitatively exploring the findings, specifically why higher levels of wellbeing are associated with a higher frequency of activity, engagement in multiple sport and team sport. Focus group interviews will also seek to explore why increases in self-efficacy may contribute to improved wellbeing. The potential negative implications of higher frequencies of physical activity on symptoms of anxiety and depression will also be discussed with a view to identifying potential explanations. Participants in focus groups have been selected from the intervention in chapter 4 which was informed by self-determination theory (Deci & Ryan, 2004) and analysis will be informed by same.

## Chapter 5:

# **“You Get To...” A qualitative study of perceived influence of physical activity and sport on mental wellbeing among adolescent girls**

### **Manuscript submitted as:**

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## **5.1 Abstract**

Physical activity is well recognised as a key risk factor for the management and prevention of mental ill-health, including anxiety and depression. The specific volumes, intensities or types of physical activity with the greatest impact on mental health are currently unclear. The current study sought to explore what aspects of physical activity may have positive or negative impacts on mental health and wellbeing. Focus group interviews were conducted with 10 adolescent females, and transcripts were analysed using thematic analysis. Three higher order themes, tenets of self-determination theory, were identified; autonomy, competence and relatedness. Single factor sub-themes such as opportunity, journey to competence and facilitator of connection were identified as were multi-factor sub-themes such as fun or enjoyment, and engagement in the activity. The perception of physical activity as an opportunity was identified as a key factor in contributing to positive mental health and wellbeing. It appears that autonomously motivated physical activity experiences provide the greatest levels of satisfaction for adolescents' psychological needs and therefore are the most effective method of enhancing mental wellbeing through physical activity. Future physical activity experiences should include an element of choice along with opportunities to engage in social interaction alongside opportunities for progression and achievement as these appear to provide the best environment to foster positive mental wellbeing in adolescents.

## **Keywords**

Self-Determination Theory; Team Sport; Resilience; Opportunity; Motivation

## **5.2 Introduction**

Physical activity is well recognised as a key risk factor for the management and prevention of mental ill-health, including anxiety and depression (Teychenne et al., 2020). Physical activity guidelines have been developed and refined over several decades (Oia & Titze, 2011). The original guidelines were published with a view to reducing the onset of cardiovascular disease-related mortality, and, subsequently, were developed to encompass other prevalent chronic conditions such as diabetes and cancer (Piercy & Troiano, 2018). Recommendations for physical health detail the volume, intensity and type of activity that should be undertaken by both adults and young people but make no reference to other contextual factors that have been shown to play a contributory role in the support or development of optimal mental health (White et al., 2017). Recent research has identified increases in adolescents suffering with mental health issues with 4 in 10 reporting elevated symptoms of depression or anxiety

(Murphy, Sweeney & McGrane, 2020). Significant increases in symptoms of depression often occur during adolescence, an already very difficult period in life (Morgan, et al, 2013). Daily life stresses are common to most adolescents (social circles, family, studies) and many are not aware of their condition which can lead to mental health issues worsening over time if not treated or acted upon (Beardslee & Knitzer, 2004; American Psychological Association, 2016). Evidence supporting the benefits of regular participation in leisure-time physical activity for adolescents has been well established (Hallal, et al., 2006), indicating that healthy lifestyle habits should be promoted among young people (Ciecchini, et al., 2020). Alongside physical benefits, research on the psychological benefits of physical activity has increased in the past decade with evidence supporting positive impacts on depression (Biddle et al., 2019; Gordon et al., 2018), anxiety (Gordon et al., 2017) and mental wellbeing (Costigan, et al., 2019). Research involving adolescents is not as frequent and results have been inconsistent (Dale, et al., 2019) as objectively measured physical activity has a null to weak relationship with mental health outcomes (Hagermann et al., 2021) although some contexts and life-domains have demonstrated much stronger relationships (White et al., 2017; Panza et al., 2020). Contextual factors across the lifespan include the life-domain that physical activity occurs in, autonomous motivation, peer support, social interaction, access to green space, and progressions and achievements over time (Richards, Doherty & Foster, 2015). A clearer understanding of the bi-directional relationship between physical activity and mental health, or ill-health, may facilitate the delivery of successful interventions in future while also aiding the design and implementation of specific physical activity guidelines for mental health (Teychenne et al., 2020).

In the quest to understand human behaviour, self-determination theory (Deci & Ryan, 1985) has been frequently utilised by researchers. Vallerand (2001) suggests the major types of behavioural regulations have been positioned along a continuum ranging from intrinsic to extrinsic motivation and amotivation. Intrinsically motivated individuals perform activities for the interest, gratification, and pleasure that is provided by the activity. Individuals who are more extrinsically motivated have a greater disposition for external rewards. From higher to lower levels of self-determination, it can be classified in four different types (Vallerand, 2001): (a) integrated: perform an activity because it is consistent with the individual's standard of living; (b) identified: perform an activity showing inner perceptions of causality; (c) introjected: perform an activity to avoid feelings of culpability and strengthen personal ego; and (d) external: perform an activity to obtain a compensation or avoid a penalty. The lack of motivation to perform an activity is known as amotivation. Optimal motivated behaviour and

psychological wellbeing are dependent on the three key tenets of self-determination theory (Vlachopoulos, Katartzi, Kontou, 2011) which are: (a) autonomy: seeing one's behaviour as self-endorsed; (b) competence: feelings of operative interaction with the context; and (c) relatedness: feelings of effective associations with others (Niemec & Ryan, 2009). Among adolescents, intrinsic motivation is positively associated with academic achievement, school engagement, self-esteem, confidence, subjective wellbeing, and increased satisfaction with school (Ryan & Deci, 2020). In terms of physical activity, research has shown how intrinsic motivation is positively associated with adaptive outcomes including enjoyment and physical activity intentions (Vasconcellos et al., 2019), and increased levels of physical activity (Lonsdale et al., 2019). Extrinsic motivation, however, is positively associated with maladaptive outcomes including boredom and negative affect (Vasconcellos et al., 2019). The positive effects of autonomy support and self-regulation on physical activity have also been found on a variety of mental health problems such as depression and depressive symptoms (Cecchini et al., 2017; Cecchini-Estrada et al., 2015). Further in-depth investigations are required to explore the various types of motivation that impact the relationship between physical activity and wellbeing in adolescents.

Previous research in Irish adolescents has found that those who engage in team sport and 2 or more sports have higher levels of mental wellbeing and report lower symptoms of depression and anxiety (Murphy et al., 2020; Murphy, McGrane & Sweeney, 2021). Similar research in European adolescents suggest that team sport offers a protective effect against symptoms of anxiety and depression (McMahon et al., 2017). The main goal of this study was to qualitatively examine the associations between physical activity, participation in sport, and self-determined motivation on mental health outcomes in adolescent females.

### **5.3 Methods**

#### **Methodological Approach and Epistemological Perspective**

Qualitative methods are important in exploring the potential mechanisms that underlie the relationship between physical activity and wellbeing in adolescents (Mutrie, 1997) and are particularly useful when trying to understand a relationship that is impacted by different contextual factors (Faulkner & Biddle, 2004). Therefore, this study was conducted using qualitative methods to explore the key factors that may underpin the relationship between physical activity and wellbeing. A realist epistemological perspective was employed as realism purports that investigating an event (physical activity) as well as the context and mechanisms

associated with that event lead to an enhanced understanding of the outcomes experienced (Pawson & Tilley, 1997).

### **Participants**

In order to explore the relationship between physical activity and wellbeing in Irish adolescents, convenience purposive sampling led to the recruitment of 10 participants from a pilot school-based physical activity intervention. The intervention was informed by self-determination theory and consisted of games-based physical activities during lunchtime and was targeted at 1<sup>st</sup> year students. All 10 participants attended the 10 week intervention, were female, aged between 12 and 14 years, currently involved in 1 or more team sports and attended an all-girls catholic voluntary secondary school in the South East of Ireland. Information packs containing a participant information sheet and consent/assent forms were distributed and returned having been signed by parents/guardians prior to the focus groups taking place.

### **Procedures**

Focus groups were used to explore the factors that influence the impact of physical activity on wellbeing as they gave the participants an opportunity to share and compare their experiences of physical activity, allowed the research team to gather information on adolescents' collective views and have been used previously for exploring the relationship between physical activity and wellbeing in adolescents (Breen, 2006; White et al., 2018).

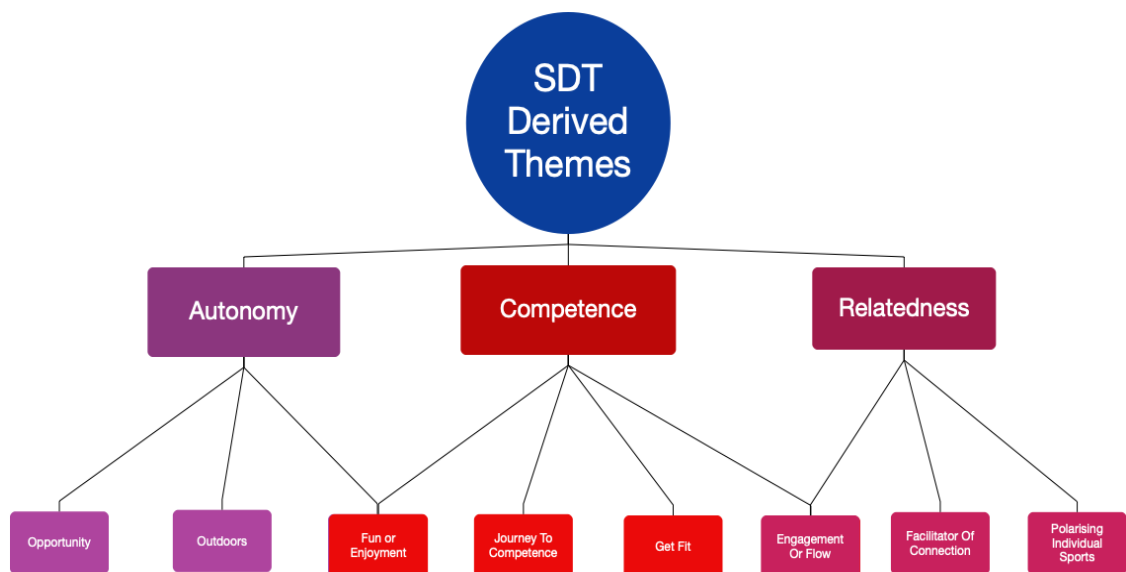
Two focus groups were conducted with five participants in each group. Participants were grouped together based on their classes and comprised a mixture of physical activity sports participation levels. The first author conducted both focus group interviews. A semi-structured interview guide was developed by the research team and informed by previous literature (Gavin, et al., 2016) and was approved in advance by the DCU ethics committee. Questions focused on what aspects of physical activity and sport the participants enjoyed and did not enjoy, how physical activity impacted their social skills and overall wellbeing. The questions asked during the focus groups were purposely kept broad to capture the settings and types of physical activity and sport that were meaningful from the perspective of the participants.

### **Data Analysis**

All focus groups were audio-recorded and transcribed verbatim by the lead researcher. The transcripts were imported into NVivo 12 and analysed using a hybrid process of inductive

(data-driven) and deductive (theoretical) coding adapted predominantly from Fereday and Muir-Cochrane (2006) with influence from Braun and Clarke (2006), Boyatzis (1998) and Crabtree and Miller (1999) in order to encapsulate participants' shared views of physical activity and wellbeing to get an overall understanding of potential underlying mechanisms. The analysis was conducted by the first author who became familiar with the data by reading and re-reading transcripts. Codes were conducted "a priori", based on prior research or theoretical perspectives, or created on preliminary scanning of the text with some initial codes refined or modified during the analysis process (Crabtree & Miller, 1999). Quotes that were considered to represent a similar meaning or pattern were clustered together into potential themes and sub-themes. Throughout the process of deductively developing themes and sub-themes it was noted that themes were broadly reflective of the tenets of self-determination theory (ie., Autonomy; Competence; Relatedness) (Deci & Ryan, 1985) which has been used in previous research to illustrate the influence different factors have on physical activity and wellbeing (White et al. 2018) and participants were recruited from a self-determination theory-informed intervention. Themes were mapped to tenets of self-determination theory as appropriate. It must be noted that although participants did not explicitly use the words "autonomy" or "competence" in their responses; however, based on tenets of self-determination theory, the authors derived latent codes mirroring autonomy, competence or relatedness from quotes relating to these (Marks & Yardley, 2004).

Thematic data analysis was conducted by the lead author to explain participants' perceptions of the relationship between physical activity and wellbeing. Nine sub-themes were identified as can be seen in table 9 and figure 15. These were then categorised into three overarching themes, guided by tenets of self-determination theory: Autonomy; Competence; and Relatedness. Two sub-themes overlapped between themes: "Fun or Enjoyment" overlapped between Autonomy and Competence; and "Engagement or Flow" overlapped between Competence and Relatedness.



**Figure 15:** Themes and sub-themes informed by tenets of self-determination theory.

## 5.4 Findings & Discussion

This paper explores how young people’s experiences of physical activity and sport may interact with their mental wellbeing. Key findings from the focus groups will be presented as quotes depending on the theme or sub-theme they best represent. Throughout the results section, two reporting styles will be used to share findings (Krueger, 1998), providing summary description with illustrative quotes and in some instances summary description with illustrative quotes followed by interpretation.

### Autonomy

#### *Opportunity*

An initial frequency count of most commonly used words showed that “get” was the most frequent. This was predominantly used to describe opportunities to participate in, and improve at various forms of physical activity or sports such as “*just getting to play the sport more*” [FG1] or “*we’d get to learn new skills*” [FG1]. Some participants saw it as an opportunity to try new experiences such as a new activity/sport with one girl commenting that; “*To stay fit and Kilkenny don’t play football so I thought it would be a good chance to see if I like it or not*” [FG2]. Another said that she took part “*Because, kinda... different. Try to do something else*” [FG2]. Others felt it was an opportunity to improve at the sports they already play: “*I liked getting to play all the matches. It was good to see the drills we did being put into practice*” [FG1]. Previous qualitative investigations identified physical activity behaviours that adolescents associated with positive affect were largely undertaken for autonomous reasons,

such as enjoyment (Intrinsic motivation) and the valued benefits (identified regulation) (White et al., 2018). Perceiving physical activity as an opportunity helps increase the personal relevance to adolescents (Coulter et al., 2020). The participants noted how they felt physical activity was an opportunity to be active, get fit, improve or interact with others. They also mentioned the importance of choice within activities: *"I don't mind training in the rain but sometimes I'd like if they asked us what we'd like to do at training. That way we could do stuff that helps our mental positivity more."* [FG2]. Autonomy and choice of activities have previously been demonstrated as having positive associations with intrinsic motivation, are more enjoyable and lead to increased and more sustained participation in physical activity (White et al., 2020). Others liked the fact they got to meet new people: *"I think meeting new people cos we got to mix with other classes and we didn't know what they were like or what they did"* [FG2]. Collective physical activity is more meaningful and can make explicit connections between current physical activity experiences, and future aspects of daily living outside of the school or sport setting when personally relevant (Azzarito & Ennis, 2003; Enright & O'Sullivan, 2010) thereby increasing intrinsic motivation (Deci & Ryan, 2004).

## **Outdoors**

Participants stated that they preferred being outdoors when given the choice: *"A lot more people might want to do it when it's outside. A lot more people like it outside"* [FG1]. The physiological benefits of physical activity have been well established in adolescents ((Hallal et al., 2006) with evidence growing around the mental health benefits (Biddle et al., 2019). Additional physiological and mental health benefits have been found when physical activity is performed outdoors as people look to develop a greater connection with nature when exercising (Gladwell et al., 2013). Participants also had an awareness of the perceived health benefits of being outside:

*"You're inside all day anyway but it's great to get outside with other people cos you wouldn't go outside otherwise. And you're being active out there. Especially in the autumn and winter cos it's dark in the morning and when you go home so lunch is the only time we get to go outside"* [FG2].

With one participant even noting the mental health benefits when stating she likes to go outside: *"To clear your head."* [FG2]. A review of studies examining physical activity completed outdoors revealed that exercising in natural environments was associated with greater feelings of revitalisation and positive engagement, decreases in tension, confusion, anger, and depression, and increased energy (Thompson-Coon et al., 2011). Participants in outdoor

activity also reported greater enjoyment and satisfaction, and declared a greater intent to engage in the activity in the future (Thompson-Coon et al., 2011).

## **Competence**

### ***Journey to Competence***

Further to the above stated points about opportunities for improvement, participants went on to explain that experiencing improvements and achievements in sport generally makes them feel good about themselves and boosts their self-confidence, often coming from a feeling of accomplishment with one girl stating: *“Yeh cos you’d be thinking that yes I did that. I did it well and I was ok at it. Like you’ve kind of accomplished something.”* [FG2]. This suggests the ‘journey to competence’ plays an important in the relationship between autonomously motivated physical activity and affective wellbeing which is similar to previous qualitative investigations where positive affect and physical activity was associated with feelings of achievement and progress (White et al., 2018). An optimal level of challenge was also noted as important with greater sense of achievement being felt when the challenge was more difficult but still attainable:

*“Oh yeh, yeh, yeh. Cos if you work for something and get there after that then it’s way better. Like if you put effort into football then you make the county team or go on trips with your team it’s way better cos you’ve kind of achieved or earned those things”* [FG1].

Meaningful experiences in physical activity have previously been attributed to young people’s perceptions of their own high motor competence (Gray et al., 2008), therefore suggesting improvements, accomplishments and learning all contribute to greater enjoyment of physical activity experiences which aligns with Scanlan and Lewthwaite’s (1986) model of sport enjoyment based on the two continua of intrinsic-extrinsic and achievement-non-achievement. The sense of accomplishment in being recognised as a good player or of improving are highlighted by one participant:

*“Like when you achieve something cos of your own effort you feel better than anything else. Like if you made the county team and other girls at home didn’t you get a sense of earning it and of success in yourself”* [FG1].

Self-determination theory (Deci & Ryan, 2004) suggests autonomous behaviours are likely to be associated with greater mental health benefits as individuals who participate in activities



of their own volition do so to satisfy their psychological needs of autonomy, competence and relatedness.

### ***Getting Fit***

Getting fitter is closely related, and even a key part of, increasing competence in a chosen physical activity or sport although the participants in this study noted the importance of increases or maintained fitness in its' own right as two girls referred to the benefits of sport as *"being fit"*. Adolescents' attitudes towards the health benefits of physical activity have differed based on previous levels of activity as inactive adolescents have highlighted *"not getting fat"* or weight management as the key benefits (Belton, et al., 2014) while the participants in this study noted the potential negative consequences:

*"because you can't be lazy and be sat down cos then you'll just be overweight and have bad cholesterol and a bad heart. When you could have the chance to go outside and be active and then you'll ask why didn't I go out and you'll feel all bad about it"* [FG2]

alongside the positive aspects suggesting a more balanced view of the importance of exercise and fitness. This is in contrast with previous findings which suggested young females are more interested in the short-term benefits of being active than the longer term benefits (Sleap & Wormald, 2001; Biddle, Sallis & Cavill, 1998) suggesting that either those who are already active are more aware of the longer term benefits or those who are aware of the longer term benefits are more likely to remain involved in physical activity.

### **Relatedness**

#### ***Facilitator of Connection***

A previous quantitative investigation found that participants who completed some of their physical activity with other people were less likely to experience symptoms of depression when compared to individuals who completed all of their physical activity alone (Teychenne, Ball & Salmom, 2010). This has been backed up by qualitative research in adolescents, and appears to be most beneficial when a sense of belonging is experienced (White et al., 2018). One tenet of self-determination theory, *relatedness*, was mentioned as a key factor in enhancing the positive experiences mentioned above such as when increasing competence along with friends or peers: *"Yeh, because you make friends for life that you've been playing with all the time. You'd just be happier cos you have them as well as playing the sport"* [FG1].

Although engaging in physical activity or sport with friends was deemed important, participants stated how they found physical activity to be an excellent facilitator for engaging with friends and meeting new ones: *“If you play a few sports then you’ve a wider variety of friends and of interests so you’re not just focused on that one sport or that one thing. It kinda stops you worrying about it.”* [FG2]. Participants also mentioned how experiences from playing sport together can lead to much stronger friendships and relationships, potentially from having more in common:

*“I think it’s easier to talk to people when you’re on a team because you’re just playing the sport and if you’re playing the games it’s obviously something you have in common that you enjoy together and if not you wouldn’t be doing it. So like, it’s an easier way to talk to people cos you’re already in a conversation and stuff”* [FG2].

Relatedness appears to be a key contributor to the positive affect experienced during and after participating in physical activity (Baumeister & Leary, 1995). Although challenging situations were also mentioned as having a significant impact on the strength of relationships with one girl stating:

*“Cos everyone is so sad in the dressing room and you’re all kinda sharing it. You’re with them about 3 times a week so you already know each other well so it’s easier to say the right thing or even nothing if you don’t want to”* [FG1].

The challenging nature of sporting activities and sense of togetherness that is experienced by teammates are likely contributors to the sense of belonging that adolescents experience when participating in team sports, often compounded by both positive and negative results in the sport:

*“Like your teammates are supportive for each other. You’ve already bonded over like simple or everyday stuff so the losing together makes it stronger. You have all the stuff to talk about too like funny stuff that happened in training or that and that helps cheer you up”* [FG2].

Merely participating in physical activity with others is unlikely to be beneficial on its own, instead, the satisfaction of the basic psychological need for relatedness appears to influence whether physical activity experiences are associated with positive affect, and therefore are an important mechanism (White et al., 2018).

### ***Family Influence***

Building connections with friends through physical activity and sport was mentioned many times but the influence of family for getting involved in sport was deemed important by a few participants. Parents play a key role in adolescents' physical activity motivation and participation (Whitehead & Biddle, 2008) with active parents more likely to initiate greater physical activity involvement than inactive parents (Robertson-Wilson, et al., 2003). Consistent with previous work, our findings suggest that parental encouragement not only plays a role in how active an adolescent will be (Biddle, et al., 2005), but also what particular activity they are most likely to participate in: *"I think the way \*\*\*\* says camogie is a family thing that's like me too. No one in my family does soccer so none of us play or have interest in it"* [FG1]. Family influences were also deemed to be important to stay involved in sports even when they don't perceive themselves to be good at it, particularly at the outset: *"I prefer hurling but that's only cos it's a family thing. I wasn't very good at the start but kept going cos I knew it was important at home"* [FG1]. As parents are most likely to encourage their children to be physically active from a young age, by the time they reach teenage years, being active has become habitual and often forms part of their overall identity (Rhodes, Kaushal & Quinlan, 2016) contributing to an overall greater sense of purpose each time they engage in activity (Yemiscigil & Vlaev, 2021).

### ***Polarising Views of Individual Sports***

Previous research has shown that adolescents involved in a greater number of sports and in team sport have higher mental wellbeing than those in singular or individual sports (Murphy et al., 2020) although the reasons behind this are currently unknown with a dearth of literature looking at differences in personality traits between individual and team sport. The relationship between personality and participation in sport is likely bidirectional (Nia & Besharat, 2010) with participants suggesting that participating in individual sports suggesting that: *"It kinda brings you more in either direction"* [FG2]. Adolescents participating in individual sports may possibly experience greater extremes in terms of mental wellbeing with one participant suggesting:

*"sometimes you can have more time to think about it in individual sports and time to think about yourself when you're practicing and all. But then you've no one to talk to at the same time. While in camogie or in team sport you don't feel like everyone's watching you. When you're playing something there's like 15 people but then when there's only 1 there's like a lot more pressure on them"* [FG2].

Previous investigations examining personality traits and participation in team sport (Laborde, Guillen & Mosley, 2016) suggest that Trust, one of the components of agreeableness, as an interpersonal factor helps the participant so that they can rely on others more easily and develop the group activities and relationships. Team sports provide a suitable ground for achieving this characteristic as agreeableness based on trust prepares the individual for team sports (Nia & Besharat, 2010). The trust developed when engaging in team sport was mentioned by one participant who stated: *“Like the girls who play team sports are easier to get on with cos they just know how to make friends with someone”* [FG1]. Other participants felt similar and that adolescents who only engaged in individual sport were unable to develop the same social skills: *“They’re just focused on them... Like they couldn’t play a match cos they wouldn’t always be on the ball”* [FG1] with others suggesting they struggled to share the attention: *“When I do ballet there are a good few that only do dance and they’re way more self-involved than most people”* [FG1]. In contrast to some of the potential negative aspects, some felt that participating in individual sports can lead to facing more pressure:

*“I think there is a lot of pressure on them. Like say you messed up doing something in camogie then there will be someone else there that will back you up on it but in like horse riding or individual sports then all the pressure is on you. So if you mess up you’re kinda gone like”* [FG1].

Although another participant responded that in turn it may develop a greater internal drive or self-motivation: *“But that kinda makes them more driven and more independent to achieve what they want”* [FG1]. This is in line with previous findings suggesting that individual athletes scored higher than team sport athletes in personality-trait-like individual differences such as perseverance, positivity, and self-esteem (Laborde, et al., 2016). These findings may be taken with caution however as adolescents most likely to persist in individual sports may already have higher levels of perseverance and therefore are likely to stay with sport in the longer term as opposed to it being developed through the sport itself. The impact of participation in team and individual sport on mental wellbeing and personality traits warrants further investigation.

**Table 9:** Single factor themes and sub-themes informed by tenets of self-determination theory.

Theme Sub-Theme	Demonstrating Quote
<b>Autonomy</b>	
<i>Opportunity</i>	<p>"Just getting to play the sport more"</p> <p>"We'd get to learn new skills"</p> <p>"Cos you get to play games"</p>
<i>Outdoors</i>	<p>"A lot more people might want to do it when it's outside. A lot more people like it outside"</p> <p>"Yeh cos you need to get fresh air"</p> <p>"To clear your head"</p>
<b>Competence</b>	
<i>Journey To Competence</i>	<p>"Yeh cos you'd be thinking that yes I did that. I did it well and I was ok at it. Like you've kind of accomplished something"</p> <p>"Like when you achieve something cos of your own effort you feel better than anything else. Like if you made the county team and other girls at home didn't you get a sense of earning it and of success in yourself"</p>
<i>Get Fit</i>	<p>"Keep us fit."</p> <p>"If you don't do any physical activity at all like even if you don't walk like if you were extremely lazy then that would be so bad for you."</p>
<b>Relatedness</b>	
<i>Facilitator Of Connection</i>	<p>"Like your teammates are supportive for each other. You've already bonded over like simple or everyday stuff so the losing together makes it stronger. You have all the stuff to talk about too like funny stuff that happened in training or that and that helps cheer you up"</p>
<i>Family Influence</i>	<p>"I prefer hurling but that's only cos it's a family thing. I wasn't very good at the start but kept going cos I knew it was important at home"</p>
<i>Polarising Individual Sports</i>	<p>"I think there is a lot of pressure on them. Like say you messed up doing something in camogie then there will be someone else there that will back you up on it but in like horse riding or individual sports then all the pressure is on you. So if you mess up you're kinda gone like."</p> <p>"But that kinda makes them more driven and more independent to achieve what they want."</p>

## Multi-Factor: Competence & Autonomy

### *Fun or Enjoyment*

The main benefit of physical activity highlighted by the majority of young people is fun or enjoyment, whether they be active or inactive (Coulter et al., 2020) and serves as an integral part of young people's experiences in collective physical activity and falls under the broader themes of both 'Competence' and 'Autonomy'. The majority of participants described physical activity as enjoyable but for a variety of reasons that included both the reasons for participating and the extent to which they improved or developed proficiency: *"When you have a feeling that you're getting good then you enjoy it a bit more. Like if I'm getting better then I like doing the drills and playing the games a bit more"* [FG1] or in simpler terms: *"You enjoy it cos you've been playing it for longer so you're better at it"* [FG2]. Improvements in the activity or sport seemed to increase enjoyment. When asked if they enjoyed it first then

started to get good or became good then started to enjoy it more participants responded with a combination of both:

*“They’re both at the same time. When you have a feeling that you’re getting good then you enjoy it a bit more. Like if I’m getting better then I like doing the drills and playing the games a bit more” [FG1].*

The importance of enjoyment is echoed in research into young people’s participation in competitive sport which suggests the degree to which young people drop out is almost always found to be one of their primary reasons for participating or dropping out (Gill, Gross & Huddleston, 1983; Gould, Feltz & Weiss, 1985). The motivation to practice an activity appears to be linked to their level of competence, both in terms of the enjoyment derived from practice but also to the level of effort put in. Having something to work towards and improve upon was also highlighted as important for greater enjoyment: *“I think enjoying it is more important cos if you don’t enjoy it then you will just give up and not get better anyway. Like if you enjoy it then you’ll try harder and get better quicker” [FG1].* For fun to be considered part of a meaningful experience it should not reflect an unstructured or undisciplined approach (Quennerstedt, 2013), but provides meaning in a manner that is enjoyable to the participant through improvements, progression and an appropriate level of challenge as one participant stated: *“Like I know you need to practice each skill every so often but not the same ones all the time. You want to get better at all kinds of skills and stuff not just the same ones” [FG2].* This has similar conceptual overlap to Achievement Goal Theory (Ames, 1992) whereby the pursuit of a goal the adolescent identifies for themselves brings enjoyment. These findings provide some support for the mastery hypothesis which suggests that participating in physical activity enhances feelings of success and confidence that benefit mental health when the feeling of mastery is carried into other areas of life (Paluska & Schwenk, 2000).

### **Multi-Factor: Competence & Relatedness**

#### ***Engagement in The Activity Leading to Flow or Mindfulness***

Engagement in physical activity has previously been identified by adolescents as an opportunity for distraction from everyday stressors and for mindfulness (White et al., 2018). The formation and maintenance of social relationships coupled with academic pressures are major stressors in the lives of adolescents. Physical activity serves as an opportunity to take a ‘mental break’ from some of these stressors: *“It gives you a mental break. It takes your mind off tests and all that. You’re not thinking about the work you’re doing in the next class or*

worrying about any of that stuff” [FG1]. Both stress relief and mindfulness were mentioned by participants, especially when engaging in physical activity on their own:

*“Sometimes when you’re on your own it kind of gives you time to think like when you’re running around the pitch on your own it’s kind of nice as well to get a break. It’s just a nice mixture to be with your friends but on your own as well”* [FG2].

Participants sometimes described participation in physical activity as an opportunity for mindfulness or to experience states resembling flow: *“And when you’re playing a sport you just kind of concentrate on sports, you’re not worrying about tests or anything”* [FG1]. These “flow-like” states come from a deep engagement in the activity. It has been argued that motivation to perform or complete a task is highest when the difficulty of said task is matched by the individual’s personal abilities and skills (Nakamura & Csikszentmihalyi, 2014). This meeting of optimal challenge, skill and ability led to a state of ‘flow’, or supreme enjoyment and engagement in the task. Suboptimal pairings of challenge and ability can lead to boredom (high ability, low challenge) or anxiety (low ability, high challenge). The participants in this study noted autonomously regulated reasons for participating in and improving at their chosen activities alongside feelings of distraction. Autonomy supportive behaviours should be promoted and encouraged in the future, not only to increase physical activity but also to enable adolescents to develop deeper feelings of intrinsic motivation and positively impact their wellbeing (Cheon, Reeve & Moon, 2012).

**Table 10:** Multi factor themes and sub-themes informed by tenets of self-determination theory.

Themes Sub-Theme	Demonstrating Quote
<b>Competence &amp; Autonomy</b>	
<i>Fun or Enjoyment</i>	<p>"They're both at the same time. When you have a feeling that you're getting good then you enjoy it a bit more. Like if I'm getting better then I like doing the drills and playing the games a bit more."</p> <p>"I think enjoying it is more important cos if you don't enjoy it then you will just give up and not get better anyway. Like if you enjoy it then you'll try harder and get better quicker."</p>
<b>Competence &amp; Relatedness</b>	
<i>Engagement In The Activity Leading To Flow Or Mindfulness</i>	<p>"And when you're playing a sport you just kind of concentrate on sports, you're not worrying about tests or anything."</p> <p>"If you're ever angry then you go and hit the ball off the wall and hit it harder and harder then you're not angry anymore."</p> <p>"Sometimes when you're on your own it kind of gives you time to think like when you're running around the pitch on your own it's kind of nice as well to get a break. It's just a nice mixture to be with your friends but on your own as well."</p> <p>"Just playing sport."</p>

## 5.5 Conclusion

Although the focus groups provided a great deal of rich data, the study was not without its limitations. As with any qualitative research of this nature, it is acknowledged that the findings are specific to the participants in this study and cannot necessarily be extrapolated to the population as a whole. Although the participants seemed typical of younger adolescent females in Ireland, they all self-identified as active and involved in team sports, thereby already having positive bias towards higher levels of physical activity and engagement in sport. It is reasonable to expect that their collective opinions were generally representative of other active adolescent females although future investigations should seek to include voices from inactive adolescents, those not involved in team sport and adolescents with reduced activity levels so as to avoid a 'survivorship bias'. Our findings, in line with previous research, conclude that physical activity in and of itself is not directly associated with higher levels of mental wellbeing. The various aspects that contribute to the context within which physical activity is experienced play a major role in the potential mental wellbeing benefits that can be derived. In line with self-determination theory, physical activity experiences should include an aspect of choice or autonomy; room for progression, improvements or opportunities to develop a level of competence; and include opportunities for social interaction. It appears that autonomously motivated physical activity experiences provide the greatest levels of



satisfaction for adolescents' psychological needs and therefore are the most effective method of enhancing mental wellbeing through physical activity. We recommend that coaches, teachers and parents should support future physical activity experiences that include an element of choice along with opportunities to engage in social interaction in conjunction with opportunities for progression and achievement as these appear to provide the best environment to foster positive mental wellbeing in adolescents.

### **Declaration of Conflicting Interests**

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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### **Link from Chapter 5 to Chapter 6**

Chapter 5 sought to qualitatively examine the associations between physical activity, participation in sport, and self-determined motivation on mental health outcomes in adolescent females. Results suggest higher frequencies of physical activity are not automatically associated with higher levels of mental wellbeing and that the context within which physical activity experiences are framed, have a significant bearing on outcomes of mental health. Adolescent's basic psychological needs, namely autonomy, competence, and relatedness, were identified as important factors that should be included when designing physical activity experiences. Higher frequencies of physical activity may negatively impact mental health outcomes through controlled or forced participation in physical activity, or by exposing adolescents to unenjoyable physical activity experiences. The findings in this chapter are in line with previous qualitative investigations among adolescents (White et al., 2018) although all participants were actively involved in physical activity and sport. Future focus groups should also seek to include the viewpoints of adolescents who identify as inactive or do not engage in team sport.

Chapter 6 sought to build on previous findings, specifically from chapters 3 to 5. A larger sample of adolescents, including males, were included in focus groups. Interviews were grouped based on sub-categories of physical activity, namely team sport, individual sport or activity and adolescents who self-identified as inactive. Participants were asked to bring an object that represented physical activity and an image that represented wellbeing to the interview. Focus group questions centred around the exploration of associations between physical activity and wellbeing, potentially through artefacts and images that were brought by participants. Follow up questions also sought to investigate the quantitative findings from previous chapters such as increases in self-efficacy contributing to enhanced wellbeing, and higher levels of wellbeing observed in adolescents who engage in team sports and multiple sports. The associations between very high frequencies of physical activity and increased symptoms of anxiety and depression will also be explored.

## **Chapter 6:**

# **Self-Esteem, Meaningful Experiences & The Rocky Road. Contexts of physical activity that impact mental health in adolescents**

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## 6.1 Abstract

Abundant evidence shows that physical activity benefits adolescents' mental health and wellbeing. Quantitative evidence has shown that adolescents engaging in leisure time physical activity, a number of sports, and team sport, display better mental health outcomes than their peers. The specific contextual factors that contribute to increased mental health and wellbeing through physical activity are, as yet, unconfirmed. The purpose of this study was to identify the contexts of physical activity and sport that positively impact mental health and wellbeing as perceived by adolescents. A sample of 58 adolescents participated in 13 focus groups discussing various factors related to physical activity, sport and mental health. Participants brought an object that represented physical activity, and an image that represented wellbeing to each focus group to aid in the discussion and representation of both. An inductive thematic analysis was conducted on transcripts of the focus groups using a six phase approach. Five key themes were identified: Achievements and improvements leading to increased self-esteem; The importance of meaningful experiences, a sense of belonging and contributions to identity; Development of resilience and responding to setbacks; Social connectedness and relatedness; An opportunity to experience mindfulness, distraction and flow-states. To enhance and support wellbeing through physical activity adolescents should be encouraged, and provided with opportunities, to engage in enjoyable activities with people whom they experience a sense of belonging, where there is an opportunity to experience mastery and improvement, and include an element of autonomy or choice.

**Keywords:** Wellbeing, exercise, mechanisms, resilience, sport, qualitative, opportunity

## 6.2 Introduction

Mental health disorders are the second leading cause of the global burden of illness and prevalence is growing rapidly (Kassebaum et al., 2017). Lack of physical activity is well recognised as a key risk factor for the management and prevention of mental ill-health, including anxiety and depression (Teychenne et al., 2020), and recent physical activity guidelines have acknowledged mental health benefits for those who achieve the recommended amount of activity. However, physical activity recommendations only detail the volume, intensity and type of activities that should be undertaken while no reference is made to contextual factors that may lead to more optimal mental health benefits (White et al., 2017). Due of the inability to identify an optimal dose, recent research has shifted to the context or life-domain through which it is engaged. For example, leisure-time physical activity and active travel have been found to be positively associated with positive mental health while

leisure-time physical activity and sport were inversely associated with mental ill-health (White et al., 2017). However, physical activity was not consistently associated with lower mental ill-health across domains as work-related physical activity was positively associated with mental ill-health (White et al., 2017). These results highlight the need to investigate the most appropriate contexts for improving mental health and wellbeing.

Current evidence suggests both physiological and psychological factors impact mental health through physical activity (Lubans et al., 2016), with one hypothesis proposing that psychosocial mechanisms are largely at play including self-esteem or self-efficacy, physical self-perceptions, social connectedness, and mood and emotions. Many theoretical frameworks have further proposed that optimal psychological functioning, or wellbeing, is achieved through satisfying basic psychological needs for social connectedness, autonomy, self-acceptance, environmental mastery, and purpose in life (Deci & Ryan, 2004; Ryff & Keyes, 1995). Indeed, physical activity provides an opportunity for social interaction (relatedness), mastery in the physical domain (self-efficacy and perceived competence), improvements in appearance (body image) and overall self-perceptions (body image), and independence (autonomy) (Deci & Ryan, 2004). Participation in physical activity may also lead to improved task self-efficacy, which generalises initially to broader self-concept and then to global self-esteem (Sonstroem & Morgan, 1989). However, physical activity may also have a negative impact on mental health outcomes in adults (White et al., 2017), adolescents and children depending on the specific context and circumstances (Richards & Foster, 2013, White et al., 2018).

Because increasing physical activity in and of itself is not likely to guarantee greater mental health and reduced mental ill-health, contextual factors are crucial (White et al., 2017). Gaining knowledge of the specific factors that influence the relationship between physical activity and mental health, particularly within the leisure-time domain, will help lead to the development of contextually tailored interventions and physical activity guidelines, and improve the effectiveness of physical activity as a prevention and treatment method (White et al., 2017). Therefore, the primary aim of this study was to explore contexts of physical activity that have the strongest associations with perceived wellbeing and mental health in Irish adolescents. Secondary objectives included identifying the aspects of leisure-time physical activity that best support wellbeing, identifying the aspects of team sport that may offer a “protective effect” against symptoms of mental ill-health, and ascertaining if experiences of leisure-time physical activity and their relationship with mental health, differ between males and females.

## **6.3 Methods**

### ***Participants***

Participants (n = 58) were post-primary students from five schools in the south east of Ireland and included both males (n = 27) and females (n = 31) aged 16-18. Each participant attended one of thirteen focus groups that were sub-divided into categories of adolescents who played a team sport, those who played an individual sport, and those who identified as largely inactive outside of school. Two participating schools were all-male, two participating schools were all-female, and one was co-ed. Participants engaged in a range of physical activities and sports including hurling/camogie, gaelic/ladies football, rugby, basketball, soccer, athletics, dance, gymnastics and rowing.

### ***Design and procedure***

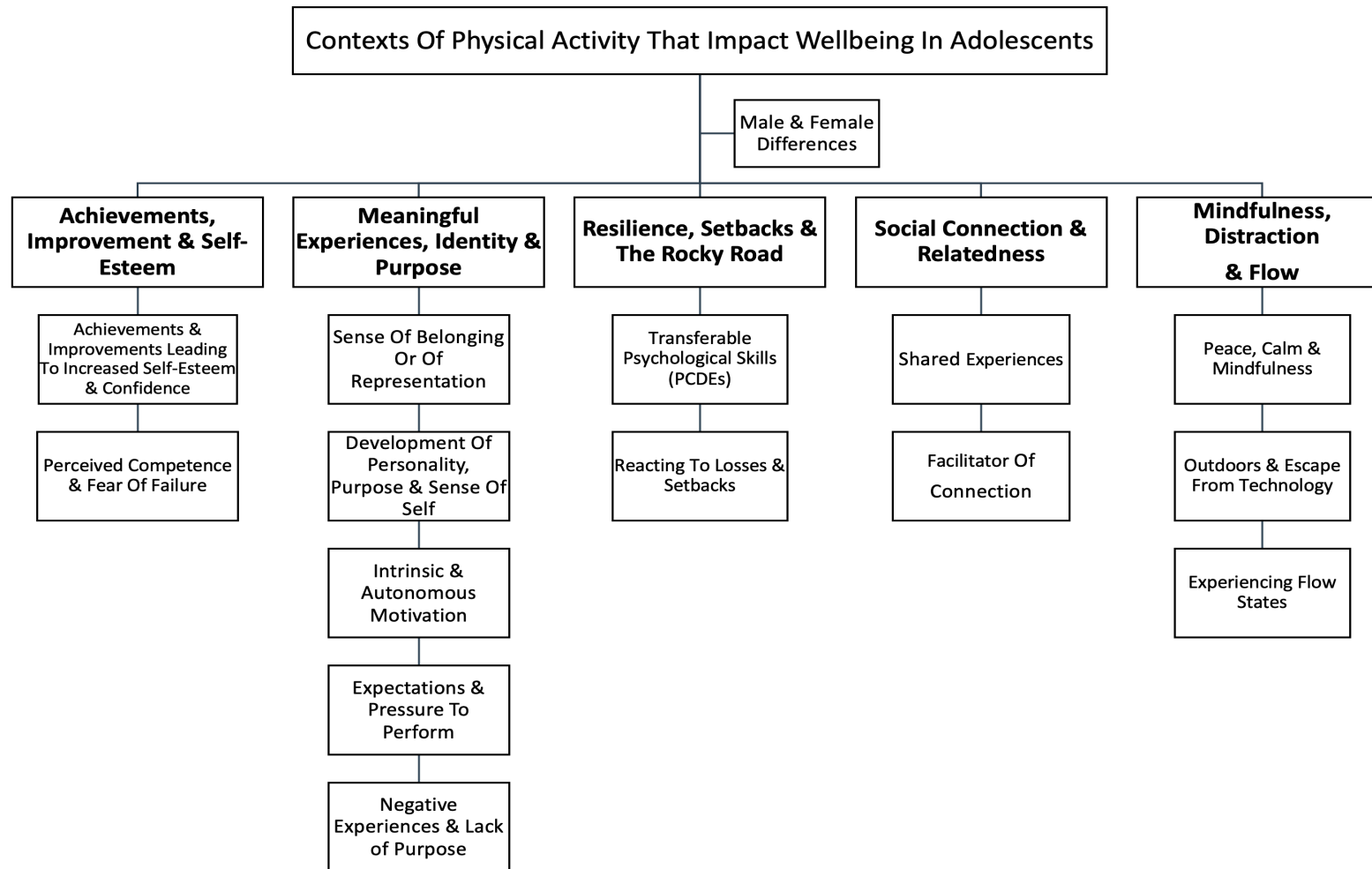
Following ethical approval by the Dublin City University Ethics Committee (DCUREC/2019/107) schools were purposively selected from a previous national questionnaire (Murphy et al., 2020). Invitations were sent to school Principals. Once consent was provided by each Principal and school management the lead researcher spoke with class groups of 4<sup>th</sup> or 5<sup>th</sup> Years about the study and invited participants to take part. Signed parental consent and participant assent were secured prior to any data collection taking place. In order Participants were asked to bring to the focus groups, an object that represented physical activity and an image that represented wellbeing for them. These aided in the discussion of their perceived connections between physical activity and wellbeing. During focus groups participants were asked about connections between physical activity and wellbeing; how physical activity may improve wellbeing; how physical activity may negatively impact wellbeing; why adolescents who engage in more or team sports report higher wellbeing and were encouraged to provide personal anecdotes of their individual experiences. Focus groups were recorded on a digital voice recorder for subsequent transcription and analysis. Notes were kept throughout each focus group for use in subsequent analysis. The lead researcher facilitated, transcribed and analysed all focus group interviews.

### ***Data analysis***

To help understand adolescents' thoughts and experiences of the relationship between physical activity and wellbeing, an inductive thematic analysis was conducted on focus group transcripts using Braun and Clarke's (2006) six-phase procedure (see supplementary Table 1). In line with guidelines, transcripts were examined and initial codes were identified and refined by the authors as nine candidate themes were proposed. Establishing internal homogeneity-external heterogeneity in a manner proposed by Braun and Clarke (2006) is important at this stage so extracts that fitted into multiple themes were collapsed into a higher order theme and a new candidate theme was generated. As the stages progressed, some extracts were removed as stronger extracts that demonstrated each theme were used as examples. This pattern was repeated until there was a consensus between the authors that there were distinct themes. Following this process, five themes remained and each theme's title was amended to reflect the study's data and literature about contexts of physical activity that support wellbeing.

### **6.4 Findings & Discussion**

This paper explores how adolescents experiences of physical activity and sport may interact with and develop their mental health and wellbeing. Such results provide valuable insights for future physical activity recommendations. Five higher order themes and fifteen sub-themes were used to convey the feelings of participants towards their experiences of physical activity and sport. These are summarised in Figure 1.



**Figure 16:** Adolescents perceived influences of physical activity and sport on mental health.

## Achievements, Improvement & Self-Esteem

### *Achievements and improvements leading to increased self-esteem and confidence*

The majority of participants noted the importance of, and enjoyment derived from, improvements in fitness, skill or all-round ability. Each participant was asked what was the most enjoyable aspect of engaging in physical activity and sport with improvements over time the most common:

*“I think definitely the chance of getting better at things. I used to hate running but I got into it and I started to like the sense of achievement after finishing it and to notice that you could get faster or you could run a bit longer and you were starting to find it easier, as you were getting fitter and getting better at it. I just really liked that” (inactive male).*

Physical activity appears to provide opportunities to master skills and this sense of mastery facilitates enjoyment on a regular basis which is essential to wellbeing. Follow up questions focused on probing why improvements are enjoyable and how they may have further positive effects on wellbeing. Increases in self-esteem that carried over to other aspects of life were key:

*“Well, I do Muay Thai. I have done it for six years. [pause] I had struggled a lot with self-esteem when I was younger and started. Through it, it helped me gain confidence in my abilities and what I can do if I set my mind to something” (Individual activity male).*

Task-specific self-confidence, or self-efficacy (Bandura, 1986), influences persistence, thoughts, stimulation and behaviour as self-perceptions lead to positive experiences. Increased self-efficacy has been identified as a possible mechanism for increased global wellbeing in adolescents (Murphy et al., 2022a) which suggests increasing task-specific self-confidence through physical activity or sport may have positive benefits for other aspects of life for adolescents. Confidence gained from the physical activity could also help adolescents through other pursuits: *“I think that sense of achievement really boosts your confidence for the rest of the week” (individual sport female).* The accumulation of smaller achievements over time helped adolescents to focus on the process of improving and of persevering with something.

*“For me I find it really rewarding because when you look back on everything that you’ve done and everything that you’ve achieved, you think “Oh wow, I’ve come really far.” And especially when you have a challenge and you get through that challenge, you feel a great sense of satisfaction from that” (individual sport male).*

Other benefits of physical achievements noted by participants were how they learn to focus on the function of their bodies over the appearance:



*“Even when you finish a hike and you're like I didn't think I could do that and you finally could and it's that sense of accomplishment. You're achieving something, and it's not directly linked to how you look because that's a huge pressure, whereas it's more ability based” (inactive male).*

While physical appearance is generally a greater predictor of global self-worth in adolescents than athletic competence (Shapka & Keating, 2005), Harter (2012) argued that the contribution of domain-specific self-worth to global self-worth, and therefore wellbeing, is a function of the importance an individual places on each domain. Therefore, increasing an adolescents' perceived value of physical competency, could enhance the ability of PA to increase global self-worth

### ***Perceived competence and fear of failure***

Participants who self-identified as inactive highlighted some of the barriers that discouraged them from engaging more in physical activity. One of these barriers was a fear of not performing or not meeting the standards of others which in turn led to less enjoyment:

*“Yeah, definitely, especially in school, even with PE, people are very demanding, and if you're not meeting their expectations they're kind of judge-y, and it just makes it less enjoyable” (Inactive male).*

A lack of confidence in their own ability, or perceived competence, was also highlighted as a barrier to participating but also in deriving greater enjoyment from physical activity and sport:

*“I think you have to have some sort of interest; you have to like what you're doing. I would not be able to play hurling for my life, so I think I would just be so caught up in my own head what everyone else is thinking. If I was to run for a ball, in my head I'd be like, 'There's no point you running for it because you won't be able to get it off someone' Or someone with more skill will come and take it” (Inactive male).*

Higher levels of perceived competence have previously been shown to facilitate adolescents in adapting to stressors while being active (Tudor et al., 2020) as they are more confident in their own physical abilities and therefore better prepared to deal with setbacks in some physical activity contexts. Self-presentation (Leary & Kowalski, 1997) has also been suggested as a negative influence on mental health through a lack of perceived competence, although, self-presentational concerns are often appearance related. Concerns that one will be unable to make the desired impression due to a lack of skills or strength required to perform the task at hand can also arise (Leary, 1992). A lack of perceived competence and fear of failure,

however, was also evident in adolescents who identified as active, especially in those who largely engaged in individual sports such as dance, gymnastics or athletics:

*“And it’s just like if you didn’t get picked to dance again for the solo, it’s just like ‘What did I do wrong? Did I not meet their standards? Why didn’t I meet their standards?’ And it’s like you’re doubting yourself and your ability” (Individual sport female).*

## **Meaningful Experiences, Identity & Purpose**

### ***Sense of belonging or of representation***

The need to form and maintain interpersonal relationships is at the core of satisfying the need for belonging. Participants were asked why adolescents who engage in team sports have reported higher levels of wellbeing in the past when compared to inactive adolescents or those who participate in individual activities. The sense of belonging to a team or group was immediately highlighted by all: *“Being a part of a team in general because you have that sense of belonging and community as well, like being part of something.”* Being part of, or representing a wider group, was highlighted as important along with the sense of pride it brought when they represented their local community:

*“I’d always say my club jersey. Because it’s kind of like, yes, it’s a great achievement to go and play in county teams and it’s great representing your county, but when it comes to a championship and they give you the jersey, you get a shiver down your back when you’re putting it on. It’s like you’re playing for everyone now, it’s not just you. It’s bigger” (team sport male).*

A sense of belonging among teams or groups satisfies a basic psychological need as adolescents who experience a greater sense of belonging have stronger inner resources, a sense of identity, and intrinsic motivation (Ryan, 1995). Current evidence is conflicted in regard to physical activity with others, such as performing exercise ‘beside’ someone as opposed to ‘with’ them. Identifying as part of a group, often working toward a common goal and sharing the experience is identified here as particularly important in contrast to simply performing exercise with others in the same location. The sense of belonging or representation was also highlighted by participants who engaged in sports largely categorised as individual, such as athletics:

*“I brought the singlet that I wear when I’m racing with the club. It represents it. When I’m wearing it, it’s nice to be able to represent the club... I’m proud of who I run for and try and represent them as much as I can” (individual sport male).*

and dance: *"Yes, it's the dance school I'm with. I brought it because it's representing my school, like if I brought a costume it wouldn't really show who I'm with."* It was important to note that a sense of belonging is not automatically felt or created but should be worked on and developed through specific activities. A sense of belonging is often characterised by feelings of inclusion, connectedness, and support (Johnson et al., 2001). While a sense of belonging is defined in various ways, including relatedness, sense of community, support and identification, an underlying theme is one of attachment (Murray & Greenberg, 2001).

### ***Development of personality, purpose, and sense of self***

Numerous studies have examined the relations between five factor model dimensions and sport activities suggesting there is a positive correlation between sport activities, and extraversion and conscientiousness, and also a negative correlation between sport activities and neuroticism (Conner & Abraham, 2001; Tafti et al., 2008; Saklofske et al., 2007). Engagement in sport helped many of the participants guide the development of their personality traits and form a purpose in life:

*"Like, without sport, I was very lost as a person. I came up from Cork, about three years ago. Without sport, I would only have school to join in with friends. Sport is a massive thing to have, just to have something in common with the lads here... If I wasn't actively playing sport, I don't know where I would be in life" (individual sport male).*

Sport helped participants to meet friends and keep friend groups together suggesting it may support a sense of extraversion or even develop openness to new experiences for more introverted adolescents. Engagement in sport also provided structure to their week and helped them to remain focused on goals over the longer term:

*"I think they just go hand in hand together. Without sport, I wouldn't be the same person I am, definitely, without sport. I wouldn't be as happy as I am, or as much friends as I have, and all that.. It gives me something to do, wake up every day, and go out, and know that I am doing something with myself. If I didn't have sport, I would just be sitting around doing nothing. I'd be wasting..." (team sport male).*

Participants also noted the importance of having other outlets in life as well as sport. This can be achieved through playing a number of sports or complementing physical activity with other non-sporting hobbies:

*"Your sport can obviously be very important to you but you have a life outside of your sport. Don't let your sport take over how you feel about yourself in the rest of life. Try*

*to pick up another hobby that's completely different and don't lose a part of yourself to your sport" (team sport female).*

Having different levels of personality characteristics proportionally influence feelings, emotions, and behaviour such as higher extraversion predicts positive emotions like happiness, optimism, and high levels of energy (David et al., 1997) while neuroticism predicts negative emotions like fear, worry, anger and guilt (Robinson et al., 2007). Sport as a collection of systematic behaviours requires more positive emotions like happiness, optimism, and high levels of energy and less negative emotions like fear, worry, anger and guilt (David et al., 1997; Robinson et al., 2007). Nia and Besharat (2010) suggest the association between personality characteristics of higher extraversion and lower neuroticism likely prepare the individual for involvement in sport activities and therefore sporting activities prepare the grounds for development of these personality characteristics.

### ***Intrinsic and autonomous motivation***

A previous qualitative study examining the relationship between physical activity and wellbeing noted how participants spoke of physical activity as an "opportunity" (Murphy et al., 2022b). Participants who engaged in team or individual sports spoke of going to training or competitions in a similar way: *"Oh, training is on tonight, thank God."* The importance of framing physical activity experiences as an opportunity was also highlighted by participants in this study:

*"There's no point in playing a sport if you're not happy doing it. I look forward to training. If you're thinking, 'I don't want to go to this training,' and all that, then you're going to go down there and have a bad day, have a bad training. You have to be positive if you're going down" (team sport male)*

Intrinsically motivated individuals are more likely to remain engaged in an activity for the longer term and derive greater enjoyment from the same activity (Deci & Ryan, 2004). Internal, and often intangible rewards, such as feelings of accomplishment, were highlighted by participants as important motivators in remaining with an activity and giving full effort:

*"The reward at the end because it's hard to stay motivated. After completing a hard session you feel good about yourself and that's the biggest reward you can give yourself. Sometimes you'd be stressed or nervous about a hard session then when you complete it you feel even better again. You've kind of shown yourself that you're capable" (individual sport female).*

Participants also highlighted the difference in enjoyment and perceived mental health benefits of engaging in intrinsically motivated physical activity as opposed to extrinsically motivated physical activity.

*“I feel like it improves your mental health, if it’s an enjoyable activity that you’re doing, it’s just kind of like you’re doing it at your own will and at your own pace. But I think it’s depending on if there’s someone telling you what to do, I think that kind of like makes it more or less enjoyable” (inactive female).*

Controlled motivation is a likely contributor to lower derived enjoyment and reduced mental health benefits as controlled reasons for participation include feeling pressured to do a sport or activity due to cultural background, family history, or being forced to participate, either by parents, coaches or teachers. These findings are in line with self-determination theory which suggests autonomously motivated behaviours are more likely to be associated with greater psychological wellbeing compared to activities which are carried out due to controlled motivation (Deci & Ryan, 2004; Ryan & Deci, 2000) and confirms previous findings from a physical education setting (White et al., 2018).

### ***Expectations and pressure to perform***

Participants who predominantly engaged in individual sports, especially those with stereotypical body image expectations noted the pressures imposed on them to look a certain way:

*“There’s a lot of pressure to be the tall skinny girl. Even though my ballet school is very accepting of everybody, but there’s still the social standard, I guess, lingering in the back of your mind, even if you don’t realise you’re thinking about it, it’s always there regardless of what you’re doing” (individual sport female).*

Self-presentational concerns (Leary & Kowalski, 1995) have already been highlighted as a contributor to lower participation in, and enjoyment from physical activity. Self-presentation is often linked with social physique anxiety (Hart et al., 1989) which is not associated with any frequency or duration of exercise but through an interaction with situational factors (Crawford & Eklund, 1994) or contexts related to the display of physique. This interaction may be manifested through selection of physical activity settings based upon factors such as the social context and normative exercise attire (Leary, 1992) which may emphasise the shape and figure of some participants. The expectations to look a certain way in a sport that also celebrates the individual over the team or group can also make it difficult to cope with some of the body image pressures. Expectations to perform well in a sport can often place pressure on

adolescents to overly focus on that aspect of their lives and not develop other areas due to the pressure to consistently perform:

*“Say, for instance, you have a fella, he’s an unreal hurler or Gaelic footballer. His entire life just circulates around the fact that he is a really important cog in this team. That ends up becoming... like it becomes their only personality trait, or their only go-to. If your fella is making teams all your life, and you don’t get the team then, you don’t know what to do with yourself” (team sport male).*

Adolescents engaged in team sport also highlighted key points around societal expectations on how one should behave: *“I think sometimes the culture that comes with sport, the idea that you have to blend in with the crowd and abide by all the social rules.”* Societal expectations can often deter some adolescents from pursuing other interests and hobbies:

*“I would be a bit of a mixed bag when it comes to sports. I would be into music and arts and stuff. I feel like, definitely in the sports world, they don’t really go hand in hand with each other. Playing, singing and acting, I feel like, they could be considered more feminine things to do. There is a bit of stigma that fellas that are involved in that could be no good at sports, or no good at putting a tackle in. I feel like it is silly. Your other interests and passions have nothing to do with how good you are at something else” (team sport male).*

Steele and Aronson (1995) propose a phenomenon known as ‘stereotype threat’ that refers to the perceived risk of confirming, through one’s behaviour or outcomes, negative stereotypes that are held about one’s social identity. They suggest stereotypical external views can deter individuals from pursuing other interests, in this case music and arts. Dee (2013) proposes an alternative model of social-identity (Akerlof & Kranton, 2002) that suggests individuals experiencing stereotype threat do not necessarily feel they personally do (or should) subscribe to the stereotyped traits of a social identity but it is the apprehension that others view them through the lens of a certain stereotype that impacts on their behaviours.

### ***Negative experiences and lack of purpose***

A lack of meaning or purpose to certain activities was highlighted in almost every group: *“If we are playing for nothing, then we are training for nothing, as well.”* A lack of fulfilment or meaning has previously been cited as a reason for dropout in adolescent sport (Farmer et al., 2018) and may ultimately lead to dropout stemming from lower enjoyment or engagement on a consistent basis. The impact of adults on adolescents’ teams was consistently highlighted as having a negative impact due to both coaching and administration. The culture or lack of camaraderie that was fostered within a team could lead to less enjoyment by the group as a whole:

*“It depends on the people you’re around. For example, I do my football and it’s really good for your wellbeing but then you have your coaches and they can really put you down.... They made everyone so competitive where we were all against each other on the team when we were supposed to be playing together” (team sport female).*

This is consistent with previous investigations of barriers to physical activity in adolescents (Farmer et al., 2018; Perry et al., 2011; Verloigne et al., 2016) although the current findings suggest it may also be a barrier to enjoyment, or development of wellbeing through physical activity. The aforementioned investigations were largely focused on girls participation in physical activity although the current study also noted the influence of adults on boys community sport, especially in the selection to certain teams:

*“I definitely think the whole politics in schoolboy sports, from a young age, isn’t good for your wellbeing. It’s completely unnecessary. You have coaches, and they’re making serious decisions about whether this fella is an A player, a B player, when they are too young to make any evaluation. I feel like pegging someone in a category at a young age in sports is setting them up for an awful hard time in breaking out of their own shells in different aspects of life. When it comes to your own values, and you’re meant to be valuing yourself really highly, and you have adults who are meant to be the people that are guiding you, that are telling you you’re not good enough, or telling you that you can’t achieve what you want to achieve, and you’re not going to get there” (team sport male).*

Administration issues and lack of communication or consistency between teams for training or match times also caused frustration and lack of enjoyment, particularly for female adolescents:

*“You’re a teenager and like we play camogie and more likely play football as well and I just don’t understand why the club can’t work together and do one night camogie, one night football so it doesn’t clash. It doesn’t make any sense” (team sport female).*

Inequalities in terms of treatment or stereotypes have previously been highlighted in research focusing on female coaches as they were found to be at greater risk of reduced wellbeing due to unfair treatment (Kentta et al., 2020; Graham et al., 2013). Although this specific issue has not been previously addressed in adolescent athletes, it does warrant further attention in terms of the allocation of equal access to resources and facilities regardless of gender.

## **Resilience, Setbacks & “The Rocky Road”**

### ***Transferable psychological skills***

Task or activity specific achievements, improvement and progressions were previously highlighted as having positive effects on self-efficacy and may transfer to global self-esteem. The psychological skills required, and often developed through these achievements may translate to other, non-physical activity related, aspects of life:

*“I think it’s important to learn and develop more mental skills across the different sports. Like individual sports would develop internal motivation and resilience while team sports would develop more communication and trust skills. If you’re doing a few different types of sports and developing a few different types of skills then you can transfer them to each other but also to normal life” (team sport female).*

Other psychological skills like hard work and resilience can be developed and transferred to other aspects of life:

*“There’s a lot of things you can take from sport and put them into life, as well. Like, times you could be down or things aren’t going right. It teaches you hard work and resilience at the same time. You’re not going to get anything from nothing. You have to put some effort and commitment into it to get something” (team sport female).*

Resilience and adaptability were highlighted by participants as being developed by sport and transferable to other aspects of life:

*“I think the fact that it’s not all easy. Like sport’s like life. There’s always ups and downs, but you always have to push through and be the bigger and better person and reflect on things, like right, okay, this is what I can change next time. I can do this better and this is what I did well and this is what... that’s not always straightforward. There’s always like things that change. So you have to adjust to it” (team sport female).*

MacNamara et al (2010) outlined a number of ‘above the neck’ skills known as psychological characteristics of developing excellence (PCDEs) shown to play a crucial role in the realisation of potential. PCDEs allow young performers to optimise development opportunities, adapt to setbacks and effectively negotiate key transitions along pathways to excellence and throughout life. One such PCDE, commitment, was outlined by participants as important to the individual themselves in staying with a sport but also in making a commitment to teammates:

*“But you’re also, especially team sport, when you know everyone else is going to be there, you’re like, well I can’t miss out. And not that you don’t want to miss out on anything but it’s just like you can’t let them down” (team sport male).*

An important life-skill is being able to deal and interact with other personalities as was highlighted here:



*“When you are playing on a team, you are playing with fellas.. that might not be my cup of tea, or whatever, fellas from all sorts of backgrounds. But when you’re on the pitch, it’s like something clicks. You wouldn’t not pass to a fella because you don’t like him. You all have the same goal, and you all have a mutual interest. I think it is really important, because it can grow friendships” (team sport male).*

### **Reacting to losses and setbacks**

Losses and setbacks are inevitable when playing sport. The various ‘setbacks’ or challenges that naturally occur through involvement in sport are deemed essential to optimal performance later in life and referred to as “The Rocky Road” in talent development (Collins & MacNamara, 2012). Learning to deal with or respond to them is important in progressing over time and in developing resilience:

*“Yes, you have to learn the skills to deal with loss because you're going to experience so much failure and setbacks in life. You have to learn to deal with it. And that’s a good thing in doing sports: it teaches you that you're going to have setbacks. Then at least you're prepped. If the first time you experience a setback is in school, you fail a test, you're going to be completely doubting your abilities, whereas you learn that from a young age” (inactive male).*

The concept of resilience refers to findings that some individuals have relatively good psychological outcomes, despite exposure to acute or chronic stressors that are associated with negative outcomes (Rutter, 2006). Definitions of resilience vary although most incorporate three pivotal concepts: stressors, positive adaptation and protective factors (Luthar et al., 2006). Losses and setbacks are obvious stressors while the support of teammates, an ability to take on board feedback and realistic performance evaluation, another PCDE, all serve as protective factors leading to positive adaptation. Learning how to reflect on losses and setbacks through the lens of a performance evaluation helps to turn each experience into part of a learning process instead of one individual outcome. Evaluating current performances compared to previous ones is also important in developing a growth mindset (Dweck, 2017):

*“Obviously, winning is the most enjoyable thing about sport. But I think what I find very satisfying as well, and enjoyable, is if we played a team last season and they beat us by, say, ten points, and then we played them again next season, and we’re getting closer and closer to beating them, it shows that we are really improving” (team sport male).*

Learning from mistakes is a key feature of individuals with growth mindsets and helps to develop resilience, or grit, over time (Hochanadel & Finamore, 2015):

*“Yeah, more or less progressing, taking feedback, and learning from your mistakes, I think that’s important... I think mistakes are fine, everyone makes mistakes, no one’s perfect. But, yeah, just to try and work on the mistakes and learn from them” (team sport female).*

Team sports naturally have an in-built support group through team mates. This makes it easier to utilise another PCDE, ‘actively seeking social support’ which in turn helps reflection on performance:

*“I think it’s kind of both. At first, you’re just annoyed at yourself, but then I think with the people around you, they kind of tell you, “Ah, yeah, you can learn from that and move on.” It will help you going forward. So it’s kind of both” (team sport female).*

Experiencing and reflecting on losses also helped adolescents to appreciate and derive greater enjoyment from successes when they do come:

*“And I think when you lose as well, when you do win it makes it feel even more rewarding because say if you just win all the time, that would eventually just start to lose its meaning, so I think when you lose once in a while it does really help to push you and do better and to help you make sure that you’re on the right path” (team sport female).*

Adolescents who participate in multiple activities were found to have higher levels of wellbeing than those who participated in one or none (Murphy et al., 2020). This may be due to having another opportunity to redeem themselves after a poor performance or result:

*“I think with multiple sports and you do something bad in one like losing or a bad performance then you have an opportunity to go into a different one and just try again or kind of make up for it. Like if you lose football on Sunday and then go to basketball Tuesday night like they don’t know how you did in the football so it’s just a clean slate straight away. It just helps you move on from the bad stuff and lets you build up your confidence again fairly quickly. A chance to redeem yourself for yourself” (team sport female).*

## **Social Connection & Relatedness**

### ***Shared Experiences***

Second to improvements and progressions over time, “winning with friends” was highlighted as the most enjoyable aspect of engaging in team sport. Sharing the experience of winning, losing and progressing over time was said to be more enjoyable than on your own:

*“The best thing is winning but celebrating it as a team together. We have that one big thing in common and can share the experience, especially after the few months of working together” (team sport male).*

Some suggested that enjoyment may last longer when it’s shared with others:

*“I suppose if something goes well with a team sport you’re all there together and you can all celebrate together, whereas by yourself I know you’ll have your family and friends or whatever but it’s only you who’s done that, whereas a team, it lasts a bit longer as well” (inactive male).*

Exploring and expanding on the memories with others may help the feeling last longer as they are celebrated first as a group then perhaps as individuals later. Sharing the experience with others also teaches a valuable life skill that it’s about the wider group and your part in it as opposed to being about the individual: “Yeah, one person didn’t win the championship – it’s the whole team. That one player isn’t everything, it’s the whole team that comes together, even the subs and the coaches” (team sport male). Sharing the experience with friends and teammates can also serve as a motivator:

*“No, it’s important to win with your friends and your teammates. When you’re playing team sports, it’s not just about you. It’s for your friends and the team. You go the extra mile for the people on your team” (team sport female).*

The shared experience of simply moving forward and trying to get better also served as a source of enjoyment for adolescents:

*“I think being with other girls and the chance to socialise but also to socialise with people who are pretty much on the same mission. We’re all there for the same reason, to get better, and that’s created a bit of a bond and we’ve created an environment where we’re just trying to do the best for the team with no judgement. That environment is just really enjoyable to be a part of. All of us just trying to be a little bit better together” (team sport female).*

The enjoyment of and perceived benefits from shared experiences were not exclusive to team sport participants. Dancers and gymnasts also spoke about how they can experience similar enjoyment when their individual effort combines with others to execute a group performance successfully:

*“It’s yourself because you practice a lot, and then when we all come in together and we all have the dance right, I think it’s kind of personal but it’s also a group effort as*

*well, because when we're in class and they're telling us to go home and practice, that's the personal part of it, whereas you practice and you try and you keep looking at yourself and being like "Is this the right way, is this not?" and then you come back the next week and then everybody has practiced and we all look good together, so it's an achievement for yourself but achievement for everybody else too" (individual sport female).*

### **Facilitator of connection**

Studies in adults have found that when physical activity is completed with others there is a lower likelihood of developing depressive symptoms (Teychenne et al., 2010). Engagement in sport and physical activity can facilitate a connection between other adolescents with similar interests: *"It's like a portal you go through to meet your friends"*. Sport serving as a facilitator of connection was evident in both females:

*"I would be very close to my friend group. Sport also provides support as it's a chance to meet some other girls and provides a distraction. I love the basketball girls as we're all there for the same reason and that helps to bond us together" (team sport female).*

and males, who also stated it was important in helping them develop a connection with teammates who were a bit older or younger:

*"I made most of my friends through Gaelic football and through school. The school team has also helped to pull us together with TYs and 6th years... We just had fun or had to communicate at training. Then when we'd meet on the corridor we'd say hello and just start meeting up more often outside of school and football" (team sport male).*

Satisfying the need for belonging depends on frequent personal contact and interactions with other individuals. Adolescents who have strong and well-established social relationships are less inclined to seek out additional bonds than adolescents who are socially deprived (Baumeister & Leary, 1995). Sport provides an opportunity to develop social relationships through frequent contact, supportive environments and expectations around commitment to each other. Further expansion on why physical activity with others is important one participant stated: *"It's like people respond to people, and it's better than doing it alone and it's something you can share what you're into with other people" (team sport male)*. Another stated the importance of making friends through sport and the impact that has had on other aspects of life:

*"I think that without sport, we would all be completely different people. We wouldn't have the same group of friends. We wouldn't all have the same passion for things as everyone else. We wouldn't be... I don't know what the word would be, we wouldn't*

*connect with people as much, because you're not into the same things as each other... If you're not connected with people, you have to have something connecting, the way you have sports to play with people, and you know what they're doing, and we're doing. But if you're not all in the same thing, then there's nothing connecting you with them" (team sport male).*

Discussions around sport acting as a facilitator of connection led to some notable points on how connections can also be formed between people and personalities who may necessarily have much in common:

*"Say you're on a team with some people that you like, and some people that you don't like, when you win, there is definitely a window for a couple of hours where you are all just delighted to be with each other. It's like a little window comes down, where you're all the same, for the day. Then you can go back to not liking each other tomorrow" (team sport male).*

The importance of making and spending time with friends for life after sport was acknowledged by adolescents:

*"I think like, not a social aspect or having a craic, I feel like, if friends weren't there, it just wouldn't...because, realistically, I don't think there's going to be a career in rugby. Like I'm not going to be a professional rugby player, especially as a girl. I'm just doing it out of pure enjoyment and enjoying spending time with my friends, doing the sport that I love and just like overall, winning and achieving something and having something to look forward to. If I didn't play sport, you'd be a bit lost. Like, even if you do play an instrument, or run, I just think it would lack enjoyment if you didn't have this team sport to play with your friends and enjoy" (team sport female).*

Participating in physical activity with, or alongside, others is unlikely to provide the same benefits as when adolescents feel connected to each other. Satisfying the basic psychological need for relatedness appears to influence whether physical activity experiences are associated with positive affect (White et al., 2018), and therefore is an important contributor to the development of wellbeing through physical activity.

## **Mindfulness, Distraction & Flow**

### ***Peace, calm and mindfulness***

Adolescent-based studies have previously highlighted the importance of physical activity as a means to distract from everyday stressors and experience mindfulness (White et al., 2018):

*"For me it's just listening to music and looking at everything, just cycling away, just taking in everything I see. Because I'm not thinking about anything, I'm just listening*

*to something. I'm not thinking about, 'I have an assignment due,' or I'm not thinking what time I'm going to bed at; stuff that I would normally overthink about" (individual sport male).*

A number of activities were suggested as helping to experience a sense of peace or calm such as running, cycling, and swimming:

*"When you're swimming it's a breakaway, you're in your own headspace, there's no-one there telling you what to do, it's just like you're there to swim. And when you're swimming, to me it's gotten so natural now that I don't think about swimming, I think about what's going on in my head?" (individual sport female).*

While some participants suggested listening to music while being active also added to the experience: *"I find listening to music to be a really immersive experience then if you're overwhelmed it just takes your mind away from it all and you kind of forget about it" (team sport female).* Getting a break from school work or other life stresses was identified as a real positive of being active:

*"Because like it's not just about playing hurling, you get away from everything – you don't really think about anything like from school and if you are having trouble at home, you just go away, just hurl and you don't need to think about anything else" (team sport male).*

Other participants noted how they found it easier to deal with a problem or to concentrate on school work after physical activity:

*"Well, sometimes, say when I'm running, at the end of it my head is cleared and I can look at it in a different way because usually before I'm running I'll be thinking a lot about it. But then when I run it just helps to free that up" (individual sport female).*

Academic failures or pressures have been identified as risk factors against the development of wellbeing in Irish adolescents (Dooley et al., 2019) and physical activity has been highlighted as an opportunity to distract from these pressures.

### ***Outdoors and green spaces***

Engaging in physical activity outdoors has demonstrated more favourable benefits to physical and mental health when compared to exercising indoors (Gladwell et al., 2013). Participants seemed aware of the benefits when questioned about differences between indoor and outdoor activity:

*“Physically you would, but emotionally and mentally I wouldn't say you would because for me it's being outside in the air and being surrounded by other things more than just being in a room sitting on a bike that goes nowhere doing nothing” (inactive male).*

Greater enjoyment was also derived from being outdoors:

*“It's all outside and training, like, I don't like being inside and sitting down or watching telly or playing PlayStation. I like being out and being active and doing sports, that's just when you are doing that, your wellbeing is better – well, mine is, anyway” (team sport male).*

The connection with nature was highlighted as an important contributor to greater enjoyment levels: *“Yes, I think it boosts your serotonin definitely because all the air and the animals around you make you feel a bit more connected to nature”* (individual sport female) along with noting how large and vast the world around us is:

*“So we'll go hiking in the mountains, you're out in nature and I know it's a bit of a cliché but it does help you feel at peace because you're on top of this huge mountain looking around and seeing how the world is so big and you're so small and the problems seem less big then, because you're walking” (inactive male).*

### ***Experiencing flow states***

'Flow-like' states are experienced when an individual is deeply engaged in an activity. Nakamura and Csikszentmihalyi (2014) suggest that motivation to perform or complete a task is highest when the difficulty of said task is matched by the individual's abilities and skills. A 'flow' state or supreme enjoyment and engagement in the task is experienced when optimal challenge meets with suitable skill and ability. Many participants described experiences similar to flow when speaking about engaging in their favourite physical activity: *“I think it feels like, everything else takes a back seat. You're living right there, right then. Nothing else matters. That is exactly what you're doing. That's all you can think about”* (individual sport female). 'Flow-like' states allow performers to block out all distractions and focus completely on the task they're currently engaged in:

*“A lot of it is about blocking out the constant noise and bright lights of the world. That is exactly what happens when you do a sport, regardless of what the sport is. You get in the zone, and everything else fades away, and you get some time to just focus on what you're doing” (individual sport male).*

When asked about what exactly they're thinking about or focusing on, participants struggled to put it into words:

*“You're just not thinking of anything. You're thinking about the match. Nothing else matters. Nothing else that has happened that day or that week will matter. That*

*doesn't even come into it. You're just thinking about what you're doing... There's no command of it. It's just, what happens, it happens in the moment" (team sport male).*

Both team and individual sport performers spoke about enjoyment of 'flow-like' states:

*"I feel like when I dance it's just a breakaway from reality. It's like I'm in my own mind-set, and when I look at this picture it feels the same; she just looks as though she's in her world, she's having the time of her life, and to me my dancing's that, that's what I feel" (individual sport female).*

Csikszentmihalyi (1975) found that adolescents experienced immense pleasure and serenity when engaged in flow states and reported higher levels of happiness with greater volumes of exposure thus leading to increased wellbeing due to more time spent in flow states.

## **Male & Female Differences**

Throughout the analysis of transcripts and field notes some notable differences in responses between male and female participants became apparent. Females discussed physical activity as an opportunity to de-stress from life's problems, mainly school or academic-related, so they could return to the situation or task with a fresher perspective while males spoke of simply wanting to avoid or distract from the situation. Most interestingly, females elaborated on the same sense of belonging and being with teammates as an important time to be with friends and develop relationships while males simply spoke of 'not being alone'. Differences in motivational factors between males and females for engaging in physical activity with others has received little attention in the past and warrants further exploration. If females require a greater emphasis on the sense of belonging aspect of sports and an opportunity to incorporate other pursuits, such as academics, into their athletic career then this should be facilitated where possible.

## **6.5 Conclusion**

One of the earliest attempts at identifying what constitutes wellbeing proposed autonomy, environmental mastery; positive relationships with others, purpose in life, realisation of potential and self-acceptance (Ryff, 1989) to be key factors. All of these factors have been identified by adolescents as being developed by, and fostered through, physical activity and sport in the current study. To enhance and support wellbeing through physical activity adolescents should be encouraged, and provided with opportunities, to engage in enjoyable activities with people whom they experience a sense of belonging, where there is an opportunity to experience mastery and improvement, and include an element of autonomy or choice. Alternatively, physical activity experiences should reduce the focus on outcome-



oriented goals such as winning and losing, comparisons to peers, focusing on body image or appearance, and forced involvement in physical activity or sport. Promoting autonomously motivated physical activity which satisfies adolescent's psychological needs is likely to be the most effective method of enhancing and supporting wellbeing through physical activity.

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### **Link from Chapter 6 to Chapter 7**

Participants in chapter 6 noted the importance of, and enjoyment derived from, improvements in fitness, skill or all-round ability. This supports findings from chapter 4 where it was suggested that increased self-efficacy may be an important contributor to enhanced global self-esteem, and therefore, wellbeing. Participants noted the importance of a sense of belonging or representation but also highlighted that it needs to be worked on and fostered to truly provide value. A sense of belonging among teams or groups satisfies a basic psychological need as adolescents who experience a greater sense of belonging have stronger inner resources, a sense of identity, and intrinsic motivation (Ryan, 1995). An early attempt at identifying what constitutes wellbeing proposed autonomy, environmental mastery; positive relationships with others, purpose in life, realisation of potential and self-acceptance (Ryff, 1989) to be key factors. All of these factors have been identified by adolescents as being developed by, and fostered through, physical activity and sport in chapter 6. To enhance and support wellbeing through physical activity adolescents should be encouraged, and provided with opportunities, to engage in enjoyable activities with people whom they experience a sense of belonging, where there is an opportunity to experience mastery and improvement, and include an element of autonomy or choice.

Chapter 7 sought to build on findings from chapter 3 by examining the impact of Covid-19 restrictions on physical activity, participation in sport, wellbeing, and symptoms of anxiety and depression in Irish adolescents. The questionnaire was re-issued during restrictions when team sports were not permitted, restrictions applied to physical education classes but school buildings were still open across the Republic of Ireland.



## Chapter 7:

# **Physical Activity, Mental Health and Wellbeing of Irish Adolescents During Covid-19 Restrictions. A Re-Issue of the Physical Activity and Wellbeing Study (PAWS).**

### **Manuscript submitted as:**

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## 7.1 Abstract

Covid-19 restrictions impacted many people's daily lives through infection, fear of infection and restrictions on movement. This re-issue of a questionnaire sought to examine the impact of Covid-19 restrictions on frequency of physical activity, participation in sports, wellbeing and symptoms of anxiety and depression in Irish adolescents. 3,021 adolescents from 61 post-primary schools in the Republic of Ireland completed questionnaires. Consistent with findings from a previous issue of the questionnaire, conducted pre-Covid-19, a minority of adolescents were found to meet the WHO's physical activity guidelines (11.6% of males and 5.2% of females) although there were large decreases in 1<sup>st</sup> year males and females. Adolescents reporting elevated symptoms of depression increased from 39% to 46% with almost 3 in 5 females reporting symptoms of depression ranging from mild to extreme. Highest levels of wellbeing were found in adolescents who participated in 3 or more sports, although there was an 8% reduction in the amount of adolescents participating in 3 or more sports. There were no changes in physical activity levels overall, despite changes within sub-groups and patterns of physical activity. There was a clear increase in symptoms of depression, with females impacted more than males. Previously active individuals were more likely to increase activity and therefore report higher levels of mental health while those who were less active were more likely to decrease activity and report lower mental health. Future interventions should seek to target adolescents currently inactive or with low levels of activity as they are most at risk of further reductions and the associated negative health implications.

**Keywords:** Exercise; Sport; Team Sport; Resilience; Identity; Health; School

## 7.2 Introduction

The World Health Organisation announced a global pandemic caused by the coronavirus disease (Covid-19) on the 11<sup>th</sup> of March 2020. Covid-19 is an infectious disease caused by a newly discovered coronavirus which is transmitted primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Governments in various countries (including Ireland) implemented national containment strategies to limit the spread of the virus and reduce the risk of national healthcare systems becoming critically overburdened. Physical distancing and self-isolation regulations were implemented to reduce person-to-person transmission of Covid-19, although these regulations may have contributed to other potentially significant public health implications such as loneliness, isolation and the associated decreases in mental health outcomes. As most attention in the early stages of Covid-19 restrictions was understandably focused on public health measures to contain the

virus, the focus has since broadened to the wider and longer-term ramifications such as social isolation, delayed help-seeking for other health conditions and reduced opportunities for leisure-time physical activity (Smith et al., 2020; McGrath, Murphy & Richardson, 2020). Reductions in leisure-time physical activity may lead to less social interaction, increased risk of cardiometabolic diseases and has been linked with increased risks from Covid-19 itself (McGrath et al., 2020). For example, a reduction in physical activity and an increase in sedentary behaviours may adversely affect immune function and enhance the risk for chronic health conditions (Sallis, Adlakha, Oyeyimi & Salvo, 2020).

Physical activity is defined as any bodily movement that requires energy expenditure and is produced by skeletal muscle while exercise is a planned, structured and repetitive sub-category of physical activity that aims to increase one or more components of physical fitness (Bull et al., 2020). Regular exposure to physical activity has displayed beneficial effects for the immune system and counteracts many comorbidities such as type ii diabetes, hypertension and obesity (Woods et al., 2020) with growing evidence for the support of positive mental health (Biddle, Ciacconi, Thomas & Vergeer, 2019). Mental health disorders are the second leading cause of global burden of disease and growing rapidly (Kassebaum et al., 2017) with depression alone accounting for more than 44 million years lived with disability (Schuch et al., 2018). Mental health issues in adolescents are increasing globally (Kieling et al., 2011), in Europe (McMahon et al., 2017) and in Ireland (Dooley, O'Connor, Fitzgerald & O'Reilly, 2019) with 4 in 10 adolescents recently reporting elevated symptoms of depression or anxiety (Murphy, Sweeney & McGrane, 2020). Physical activity is well recognised as a key risk factor for the management and prevention of mental ill-health, including anxiety and depression (Teychenne et al., 2020). Higher frequencies of physical activity have been linked with reduced symptoms of anxiety and depression, and higher levels of wellbeing in adolescents (Murphy et al., 2020, McMahon et al., 2017). Experimental research has demonstrated that exposure to aerobic exercise (Lin et al., 2020), resistance exercise (Gordon, McDowell, Lyons & Herring, 2020), and a combination of both types of exercise can improve mental health and wellbeing in adolescents (Goldfield et al., 2019). Along with the type of activity, the context has also been highlighted as important for mental health (Teychenne et al., 2020). Various aspects contribute to the context within which physical activity is carried out such as social interaction, peer groups, mastery of goals/skills, enjoyment, choice and a sense of belonging (Biddle, Mutrie, Gorely & Faulkner, 2021). Many of these were impacted by Covid-19 restrictions due to a lack of travel outside 5km from the home and social distancing guidelines especially social interaction and time spent among peer groups.

Cross-sectional research has highlighted changes in patterns of physical activity during Covid-19 restrictions in Ireland (McGrath, Murphy & Richardson, 2020; O’Kane et al., 2021) and internationally (Faulkner et al., 2021). Initial introductions of containment strategies, such as lockdowns, may have created barriers to physical activity for some, although changes in social and work patterns allowed others to find additional opportunities to be physically active (Faulkner et al., 2021). Reduced commute times and access to various online platforms have increased opportunities to partake in previously less popular activities such as HIIT, pilates, yoga and aerobics classes. ‘Daily exercise’ was highlighted by many governments as a justifiable reason for leaving your house during containment strategies. Changes in physical activity patterns have been inconsistent across populations with some increases (Quispe, Panca, Ramos & Cornejo, 2021), some decreases (Brown et al., 2021) and some reporting no change in overall frequency (O’Kane et al., 2021) although there were a number of changes in the types of activity that were partaken in and when activity was undertaken (Faulkner et al., 2021). It is interesting to note however, investigations that looked at psychological outcomes as well as physical activity found maintaining or increasing physical activity during covid-19 restrictions was associated with higher wellbeing and lower symptoms of depression and anxiety while negative changes in physical activity were associated with lower wellbeing and higher symptoms of depression and anxiety across populations (Faulkner et al., 2021; O’Kane et al., 2021; McGrath et al., 2021).

The future of Covid-19 is unknown with restrictions and social distancing possibly in place for some time to come (Kissler, Tedijanto, Goldstein, Grad & Lipsitch, 2020). Prior to the pandemic, the mental health and wellbeing of adolescents in Ireland was of concern (Murphy et al., 2020; Dooley et al., 2019) and so it is of importance that we understand how the restrictions implemented to control the transmission of Covid-19 affect their health and wellbeing. The findings of this study may inform future interventions and public health strategies aimed at supporting those seeking to be active during unprecedented times such as societal lockdowns, school closures or enforced layoffs from physical activity like injuries. The aim of this study was to explore the impact of Covid-19 restrictions on physical activity levels in adolescents and the impact on mental health outcomes by comparing data captured from the same questionnaire pre- (October 2019) and post-lockdown (November 2020), in the Republic of Ireland. The authors hypothesised a reduction in frequency of physical activity, sports participation and wellbeing, and increases in symptoms of anxiety and depression.

### **7.3 Methods**

This was a re-issue of a previous national questionnaire (Murphy et al., 2020). A cross-sectional study design was employed across post-primary schools in the Republic Of Ireland. Invitations were emailed to all 144 schools who participated in the original questionnaire. Data collection took place in November 2020.

#### ***Data Collection***

Written consent was obtained from the Principal of each school prior to the questionnaire being distributed. Parental consent forms and plain language statements were issued to all participants prior to data being collected. Participants were informed of the anonymity of all responses. All questionnaires were administered through an online Google form and could be completed via desktop computer, laptop, tablet or mobile phone. The means of administering the questionnaire was at the discretion of each participating school.

#### ***Physical Activity***

Habitual physical activity was assessed via a modified version of the Take PART questionnaire by measuring the number of days during the past 14 that participants had accumulated 60 minutes of moderate to vigorous physical activity (MVPA). The survey item assessing physical activity read: *“During a typical 2-week period, on how many days were you physically active for a total of at least 60 minutes? For each day, add up all the time you spent in physical activity. Count up the days with at least 60 minutes of physical activity in a typical 2-week period.”* A graphic summarising moderate-to-vigorous physical activity, with examples, was also included in the questionnaire. Responses ranged from 0 to 14 days. Participants were also asked to rate if they were *“more active”*, *“less active”*, or *“about the same”* due to the Covid-19 restrictions.

#### ***Participation in sport***

A further survey item asked about regular engagement in one or more sports since the onset of Covid-19 restrictions, with possible *“Yes”* or *“No”* responses (McMahon et al., 2017; Murphy et al., 2020). Participants were provided with a text box to list the sports, up to three, that they currently participated in. The lead researcher counted all sports listed and participants were coded as either *“0”*, *“1”*, *“2”* or *“3+”* sports. The lead researcher also coded activities as team sport or individual/fitness activity. Team sport was defined as *“those that typically involved three or more players on each side who compete concurrently”* (Zhou, Heim & O’Brien, 2015). Participants were assigned to the *“team sport”* category if they listed at least

one activity that met the definition. Participants were assigned to “*individual sport/fitness activity*” category if they listed individual sport or fitness activities but no team sport.

### ***Mental health***

**Symptoms of depression** were assessed using the Beck Depression Inventory (BDI) (Beck, Steer & Carbin, 1988). Specific symptoms of depression experienced by participants over the previous two weeks are assessed by the BDI. As one question relation to loss of libido was deemed unsuitable for adolescent participants, it was excluded from the questionnaire (Kendall, Hollon, Beck, Hammem & Ingram, 1987). Responses for each individual symptom range from 0 to 3, with 3 indicating a higher severity of that particular symptom. Scores are added together with a minimum possible score of 0 indicating no symptoms of depression and a maximum possible score of 60 indicating extreme symptoms of depression. Adolescent samples have previously demonstrated very good reliability and validity when assessed using the BDI (Teri, 1982; Steer, Kumar, Ranieri & Beck, 1998).

**Symptoms of anxiety** were assessed using the Beck Anxiety Inventory (BAI) (Steer & Beck, 1997). The BAI is comprised of 21 self-report questions. Responses for each individual symptom range from 0 to 3, with a higher number including a higher severity of a symptom. Scores are added together with a minimum possible score of 0 indicating no symptoms and a maximum possible score of 63 indicating extreme symptoms of anxiety. Adolescent samples have previously demonstrated very good reliability and validity when assessed using the BAI (Fydrich, Dowdall & Chambless, 1992; Steer, Kumar, Ranieri & Beck, 1995).

The Warwick Edinburgh Mental Wellbeing Scale (WEMWS) (Stewart-Brown & Janmohamed, 2008) was used to measure positive psychological wellbeing. 14 questions are asked with responses ranging from 1 to 5 leading to a minimum score of 14 and a maximum possible score of 70. The WEMWS has been previously validated in a sample of adolescents (Clarke et al., 2011).

### ***Statistical analyses***

Participants were divided into categories of physical activity based on the frequency reported. Most Active (60 minutes or more of activity on 8-14 days a typical 2-week period), Somewhat Active (60 minutes or more of activity on 4-7 days in a typical 2-week period), or Least Active (60 minutes or more of activity on 0-3 days in a typical 2-week period). Participants who reported meeting the daily physical activity guidelines of 60 minutes of moderate-to-vigorous

physical activity per day on all 14 days in a typical 2-week period were added to a sub-group known as Sufficiently Active (according to WHO guidelines). Mean frequency of physical activity between males and females were compared using t-tests with p-values of 0.05 interpreted as significant.

Two-way ANOVAs were used to compare mean scores between all sub-groups on psychological variables (WEMWS, BDI, BAI) and between males, females and those who identified as neither male or female. Post-hoc between-group comparisons were conducted using Tukey's HSD with Bonferroni correction.

Gender was controlled for when conducting analyses between physical activity sub-groups due to the significant differences in prevalence of mental health problems and frequency of physical activity between males and females. The open-source statistical software package R (R Core Team, 2014) was used to conduct all analyses. The ggplot2 package (Wickham, 2009) was used to produce all figures.

### ***Research Ethics***

Approved by DCU Ethics Committee (DCUREC/2019/107).

## **7.4 Results**

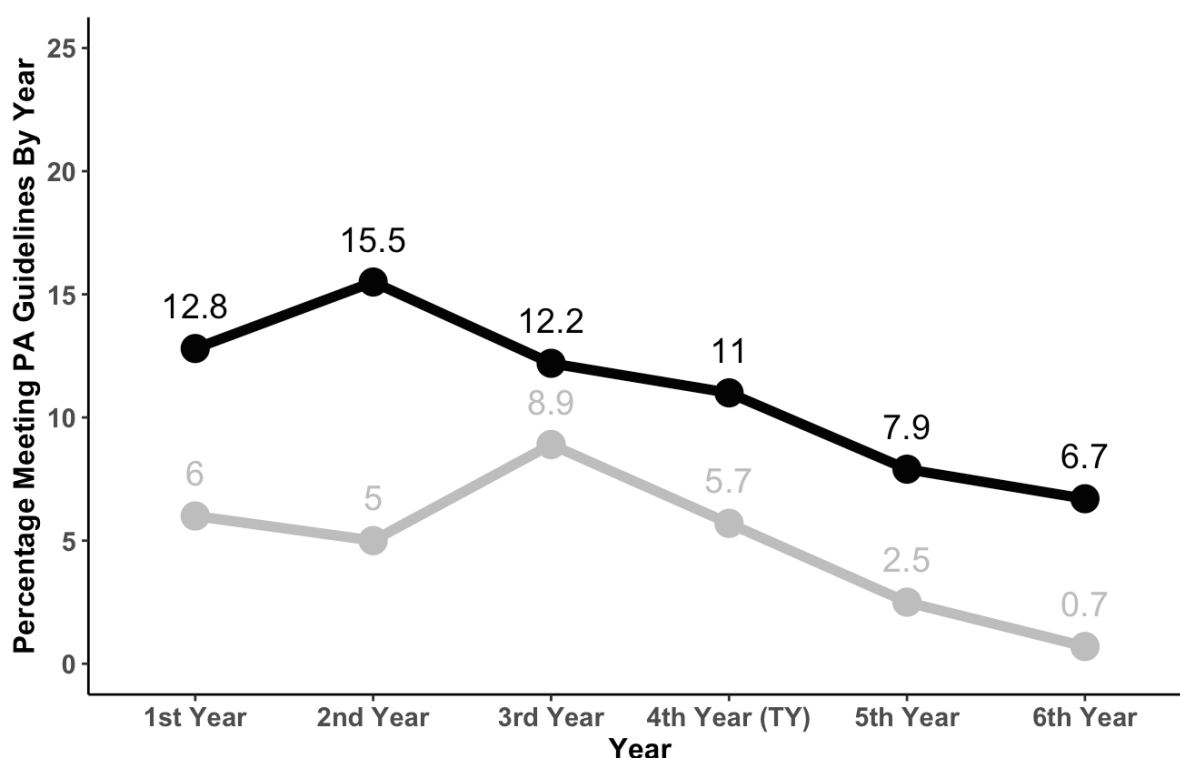
**Table 11:** *Participants by year and gender.*

<b>Year</b>	<b>Male</b>	<b>Female</b>	<b>Other</b>	<b>Total</b>
<b>1<sup>st</sup> Year</b>	335	401	10	746
<b>2<sup>nd</sup> Year</b>	278	397	6	681
<b>3<sup>rd</sup> Year</b>	139	224	3	366
<b>4<sup>th</sup> Year</b>	219	262	3	484
<b>5<sup>th</sup> Year</b>	265	238	8	511
<b>6<sup>th</sup> Year</b>	90	138	5	233
<b>Total</b>	1326	1660	35	3021

### ***Participant characteristics***

64 schools initially registered interest in the study of which 33 fully took part. Schools that were unable to fully participate listed involvement in other research, lack of time and no Principal consent as the main reasons. 3021 participants were recruited from 33 schools representing 16 different counties throughout the Republic of Ireland. Of the 3021, 1660 (54.9%) identified as female, 1326 (43.8%) identified as male while a further 35 (0.2%)

identified as neither male nor female (referred to as “other” for the purposes of reporting throughout). 1<sup>st</sup> year had the most participant (n = 746, 24.6%), followed by 2<sup>nd</sup> year (n = 681, 22.5%), 5<sup>th</sup> year (n = 511, 16.9%), transition year (n = 484, 16.1%), 3<sup>rd</sup> year (n = 366, 12.1%) and least participants from 6<sup>th</sup> year (n = 233, 7.7 %). Ages ranged from 12 to 19 years. The mean age of participants was 14.5 (sd = 1.6).



**Figure 17:** Percentage of students meeting PA guidelines by year and gender.

### ***Frequency of physical activity and sports participation***

Overall, this study found that 8% of Irish adolescents met the WHO’s guidelines of 60 minutes moderate-to-vigorous physical activity every day during Covid-19 restrictions. 11.6% of males and 5.2% of females reported meeting physical activity guidelines. The percentage of adolescents meeting physical activity guidelines increased from 9% in 1<sup>st</sup> year to 10% in 2<sup>nd</sup> and 3<sup>rd</sup> year before following a linear trend of reduction in both males and females to 3% in 6<sup>th</sup> year (figure 17).

Significantly more females (17.7%) than males (13.1%) were found in the least active sub-group and in the somewhat active sub-group (40.9% of females, 32.3% of males) while significantly more males (54.6%) than females (41.4%) were found in the most active sub-group.



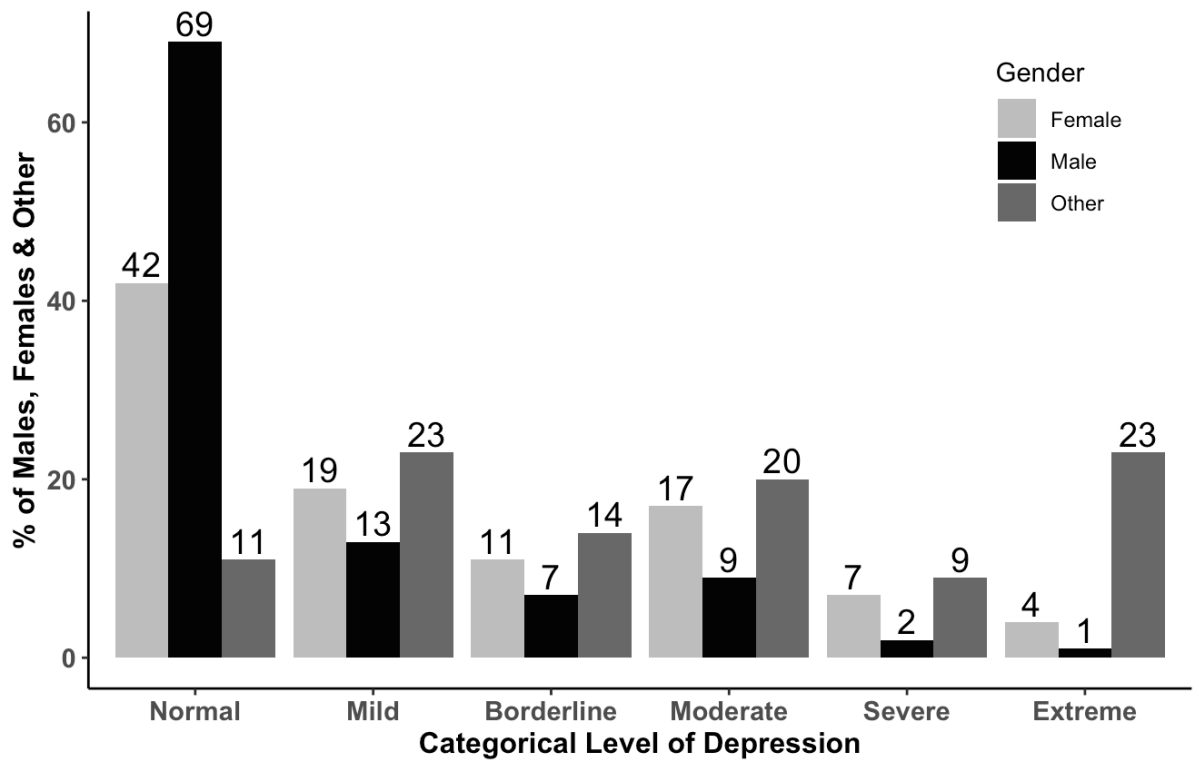
80% of the entire sample of adolescents reported engaging in at least one sport during Covid-19 restrictions while 68% reported engaging in at least one team sport although there were large differences in terms of sex (58% of females, 76% of males).

36.3% of adolescents sampled (33.4% males, 38.6% females) reported being more active during Covid-19 restrictions, 41.6% (43.8% males, 39.7% females) reported being less active, 18.7% (19.9% males, 17.7% females) reported having about the same levels of physical activity while 3.4% (2.7% males, 3.9% females) were unsure.

## **Mental health outcomes**

### ***Symptoms of depression: BDI***

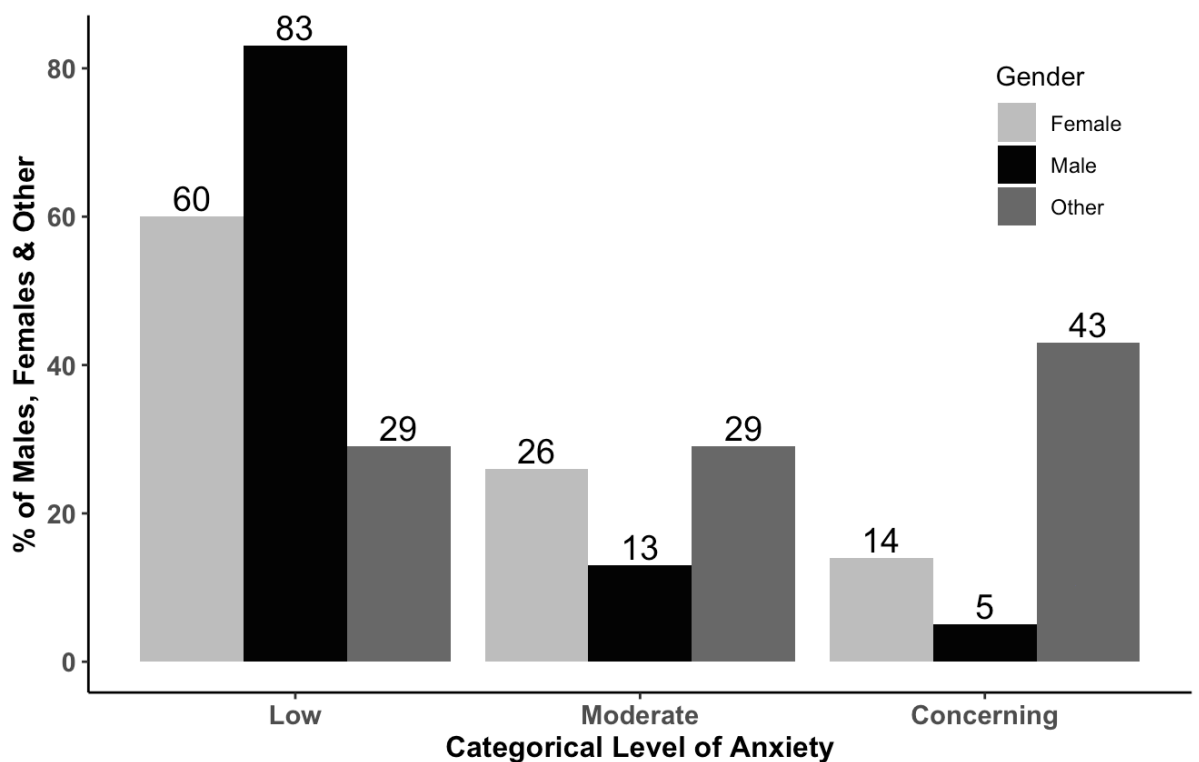
46% of the entire sample reported mild to extreme symptoms of depression with 8% reporting symptoms as either severe or extreme. 31% of males reported symptoms of depression with 3% in either the severe or extreme categories. 11% of females reported symptoms of depression with 11% in either the severe or extreme categories. 89% of those who identified as neither male nor female reported symptoms of depression with 32% in the severe or extreme categories. The lowest symptoms of depression were found in 1<sup>st</sup> year and transition year males, and 1<sup>st</sup> year females. The highest symptoms of depression were found in 2<sup>nd</sup> year and 6<sup>th</sup> year males, and 3<sup>rd</sup> and 6<sup>th</sup> year females. Significant differences were found between 1<sup>st</sup> years and 2<sup>nd</sup> years ( $p = 0.008$ ), 1<sup>st</sup> years and 3<sup>rd</sup> years ( $p = 0.001$ ), 1<sup>st</sup> years and 6<sup>th</sup> years ( $p = 0.002$ ), 4<sup>th</sup> years and 6<sup>th</sup> years ( $p = 0.01$ ), and between 5<sup>th</sup> years and 6<sup>th</sup> years ( $p = 0.004$ ). Significant differences in mean depression scores were found between genders. Other reported significantly higher symptoms than males ( $p = 0.001$ ) and females ( $p = 0.002$ ). Females reported significantly higher symptoms than males ( $p = 0.001$ ).



**Figure 18:** Participants by category of depression and gender.

#### Symptoms of anxiety: BAI

31% of the entire sample reported symptoms of anxiety that were either moderate or concerning. 17% of males, 40% of females and 71% of those who identified as neither male nor female reported symptoms that range from moderate to concerning. Lowest symptoms of anxiety were found transition year and 5<sup>th</sup> year males, and 1<sup>st</sup> year females. Highest symptoms of anxiety were found in 6<sup>th</sup> year males, and 5<sup>th</sup> year and 6<sup>th</sup> year females. Significant differences were found in mean anxiety scores between 1<sup>st</sup> years and 2<sup>nd</sup> years ( $p = 0.001$ ), 1<sup>st</sup> years and 3<sup>rd</sup> years ( $p = 0.01$ ), 1<sup>st</sup> years and 6<sup>th</sup> years ( $p = 0.002$ ), and between 4<sup>th</sup> years and 6<sup>th</sup> years ( $p = 0.03$ ). Significant differences in mean anxiety scores were found between males and females ( $p = 0.001$ ), males and other ( $p = 0.001$ ), and between females and other ( $p = 0.002$ ).



**Figure 19:** Participants by category of anxiety and gender.

#### **Wellbeing: WEMWS**

The mean score on the Warwick Edinburgh Mental Wellbeing Scale was  $46.7 \pm 9.4$  out of a maximum possible 70. Significant differences were found between 1<sup>st</sup> years and 2<sup>nd</sup> years ( $p = 0.003$ ), 1<sup>st</sup> years and 3<sup>rd</sup> years ( $p = 0.001$ ), 1<sup>st</sup> years and 5<sup>th</sup> years ( $p = 0.004$ ), 1<sup>st</sup> years and 6<sup>th</sup> years ( $p = 0.001$ ), 2<sup>nd</sup> years and 4<sup>th</sup> years ( $p = 0.02$ ), 2<sup>nd</sup> years and 6<sup>th</sup> years ( $p = 0.002$ ), 3<sup>rd</sup> years and 6<sup>th</sup> years ( $p = 0.003$ ), 4<sup>th</sup> years and 6<sup>th</sup> years ( $p = 0.001$ ), and between 5<sup>th</sup> years and 6<sup>th</sup> years ( $p = 0.001$ ). Highest wellbeing scores were found in 1<sup>st</sup> years and 4<sup>th</sup> years with the lowest wellbeing scores found in 6<sup>th</sup> years. Significant differences in mean wellbeing cores were also found between males and females ( $p = 0.005$ ), males and other ( $p = 0.001$ ), and between female and other ( $p = 0.008$ ).

#### **Frequency of physical activity, sport participation and mental health outcomes**

Significant differences were found between physical activity sub-groups on all of the mental health outcomes examined ( $p < 0.005$  for both males and females on BDI, BAI and WEMWS after Bonferroni correction). Higher frequencies of physical activity were associated with

higher scores on the WEMWS and lower self-reported symptoms of depression and anxiety were associated.

**Table 12:** Frequency of physical activity among males and females by year.

	Least Active (0-3 days) (% within sex)		Somewhat Active (4-7 days) (% within sex)		Most Active (8-14 days) (% within sex)		Sufficiently Active (% within sex)	
	Male	Female	Male	Female	Male	Female	Male	Female
<b>1<sup>st</sup> Year</b>	14.4%	15.4%	31.4%	36.9%	54.2%	47.7%	12.8%	6.0%
<b>2<sup>nd</sup> Year</b>	14.2%	12.4%	29.1%	43.7%	56.7%	43.9%	15.5%	5.0%
<b>3<sup>rd</sup> Year</b>	8.2%	21.8%	32.1%	35.9%	59.7%	42.3%	12.2%	8.9%
<b>4<sup>th</sup> Year</b>	9.3%	12.7%	36.1%	38.6%	54.6%	48.6%	11.0%	5.7%
<b>5<sup>th</sup> Year</b>	15.1%	22.8%	36.1%	48.7%	48.8%	28.6%	7.9%	2.5%
<b>6<sup>th</sup> Year</b>	15.9%	34.4%	26.1%	44.5%	58.0%	21.1%	6.7%	0.7%
<b>Mean</b>	13.1%	17.7%	32.3%	40.9%	54.6%	41.4%	11.6%	5.2%

#### Frequency of physical activity sub-group

Significant differences between the Least Active and Somewhat Active groups were found on all scores examined in post hoc sub-group comparisons. The Somewhat Active group had higher wellbeing scores ( $p = 0.001$ ) and lower symptoms of depression ( $p = 0.001$ ) and anxiety ( $p = 0.007$ ) than the Least Active group. The Most Active group also displayed significantly higher wellbeing scores ( $p = 0.003$ ) and lower symptoms of depression ( $p = 0.001$ ) and anxiety ( $p = 0.002$ ) than the Somewhat Active group in post hoc sub-group comparisons.

**Table 13:** Mental health outcomes by year and gender.

Year	Depression Mean (SD)			Anxiety Mean (SD)			Wellbeing Mean (SD)		
	Male	Female	Other	Male	Female	Other	Male	Female	Other
1 <sup>st</sup>	7.4(3.9)	12.2(5.4)	35.4(9.6)	11.1(4.7)	16.2(5.9)	40.6(6.5)	50.7(8.3)	47.6(9.1)	28.7(7.1)
2 <sup>nd</sup>	9.6(5.5)	15.2(6.0)	25.5(7.8)	12.6(6.8)	20.3(6.7)	26.5(7.3)	48.2(9.9)	44.5(9.2)	36.5(9.3)
3 <sup>rd</sup>	8.6(4.8)	17.0(6.1)	25.3(6.7)	11.6(4.9)	20.0(6.6)	36.7(3.8)	49.0(9.1)	44.0(9.9)	39.0(6.2)
4 <sup>th</sup>	7.9(3.8)	15.2(5.7)	13.7(1.2)	10.5(5.1)	20.3(6.2)	9.7(3.2)	50.0(8.3)	45.6(8.7)	58.0(13.9)
5 <sup>th</sup>	8.7(4.3)	15.6(5.8)	20.4(5.3)	10.4(5.4)	21.7(7.0)	32.4(6.5)	48.5(9.0)	44.4(8.4)	41.2(9.6)
6 <sup>th</sup>	9.7(5.0)	17.8(5.9)	22.4(5.4)	14.4(6.3)	21.6(6.9)	24.2(6.9)	46.2(8.3)	40.3(8.8)	38.2(8.4)
Mean	8.5(4.5)	15.0(5.8)	25.7(7.6)	11.4(5.5)	19.6(6.6)	31.0(7.4)	49.1(8.9)	45.0(9.3)	37.7(11.4)

### Participation in sport

Participation in sport was found to have significantly higher wellbeing scores and significantly lower symptoms of depression and anxiety in the entire cohort of participants. Highest wellbeing scores were found in participants who participate in 3 or more sport sports. Lowest symptoms of depression were found in both males and females who participated in 3 or more sports while the lowest symptoms of anxiety were found in males who play 3 or more sports but in females who play 2 sports. Significant differences in wellbeing scores were found between those who play no sports and 1 sport ( $p = 0.001$ ), no sport and 2 sports ( $p = 0.001$ ), no sport and 3 or more sports ( $p = 0.001$ ), 1 sport and 2 sports ( $p = 0.002$ ), 2 sports and 3 or more sports ( $p = 0.005$ ), and 2 sports and 3 sports ( $p = 0.002$ ). Significant differences in symptoms of depression were found between those who play no sport and 1 sport ( $p = 0.001$ ), no sport and 2 sports ( $p = 0.001$ ), no sport and 3 or more sports ( $p = 0.001$ ), 1 sport and 3 or more sports ( $p = 0.002$ ), and between 2 sports and 3 sports ( $p = 0.009$ ). Significant differences in symptoms of anxiety were found between those who play no sport and 1 sport ( $p = 0.001$ ), no sport and 2 sports ( $p = 0.001$ ), no sport and 3 or more sports ( $p = 0.001$ ), and between 1 sport and 3 or more sports ( $p = 0.002$ ).

**Table 14:** Physical activity sub-groups and associations with wellbeing, depression and anxiety by gender.

	Percentage of		Wellbeing Mean (SD)		Depression Mean (SD)		Anxiety Mean (SD)	
	Male	Female	Male	Female	Male	Female	Male	Female
<b>Physical Activity Subgroup</b>								
<b>Least Active</b> (0-3 days)	13.1%	17.7%	45.7(9.4)	41.9(9.8)	12.3(10.6)	17.8(12.7)	15.4(11.1)	21.4(14.2)
<b>Somewhat Active</b> (4-7 days)	32.3%	40.9%	48.8(8.5)	45.2(8.9)	8.8(9.1)	14.4(11.2)	11.8(11.0)	19.3(13.1)
<b>Most Active</b> (8-14 days)	54.6%	41.4%	50.5(8.1)	47.6(9.2)	7.1(9.7)	14.0(10.3)	10.3(10.1)	18.8(12.5)
<b>Number of Sports Played</b>								
<b>0</b>	15%	25%	44.4(9.6)	42.7(9.8)	12.4(11.1)	17.5(12.6)	13.6(12.6)	22.0(14.0)
<b>1</b>	29%	36%	48.7(8.9)	44.8(9.0)	7.9(10.3)	15.1(11.3)	11.5(10.5)	20.1(13.5)
<b>2</b>	33%	30%	50.0(7.5)	46.3(8.8)	8.7(8.5)	13.5(10.2)	11.6(10.9)	17.5(12.4)
<b>3+</b>	23%	10%	51.5(8.6)	47.0(8.5)	6.5(8.8)	13.1(10.3)	9.7(10.3)	18.1(12.1)
<b>Team Sport</b>								
<b>Yes</b>	76%	60%	50.2(8.1)	45.9(8.5)	7.6(8.5)	14.1(10.5)	10.8(10.2)	18.3(12.4)
<b>No</b>	24%	40%	45.6(9.5)	43.6(9.7)	11.4(11.3)	16.4(12.4)	13.4(12.4)	21.6(13.8)
<b>Changes In PA Levels</b>								
<b>Unsure</b>	2.7%	3.9%	44.2(13.6)	42.0(9.0)	11.2(5.4)	16.8(5.8)	11.7(5.8)	22.2(6.1)
<b>Less Active</b>	43.8%	39.7%	48.1(8.9)	43.4(9.2)	9.1(4.5)	16.6(5.9)	12.2(5.5)	20.2(6.6)
<b>More Active</b>	33.4%	38.6%	50.5(8.1)	46.1(9.2)	8.0(4.6)	14.4(5.8)	10.4(5.3)	19.7(6.4)
<b>About The Same</b>	19.9%	17.7%	50.0(8.9)	46.9(8.8)	7.5(4.3)	12.1(5.3)	11.3(6.0)	17.4(6.8)

### Perceived changes in physical activity

Wellbeing was highest in males and females who reported being more active or being about the same levels of physical activity during Covid-19 restrictions. Significant differences in wellbeing scores were found between those who were less active and more active ( $p = 0.001$ ), less active and about the same ( $p = 0.001$ ), less active and unsure ( $p = 0.01$ ), unsure and more active ( $p = 0.003$ ), and between unsure and about the same ( $p = 0.001$ ). Lowest symptoms of depression were found in males and females who were about the same levels of physical activity while the highest symptoms were found in males and females who were unsure.

Significant differences in symptoms of depression were found between those who were less active and about the same ( $p = 0.001$ ), unsure and more active ( $p = 0.03$ ), unsure and about the same ( $p = 0.001$ ), and between more active and about the same ( $p = 0.003$ ). Lowest symptoms of anxiety were found in males who were more active and females who were about the same while the highest symptoms of anxiety were found in males who were less active and females who were unsure. Significant differences in symptoms of anxiety were found between those who were less active and about the same ( $p = 0.01$ ), and between those who were unsure and about the same ( $p = 0.01$ ).

### **Associations between mental health outcomes**

A significant moderate inverse association ( $p = 0.001$ ,  $r = -0.54$ ) was found between wellbeing and symptoms of anxiety. A significant strong inverse association ( $p = 0.002$ ,  $r = -0.69$ ) was found between wellbeing and symptoms of depression. A significant strong positive association as found between symptoms of depression and symptoms of anxiety ( $p = 0.005$ ,  $r = 0.7$ ).

## **7.5 Discussion**

The aim of this study was to explore the impact of Covid-19 restrictions on physical activity levels in adolescents and the impact on mental health outcomes by comparing pre- (October 2019) and post-lockdown (November 2020), in the Republic of Ireland. Overall, there were no changes in frequency of physical activity although there were changes among sub-groups as adolescents in 1<sup>st</sup> and 2<sup>nd</sup> year reported reductions in physical activity. Symptoms of depression increased, most notably in females, although there were no notable changes in symptoms of anxiety or wellbeing. The largest reduction in sports participation was among adolescents participating in 3 or more. Similar to previous investigations of physical activity in Irish adolescents (Murphy et al., 2020; Woods et al., 2019), only a small minority (8%) met physical activity recommendations (11.6% of males, 5.2% of females). Meeting physical activity guidelines on a greater number of days was associated with higher levels of wellbeing and lower symptoms of anxiety and depression in both males and females. As has been previously shown in adult populations (Faulkner et al., 2021), this study demonstrated that individuals with negative perceived changes in physical activity during Covid-19 restrictions reported lower wellbeing and higher symptoms of depression and anxiety with those unsure of activity levels reporting the most negative outcomes of all sub groups. 44% of males reported being less active during restrictions compared to 40% of females. This may be due to greater male than female involvement (76% v 58%) in organised team sport which was more

severely impacted by restrictions than many other individual sport or fitness activities. Approximately one third of males (33.4%) reported being more active during restrictions compared to a higher percentage of females (38.6%). Less than one fifth of adolescents overall reported the same levels of physical activity with more males (19.9%) remaining the same than females (17.7%).

Throughout the entire sample there was a 7% increase of Irish adolescents reporting symptoms of depression that are outside the normal range. Within this there was no change in those who identified as neither male nor female (89%) while there was a 3% increase in males and a 9% increase in females with a worrying 11% reporting either severe or extreme symptoms. Highest symptoms of depression were once again reported by females in 3<sup>rd</sup> and 6<sup>th</sup> year suggesting state examinations, and the uncertainty surrounding them, may play a role as it was unclear if Junior and Leaving Certificate examinations would proceed at the time of completing the questionnaire. The highest symptoms of depression reported by males were in 6<sup>th</sup> year also and 2<sup>nd</sup> year which may be caused by the interruption to their 1<sup>st</sup> year in post primary school and the lack of extra-curricular and sporting activities on offer. Lowest symptoms of depression were reported by both 1<sup>st</sup> year males and females. Increased symptoms of depression are consistent with longitudinal findings from the wider population during Covid-19 restrictions (Hyland et al., 2021). Adolescents and younger adults were identified as the most likely to report higher symptoms of depression during restrictions (Hyland et al., 2021; Brown et al., 2021) as higher levels of loneliness (McHugh et al., 2020) and lower levels of resilience (Shapero et al., 2019) have been identified as key risk factors (Hyland et al., 2021). Notably, individuals living in urban settings were less likely to develop increased symptoms of depression in a longitudinal study (Hyland et al., 2021) which suggests increased opportunities for social interaction may protect against symptoms of depression and could be one of the main factors also present through engagement in team sport.

Changes in symptoms of anxiety were less prevalent with only a 1% increase in those reporting symptoms outside the normal range (2% increase in males, 1% increase in females). This is consistent with a longitudinal assessment of mental health outcomes in the Republic of Ireland where slight increases in symptoms of anxiety were detected at the outset of the pandemic but these had returned to pre-lockdown levels after 6 weeks (Hyland et al., 2021). A closer look at symptoms of anxiety by year group revealed a reduction in symptoms among all male groups bar 6<sup>th</sup> years who increased as did 1<sup>st</sup> and 5<sup>th</sup> year females. Well established



risk factors for elevated symptoms of anxiety include being female (Hyland et al., 2016), as is consistent with current findings along with lower levels of Conscientiousness and higher levels of Openness (Costache et al., 2020) and higher levels of loneliness (Beckhuis et al., 2016) suggest that less opportunities for participation in extra-curricular sporting activities, are likely to play a part. Extra-curricular activities, such as engagement in sport, provide adolescents with an opportunity for increased physical activity and social interactions (Panza et al., 2020), both of which have been independently established as protective factors against symptoms of anxiety and depression (Eime et al., 2013; Fraser-Thomas, Cote & Deakin, 2005; Paluska & Schwenk, 2000).

There was no meaningful change in terms of wellbeing across the entire sample although there were reductions in mean wellbeing score among both males and females in 2<sup>nd</sup> year and 6<sup>th</sup> year. Once again, this is difficult to explain although the largest reduction in adolescents meeting physical activity guidelines was in 2<sup>nd</sup> years (-3%) when compared to the previous edition of this questionnaire (Murphy et al., 2020) while the largest increase in adolescents in the Least Active sub-group compared to the previous edition was in 6<sup>th</sup> years (+4%). An increase in participants in the Least Active group suggests greater sedentary time which has been repeatedly associated with deteriorated wellbeing in large-scale epidemiological studies across both adolescent (Burkhardt & Brennan, 2012; Biddle et al., 2019) and adult populations (Zhai, Zhang & Zhang, 2015).

The overall number of adolescents meeting physical activity guidelines remained the same as the previous edition (Murphy et al., 2020) although there were a number of differences between sub-groups. The previous edition found 1<sup>st</sup> year males and females had the highest frequency of physical activity with clear declines throughout school thereafter. The current findings show that 7% less males and 3% less females met the physical activity guidelines during Covid-19 restrictions with other reductions in 3<sup>rd</sup> year males (-2.5%) and 2<sup>nd</sup> year females (-4.2%). The largest increases were found in 3<sup>rd</sup> year females (+4%) and 4<sup>th</sup> year males (+3%). Less than 1% of females in 6<sup>th</sup> year met the physical activity guidelines.

The key sub-group differences were observed in the Least Active and Most Active groups. 1<sup>st</sup>, 2<sup>nd</sup> and 6<sup>th</sup> year males increased by 6%, 3% and 3% respectively in the Least Active group while only 6<sup>th</sup> year females had increases in the Least Active group (5.5%). Again 1<sup>st</sup> and 2<sup>nd</sup> year males had decreases in the Most Active Group of 10% and 1% respectively along with 6<sup>th</sup> year females who had a 9% decrease. Physical activity levels appear to have remained the same or increased through the middle section of post-primary school (3<sup>rd</sup>, 4<sup>th</sup> & 5<sup>th</sup> year) as they

decreased in both males and females at the beginning and end. Increases in the Least Active group are consistent with other investigations of physical activity levels in both Ireland (McGrath et al., 2020; O’Kane et al., 2021) and internationally (Lesser & Nienhuis, 2020; Faulkner et al., 2021) as less active individuals were likely to become less active during Covid-19 restrictions. One qualitative examination of physical activity during restrictions in Ireland found that adolescents reported a decline in motivation for exercise (O’Kane et al., 2021) and that changed circumstances interrupted many automatic behaviour patterns through ‘habit discontinuity’ leading to formation of new habits or dropping previous habits and health behaviours (Wood & Neal, 2016).

The largest decrease in terms of physical activity sub-group was observed in both males and females who participate in 3 or more sports as both decreased by 8%. This is likely due to a reduction in access to activities as many community and school sports were cancelled due to restrictions. Males who remained involved in 3 or more sports had an increase in wellbeing and decrease in symptoms of anxiety while those who did not engage in any sport had a decrease in wellbeing and increase in symptoms of depression. Females who played 1, 2 and 3 or more sports had increases in symptoms of depression while those who played 3 or more had increases in symptoms of anxiety. Engagement in a number of sports appears to support higher levels of wellbeing and protect against symptoms of depression in males. This is consistent with previous cross-sectional examinations (McMahon et al., 2017; Murphy et al., 2020) and meta-analytic evidence (Panza et al., 2020) and has been attributed to increased opportunities for physical activity and social interaction that, independently, are protective factors (Eime, Young, Harvey, Charity & Payne, 2013;).

Involvement in sport has also been linked to other health behaviours that influence mental disorders, such as diet, sleep and lifestyle choices, or may develop self-regulation skills for managing daily stressors (Fraser-Thomas, Cote & Deakin, 2005, Paluska & Schwenk, 2000).

Engagement in team sport remained exactly the same in males although there was a 2% reduction for females. Males engaged in team sport had an increase in wellbeing and decrease in symptoms of anxiety. This aligns with previous research where it is suggested that team sport has a protective effect against symptoms of depression and anxiety (Murphy et al., 2020; McMahon et al., 2017; Panza et al., 2020) although this relationship may differ between genders as females engaged in team sport had decreases in wellbeing and increases in symptoms of depression. The difficulty of access to sporting opportunities may be a factor.

Our findings appear consistent with other research completed on physical activity during Covid-19 restrictions where overall levels of physical activity did not change, although many adolescents tried new forms of physical activity and patterns of activity changed (O’Kane et al., 2021). Available evidence suggests children and adolescents are less vulnerable to Covid-19 than adults (Lee, Hu, Chen, Huang & Hsueh, 2020) although some research suggests that adolescents have experienced higher rates of mental ill-health during restrictions (Riiser, Helseth, Haraldstad, Torbjornsen & Richardsen, 2020). Covid-19 restrictions and social distancing can increase social isolation leading to adolescents feeling frustrated, nervous, disconnected and bored (Imran, Zeshan & Pervaiz, 2020). Engagement in physical activity and sport provide adolescents with an opportunity to form social relationships which can increase motivation and enthusiasm (Davis & Clifton, 1995). Loneliness has been highlighted as a key contributor to decreased wellbeing during restrictions in other populations and is also associated with poorer perceived health, lower life satisfaction and lower rates of physical activity (McGrath et al., 2020).

Changes in physical activity levels appear to be somewhat polarised. An online survey investigating how restrictions impacted physical activity and wellbeing of Canadians found that inactive individuals were more likely to become less active whereas individuals who identified as active were more likely to increase activity levels (Lesser & Nienhuis, 2020), most likely due to increased availability of time or motivation. Our findings highlight the importance of an awareness of activity levels as adolescents who were unsure of perceived changes in activity levels had the lowest wellbeing and highest symptoms of depression and anxiety. One specific component of wellbeing that has received increased attention recently is ‘sense of purpose in life’ (Yemiscigil & Vlaev, 2021; Kennedy, 2021). A bi-directional relationship has been found between sense of purpose and physical activity whereby an increased sense of purpose was associated with higher levels of physical activity while at the same time, increased physical activity was found to increase sense of purpose in life (Yemiscigil & Vlaev, 2021). As both males and females who reported increasing or maintaining levels of physical activity during Covid-19 restrictions had the highest wellbeing it is very possible that previous levels of physical activity developed a sense of purpose in life and thereby led to higher wellbeing and physical activity during restrictions.

Limitations of this study include the use of a self-report questionnaires to measure frequency of physical activity, wellbeing, and symptoms of depression and anxiety which may be prone to recall bias and varying interpretations (Hallal et al., 2012) however, it is worth noting that constructs of wellbeing and perceived health status are subjective in their own right and the

evaluation is pragmatic in its approach. The majority of schools who participated were of non-DEIS status meaning we lacked representation from schools of lower socio-economic status which may skew the results as it is not a true representative sample of the post-primary school population. Our study did not look at the specific details of what physical activity and sport opportunities were available on a school-by-school or sport-by-sport basis as there were large differences in what was offered to adolescents. This may also have impacted how active adolescents were and the context within which activity was conducted.

## **7.6 Conclusion**

This study adds to the knowledge base on the impact of restrictive measures implemented to reduce the transmission of Covid-19 on physical activity, wellbeing and symptoms of depression and anxiety in Irish adolescents. There were no changes in physical activity levels overall, although there were many changes within sub-groups and the patterns of physical activity. There was a clear increase in symptoms of depression, with females impacted more than males. Access to physical activity opportunities, especially sport, uncertainty about state examinations and decreased opportunities for social interaction are the most likely contributors to this increase in symptoms. Previously active individuals were more likely to increase activity and therefore report higher levels of mental health while those who were less active were more likely to decrease activity and report lower mental health.

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## **Chapter 8:**

### **Conclusion and Future Directions**

## 8.1 Overview of Thesis

Publications citing and reporting the psychological benefits of physical activity date back over many centuries (Biddle, Ciacconi, Thomas & Vergeer, 2019). Many of these claims were often quite extravagant and without the benefit of supporting scientific evidence (Biddle & Vergeer, 2019). Physical activity guidelines often claim that physical activity is inherently ‘good’ for young people without referencing the various life-domains or contexts most strongly associated with positive mental health. Guidelines for physical activity were originally published to protect against lifestyle-related diseases such as obesity, type 2 diabetes, and hypertension, among others. The guidelines have since evolved to include other conditions such as depression and anxiety, although the current evidence for development of mental health through physical activity is not reflected in the most up to date guidelines (Teychenne et al., 2020). The role of contextual factors such as reasons or motivation for being active, who exercise is conducted with, and where exercise is performed, have all been shown to contribute to the mental health benefits derived from physical activity. Based on the current evidence, and with a view to informing future physical activity guidelines for mental health, the primary aims of this thesis were to:

- 1      Examine associations between frequency of physical activity and engagement in sport with wellbeing, and symptoms of anxiety and depression in a sample of Irish adolescents;
- 2      Explore which contexts of physical activity have the strongest associations with mental health and wellbeing in Irish adolescents;

Secondary objectives were to:

1.      Examine the impact of a self-determination theory-informed school-based lunchtime games intervention on wellbeing, and symptoms of anxiety and depression in Irish adolescents;
2.      Explore the impact of Covid-19 restrictions on physical activity levels in Irish adolescents;
3.      Explore the impact of Covid-19 restrictions on wellbeing, and symptoms of anxiety and depression in Irish adolescents;
4.      Identify aspects of leisure time physical activity that best support positive mental health and wellbeing in Irish adolescents;

5. Explore potential differences in physical activity experiences between males and females to identify if they impact differently on mental health and wellbeing.
6. Identify the aspects of team sport that may offer a “protective effect” against symptoms of mental ill-health;

Study 1 sought to examine the current levels of physical activity and sports participation, and determine associations with symptoms of anxiety and depression, and wellbeing. A small minority of participants (8%) reported meeting the physical activity recommendations with females less likely to report meeting the guidelines than males. 40% of adolescents reported elevated symptoms of anxiety and/or depression, with a higher proportion of females over males reporting elevated symptoms. Higher levels of wellbeing, and lower symptoms of depression and anxiety were associated with higher frequencies of physical activity. The findings of this study suggest meaningful differences in symptoms of depression and anxiety from higher frequencies of physical activity for both males and females, particularly as they move from the Least Active to Somewhat Active groups. The greatest differences in terms of all mental health outcomes examined, were found between adolescents who played either 0, 1, 2 or 3+ sports as adolescents engaging in 3 or more reported the highest levels of wellbeing, and lowest symptoms of anxiety and depression. Participating in a team sport was also found to confer additional benefits to mental health as is consistent with previous meta-analytic evidence (Panza et al., 2020).

Previous investigations involving adult populations found associations between greater mental health outcomes and higher frequencies of physical activity, with particularly low and particularly high thresholds of activity associated with lower levels of mental health (Kim et al., 2012). It must be noted that wellbeing continued to increase with a higher frequency of activity in both males and females. This suggests there may be an optimal range of physical activity frequency for mental health benefits, although the various factors that contribute to higher frequencies of physical activity, specifically motivation, warrant further investigation.

The findings of this study are largely in line with previous research suggesting a positive relationship between higher frequencies of physical activity with positive aspects of mental health. The specific factors that contribute to higher levels of mental health require further investigation, although certain aspects of engagement in multiple, and team, sports provide guidance for further exploration as can be seen in studies 2, 3 and 5.

Study 2 sought to build on findings from Study 1 and further investigate factors suggested as contributing to increased mental health by Lubans et al. (2016). Overall, this intervention had significant positive impacts on mental health and wellbeing in a sample of adolescent females. Participants who attended lunchtime games two times per week had significant reductions in symptoms of anxiety and depression, while those who attended three times did not. This suggests there is a ceiling effect or 'sweet spot' in terms of the frequency of activity that is required to protect against anxiety and depression. Study 3 was informed by self-determination theory, therefore incorporating basic psychological needs: autonomy, competence and relatedness (Deci & Ryan, 2004), thus impacting the context through which physical activity was experienced by participants. The similarity in effect size between improvements in wellbeing and self-efficacy highlight the potential psychosocial processes that underlie the mechanisms of physical activity and wellbeing promotion. Studies 1 and 2 have quantitatively identified potential contributors to increased mental health and wellbeing through physical activity such as opportunities for social interaction in team sport increases in self-efficacy leading to improved wellbeing.

Studies 3 and 4 sought to build on quantitative findings from Studies 1 and 2 by elaborating further on aspects of physical activity and sport that are positively associated with mental health and wellbeing in adolescents. Participants in Study 4 noted the importance of, and enjoyment derived from, improvements in fitness, skill or all-round ability. Each participant was asked what was the most enjoyable aspect of engaging in physical activity and sport with improvements over time the most common. This supports findings from study 2 where it was suggested that increased self-efficacy may be an important contributor to enhanced global self-esteem, and therefore, wellbeing.

The aim of Study 5 was to explore the impact of Covid-19 restrictions on physical activity levels in adolescents, and the impact on mental health and wellbeing by comparing results to those gathered in Study 1 (before Covid-19 restrictions). Overall, there were no changes in frequency of physical activity although there were changes among sub-groups as adolescents in 1<sup>st</sup> and 2<sup>nd</sup> year reported lower levels of physical activity than in Study 1. Symptoms of depression were higher, most notably in females, although there were only minimal changes in wellbeing or symptoms of anxiety. Meeting physical activity guidelines on a greater number of days was, once again, associated with higher levels of wellbeing and lower symptoms of anxiety and depression in both males and females. As was previously highlighted in adult populations (Faulkner et al., 2021), Study 5 demonstrated that individuals with negative perceived changes in physical activity during Covid-19 restrictions reported lower wellbeing, and higher

symptoms of anxiety and depression with those who were unsure of activity levels reporting the most negative outcomes of all sub-groups. 44% of males reported being less active during restrictions compared to 40% of females.

Study 5 found larger percentage (7%) of Irish adolescents reported elevated symptoms of depression with a greater proportion of females reporting elevated symptoms. An increase in symptoms of depression are consistent with longitudinal findings from the wider population during Covid-19 restrictions (Hyland et al., 2021). Findings from Study 5 were consistent with other research completed on physical activity during Covid-19 restrictions where overall levels of physical activity did not change, although many adolescents tried new forms of physical activity and patterns of activity changed (O’Kane et al., 2021). The available evidence suggests children and adolescents are less vulnerable to Covid-19 than adults (Lee, Hu, Chen, Huang & Hsueh, 2020) although some research suggests that adolescents have experienced higher rates of mental ill-health during restrictions (Riiser, Helseth, Haraldstad, Torbjørnsen & Richardsen, 2020). Covid-19 restrictions and social distancing increased social isolation leading to adolescents feeling frustrated, nervous, disconnected and bored (Imran, Zeshan & Pervaiz, 2020). Engagement in physical activity and sport provide adolescents with an opportunity to form social relationships which can increase motivation and enthusiasm (Davis & Clifton, 1995). Findings of Study 5 highlight the importance of an awareness of activity levels as adolescents who were unsure of perceived changes in activity levels had the lowest wellbeing and highest symptoms of anxiety and depression.

In summary, the purpose of this thesis was to identify contexts of physical activity that contribute to the support and development of mental health and wellbeing in adolescents. Quantitative findings highlighted higher frequencies of activity, engagement in a number of sports and team sport as contributing to higher levels of wellbeing and lower symptoms of anxiety and depression. An intervention in Study 2 suggested that increases in self-efficacy through physical activity contribute to improvements in wellbeing. Further qualitative exploration suggested that autonomy, environmental mastery, positive relationships with others, purpose in life, realisation of potential and self-acceptance were key contributors to and indicators of higher levels of wellbeing. Future physical activity guidelines should acknowledge these findings and include recommendations on the contexts of physical activity that best support mental health and wellbeing. These include the promotion of physical activity experiences where adolescents are encouraged, and provided with opportunities, to engage in enjoyable activities with people whom they experience a sense of belonging, where there is an opportunity to experience mastery and improvement, and include an element of

autonomy or choice. Alternatively, physical activity experiences should reduce the focus on outcome-oriented goals such as winning and losing, comparisons to peers, focusing on body image or appearance, and forced involvement in physical activity or sport. Promoting autonomously motivated physical activity which satisfies adolescent's psychological needs is likely to be the most effective method of enhancing and supporting wellbeing through physical activity.



## 8.2 Research Strengths

Strengths of this thesis include the large sample of adolescents ( $n = 5,661$ ) who participated in study 1. To date this is the largest number of Irish adolescents that have participated in a study exploring associations between physical activity and mental health and wellbeing. A large sample size helps to paint a clearer picture of current trends and associations that may represent an entire population. Smaller, regional or biased samples may provide data that is representative of a specific sub-group of adolescents rather than being representative of Irish adolescents as a whole. While it was unrealistic to sample every adolescent, or even every school, in Ireland the researcher did ensure at least one school from every county was included. A range of adolescents from different types of school such as DEIS, non-DEIS, catholic voluntary, vocational, community, other religious orders, single sex, and mixed were included with the aim of providing data that was representative of Irish adolescents. The sample size is also similar to previous cross-sectional investigations studies of physical activity such as the CSPPA ( $n = 3,594$ ) (Woods et al., 2019).

The quantitative studies used validated and reliable tools to assess frequency of physical activity, participation in sports, wellbeing, self-efficacy, and symptoms of depression and anxiety in adolescents. The use of validated and reliable tools are important for two reasons. First, it provides measures of specific outcomes that have previously been developed through specific research. Validation of tools generally includes consultation with experts in the field (Stewart-Brown et al., 2011) and sampling across a variety of demographics to ensure it is valid and reliable in various sub-groups (Bose-Deakins & Floyd, 2004). Ensuring a tool measures what it purports to measure, i.e., validity, strengthens future recommendations and guidelines that are developed based on research utilising validated tools such as recommendations for the development and support of wellbeing drawing upon research using the Warwick Edinburgh Mental Wellbeing Scale. Second, as a body of research grows in a field, the use of validated and reliable tools aids in the comparison of groups to established or previously agreed upon normative data. For example, the current study could compare data to a previous investigation among European adolescents as the same scale was used for assessing frequency of physical activity (McMahon et al., 2017).

The majority of previous literature on physical activity and mental health has focused on association-based research. Interventions have focused largely on primary outcomes which do not fully identify underlying mechanisms that contribute to the development of mental health and wellbeing through physical activity. Study 2 experimentally demonstrated that a

physical activity intervention had positive effects on mental health and wellbeing of adolescents. The inclusion of self-efficacy as a secondary measure also suggested that increases in self-efficacy may be a contributor to enhanced wellbeing. Self-efficacy was included as a secondary measure based on a conceptual model for the development of wellbeing through physical activity (Lubans et al., 2016).

Study 4 used novel data collection techniques, combining photo and artefact elicitation, to gather insights on the relationship between physical activity and mental health from a large sample of Irish adolescents. Including a variety of 'voices' such as males, females, active and inactive adolescents, ensured a comprehensive range of opinions were included in the analysis and interpretation of adolescents' viewpoints.

Study 5 captured novel, and otherwise unknown, data in relation to physical activity and mental health and wellbeing during a global pandemic. The impact of events such as Covid-19, and related restrictions, are impossible to estimate, therefore our findings may inform the implementation of, and supports around, future restrictions.

### 8.3 Research Limitations

Limitations in Studies 1, 2 and 5 include the use of self-report questionnaires to measure frequency of physical activity. In general, self-report measures of physical activity demonstrate greater variability of methodological effectiveness than device-measured physical activity (Juarbe, Gutierrez, Gilliss & Lee, 2006). Self-report measures may also be susceptible to overreporting, potentially resulting from misclassification of sedentary or light activity as moderate, or overestimation of activity duration (Juarbe et al., 2006; Kanamori et al., 2018). However, there is no evidence to suggest reporting error should differ according to mental health status. Additionally, differences between self-report and device measured physical activity may be partially attributable to conceptual differences (Kaseva et al., 2016). For example accelerometer-based monitors quantify acceleration at a fixed point of the body (i.e., hip, wrist, etc.) over short periods determined by the device settings, whereas self-report instruments reported time periods of longer duration engaged in specific behaviours, many of which are continuous in nature (Kaseva et al., 2016). Therefore, on occasion it may be preferable to use self-report instruments; for example, assessing compliance with physical activity guidelines, which were developed based on epidemiological relationships between self-reported physical activity and health outcomes.

Studies 1 and 5 were cross-sectional in nature and therefore cannot provide causal information because these studies lack temporal sequence. It has been previously demonstrated that low physical activity can precede the onset of symptoms of anxiety and depression, and that symptoms can precede low physical activity (Brown et al., 2012). Cross-sectional analyses are useful in identifying trends and associations, especially in population groups although should be interpreted with caution due to the inability to determine cause and effect. Association-based findings from cross-sectional studies should inform future research that seeks to expand upon these associations and determine both cause-and-effect, but also the underlying mechanisms responsible. The identification of a significant association between frequency of physical activity and engagement in sport with higher levels of wellbeing highlights the need for future qualitative and quantitative research to firstly identify if engagement in activity leads to higher wellbeing or if adolescents with higher wellbeing are more inclined to engage with physical activity in the longer term. Identifying possible trends and associations is important in the early stages of a growing body of research but it should be acknowledged that future investigations should build upon these initial findings to establish causality.

Participants in Studies 2 and 3 were females, aged 12 to 14, from one school in the south east of Ireland. Caution must be taken when extrapolating results from these studies as they may not be truly representative of adolescents, or of younger females. This limits the generalisation of study results to other adolescents, children, and young people in other geographical locations, nationally or internationally. The results from these studies provided useful preliminary findings but are specific to that specific demographic. It is important that these limitations are acknowledged in future research to limit the lack of generalisability and to ensure a broader sample of adolescents are included.

Participants in Study 2 voluntarily assigned themselves to groups, or to act as controls, therefore, motivation to participate must be considered as a potential confounding variable, not least because it is an important correlate and potential determinant of engaging in and sustaining physical activity (Ng et al., 2012).

Participants in study 3 self-identified as active and engaged in at least 1 team sport each, therefore it is acknowledged that the findings are specific to the participants in this study and cannot necessarily be extrapolated to the population as a whole. It is probable that participants already had positive bias towards higher levels of physical activity and engagement in sport. A greater variety of participants would most likely have led to greater variety in responses and therefore, a need to conduct additional focus group interviews with a larger number of participants. This, once again, limits the generalisability of the findings but was very important when informing the design of study 4, most notably the inclusion of adolescents who identified as largely inactive and for the inclusion of male participants. The similarity of participants in study 3 also led to data saturation and repetition of responses quite early in the data collection phase.

## 8.4 Future Directions

The non-randomised trial in Study 2 demonstrated that aspects of mental health and wellbeing could be improved through a games-based physical activity intervention. Secondary outcomes, such as health-related components of physical fitness and self-efficacy were assessed to identify potential underlying contributors to increases in mental health and wellbeing through physical activity. Future investigation should seek to employ a cluster-randomised controlled experimental design that includes a larger number of both male and female participants from a variety of schools. The inclusion of more adolescents who self-identify as inactive or 'less-active' should also be prioritised as participants in this thesis were already quite active and the positive results that were reported may not be representative of the adolescent population as a whole. An example of this would be similar to the cluster-randomised controlled trial investigating physical activity and fundamental movement skills in Irish adolescents, Y-PATH (McGrane, Belton, Fairclough, Powell & Issartel., 2018). Randomisation was included at the school level while focus group interviews were conducted at the outset to ensure activities provided opportunities for a number of participants, particularly those who already had lower levels of activity. Identifying adolescents with lower levels of activity in the early stages of planning intervention activities is important in developing the confidence and motivation required to both begin and sustain involvement in the activities. Similar to study 2, this cluster-randomised trial would gather data on initial levels of wellbeing, self-efficacy, symptoms of anxiety and depression, frequency of physical activity and engagement in sport. It would also expand upon the findings of study 2 to determine what proportion of activity comes from sport, recreational activity and how much each particular activity contributes to total PA if participating in a number of activities. Data will also be gathered on total sedentary behaviour and where most sedentary behaviour is likely to accumulate such as studying, gaming, time on phones, etc., This additional data would be included as covariates in the statistical analysis investigating the impact of the intervention.

Increases in self-efficacy were identified as a potential contributor to improved wellbeing through a physical activity based intervention. Future investigations should include methods of increasing self-efficacy through physical activity as well as through more sedentary methods to ascertain if the physical activity component is necessary or if it provides extra benefits. A potential example of this would include recruitment of adolescents to three distinct groups in terms of activity. One group would engage in a physical activity programme, similar to the one outlined in study 2. A second group would engage in sedentary activities that allow room for progression or achievement such as learning a musical instrument or chess. A third group

would act as the control. Both groups 1 and 2 would have opportunities to improve self-efficacy through their activities such as learning new skills, increasing a component of fitness, learning new songs or skills, etc., Pre- and post- measures of self-efficacy and wellbeing would examine if increases in self-efficacy alone have the same impact on wellbeing as increases in self-efficacy through physical activity.

Adolescents involved in multiple and team sports reported higher levels of mental health and wellbeing, although it is currently unclear what direction cause and effect occurs. Longitudinal research is required to determine if adolescents with greater mental health outcomes are more likely to begin, and remain with sports, or if sports develop and support greater mental health outcomes, and the various psychological skills such as resilience, that aid the development of mental health and wellbeing. Potential research in this area could include the long term assessment of wellbeing among children and adolescents as they progress through school, such as every 6 to 12 months, while also capturing data on their engagement in physical activity and sport. This would provide data on trends in both domains and help to identify the direction that causality may occur. It may also help to pinpoint the age or stage of development that adolescents transition away from physical activity or from one mode of physical activity to another, such as from team sport to an individual fitness activity.

## **8.5 Concluding Remarks**

Not all physical activity experiences guarantee the development and support of mental health and wellbeing. Regular engagement in physical activity and sport is associated with greater mental health outcomes, although results have often been inconsistent. Benefits to mental health appear to be greatest when individuals perceive the physical activity experience as an opportunity to display autonomy, strive for environmental mastery, develop positive relationship with others, realise their own potential, and self-actualise. Future physical activity guidelines should recognise the importance of these factors when stating the mental health benefits of physical activity instead of relying solely on biological based guidelines for physical health. The aforementioned factors of autonomy, environmental mastery, positive relationships and realisation of potential should also be prominent in the design of all physical activity experiences in the future. Mental health and wellbeing has never been more topical, particularly in young people, yet evidence-based strategies to support and develop mental health outcomes in adolescents is slightly lacking. The contexts of physical activity outlined in this thesis, together with the various factors that contribute to these contexts, can serve as important supports to the development of mental health and wellbeing in young people. These findings should be highlighted to all stakeholders including national governing bodies, sports coaches, physical education teachers, parents and young athletes themselves so as to ensure physical activity experiences are as positive, enjoyable and meaningful as possible for those involved.

## 8.6 References

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## **Appendix A**

### **Focus Group Question Guide**

## Question Guide – With Prompts

**What object did you bring that represents physical activity?**

**How does it represent activity for you?**

**Do you think it was the best object to represent the activities that you're most interested in?**

- Why?
- Why not?
- What else might represent physical activity for you?
- Do different objects represent different activities?
- Do you think there is an object to represent being active overall?

Notes

**What photo did you bring to represent wellbeing?**

**How does this photo best represent wellbeing for you?**

- Is “....” important for wellbeing?
- Why, Why not?
- Is anything else not in the photo important for wellbeing?
- Does this represent how you feel when you're active? Why do you think that is?
- Do you think you could describe what wellbeing is?

Notes

**Is there a connection between the object and the photo?**

- What connects them?

**If so, does that mean physical activity and wellbeing are connected?**

- How are they connected?
- Why do you think this is?
- Can you give me an example of how they're connected?

**If being active is connected to or important for wellbeing, why do you think that is? (Or why not?)**

Notes

**Are some types of physical activity more beneficial (or harmful) to wellbeing than others?**

- Could you think of an example where it has been beneficial for you?
- Could you think of an example where it might have had a negative impact for you?
- Why do you think some types are more beneficial than others?

**In our previous work, we found that playing a variety of sports (2, 3 or more) are associated with higher levels of wellbeing.**

- Why do you think that might be?
- Could playing less be better at some times?
- Would adding an extra sport or activity to your week have a positive or negative impact on wellbeing?
- Why do you think so?

Notes


**We also found that playing team sport (3 or more people on a team at the same time) was associated with higher wellbeing, why do you think that might be?**

- If you don't play team sport, do you think you can still get the same social benefits from exercising or just hanging out with friends?
- Do you feel closer to friends that you've played sport with for a while? Why or why not?
- If you don't play team sport, did you before and choose not to anymore? Why did you decide not to continue?

**What aspects of physical activity do you enjoy the most?**

- Friends
- Being outdoors
- Challenge
- Getting better
- Other

**Why do you enjoy those aspects?**

- Do any of these connect to the photo or object that you brought?

Notes

**Is enjoyment important when being active?**

- What does enjoyment look like when you're active – laughing and smiling or something else?

**Are there any aspects of physical activity that you do not enjoy?**



- Why do you not enjoy those aspects?
- If you could change anything about the times you're active to make it more enjoyable, what would you choose to change?

**Is there anything else related to physical activity and wellbeing that you'd like to say more about?**

[illegible]

## **Appendix B** Questionnaire in Order Including Measurement Tools &

Scales

### **Questionnaire In Order Including Measurement Tools & Scales**

Please provide some basic information about yourself

Gender \*

- ☐ Male
- ☐ Female
- ☐ Other...

Age \*

- 1. 11
- 2. 12
- 3. 13
- 4. 14
- 5. 15
- 6. 16
- 7. 17
- 8. 18
- 9. 19
- 10. 20

---

What year are you currently in? \*

1. 1 - First Year
2. 2 - Second Year
3. 3 - Third Year
4. 4 - Transition Year
5. 5 - Fifth Year (Leaving Cert 1)
6. 6 - Sixth Year (Leaving Cert 2)

---

What is your nationality? \*

1. Irish
2. Other - EU
3. Other - Non EU

---

If other, state nationality here.

Short answer text

---

## Section 2 – Frequency of Physical Activity

### CSPPA/Take Part – Adapted to 14 day scale

Intensity	RPE	Description
Low	4 – 5	Heart is beating faster than usual. You can carry on a conversation easily and continue exercising for a long time without being overly fatigued.
Moderate	6 – 7	Heart is beating faster than usual and you are breaking a sweat. Carrying on a conversation is difficult, but not impossible.
Vigorous	8 – 9	Heart is beating very fast and you are breathing hard. Carrying on a conversation is almost impossible, and you are likely sweating profusely.

How many days in the past 14 were you physically active for a total of at least 60 minutes or more. You should only include moderate or vigorous activity. 60 minutes can be added up throughout the day. \*

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10
11. 11
12. 12
13. 13
14. 14

In the past 6 months have you regularly (at least once a week) played one or more sports? \*

☐ Yes

☐ No

Name the sport you play the most (Leave blank if you don't play any).

Short answer text

Name the second sport you play the most (Leave blank if you only play one or none).

Short answer text

Name the third sport you play the most (Leave blank if you only play two or none).

Short answer text

## Warwick Edinburgh Mental Wellbeing Scale (WEMWBS)

Below are some statements about feelings and thoughts.

Please tick the box that best describes your experience of each over the last 2 weeks.

<b>Statements</b>	<b>None of the time</b>	<b>Rarely</b>	<b>Some of the time</b>	<b>Often</b>	<b>All of the time</b>
I've been feeling optimistic about the future	1	2	3	4	5
I've been feeling useful	1	2	3	4	5
I've been feeling relaxed	1	2	3	4	5
I've been feeling interested in other people	1	2	3	4	5
I've had energy to spare	1	2	3	4	5
I've been dealing with problems well	1	2	3	4	5
I've been thinking clearly	1	2	3	4	5
I've been feeling good about myself	1	2	3	4	5
I've been feeling close to other people	1	2	3	4	5
I've been feeling confident	1	2	3	4	5
I've been able to make up my own mind about things	1	2	3	4	5
I've been feeling loved	1	2	3	4	5
I've been interested in new things	1	2	3	4	5
I've been feeling cheerful	1	2	3	4	5

Warwick-Edinburgh Mental Well-being Scale (WEMWBS)

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## Beck Anxiety Inventory

Below is a list of common symptoms of anxiety. Please carefully read each item in the list.

Indicate how much you have been bothered by that symptom during the past month, including today, by circling the number in the corresponding space in the column next to each symptom.

Numbness or tingling	0	1	2	3
Feeling hot	0	1	2	3
Wobbliness in legs	0	1	2	3
Unable to relax	0	1	2	3
Fear of worst happening	0	1	2	3
Dizzy or lightheaded	0	1	2	3
Heart pounding / racing	0	1	2	3
Unsteady	0	1	2	3
Terrified or afraid	0	1	2	3
Nervous	0	1	2	3
Feeling of choking	0	1	2	3
Hands trembling	0	1	2	3
Shaky / unsteady	0	1	2	3
Fear of losing control	0	1	2	3
Difficulty in breathing	0	1	2	3
Fear of dying	0	1	2	3
Scared	0	1	2	3
Indigestion	0	1	2	3
Faint / lightheaded	0	1	2	3
Face flushed	0	1	2	3
Hot / cold sweats	0	1	2	3



## Beck Anxiety Inventory - Scoring

**About:** This scale is a self-report measure of anxiety.

**Items:** 21

**Scoring:**

All questions	0	1	2	3

The total score is calculated by finding the sum of the 21 items.

Score of 0-21 = low anxiety

Score of 22-35 = moderate anxiety

Score of 36 and above = potentially concerning levels of anxiety

## General Self-Efficacy Scale

1	I can always manage to solve difficult problems if I try hard enough.				
2	If someone opposes me, I can find the means and ways to get what I want.				
3	It is easy for me to stick to my aims and accomplish my goals.				
4	I am confident that I could deal efficiently with unexpected events.				
5	Thanks to my resourcefulness, I know how to handle unforeseen situations.				
6	I can solve most problems if I invest the necessary effort.				
7	I can remain calm when facing difficulties because I can rely on my coping abilities.				
8	When I am confronted with a problem, I can usually find several solutions.				
9	If I am in trouble, I can usually think of a solution.				
10	I can handle whatever comes in my way.				

**General Self-Efficacy Scale - Scoring**

**About:** This scale is a self-report measure of self-efficacy.

**Items:** 10

**Scoring:**

1	All questions	1	2	3	4

The total score is calculated by finding the sum of all items. For the GSE, the total score ranges between 10 and 40, with a higher score indicating more self-efficacy.

## Beck's Depression Inventory

1.	0	I do not feel sad
	1	I feel sad
	2	I am sad all the time and I can't snap out of it
	3	I am so sad and unhappy that I can't stand it
2.	0	I am not particularly discouraged about the future
	1	I feel discouraged about the future
	2	I feel I have nothing to look forward to
	3	I feel the future is hopeless and that things cannot improve
3.	0	I do not feel like a failure
	1	I feel I have failed more than the average person
	2	As I look back on my life, all I can see is a lot of failures
	3	I feel I am a complete failure as a person
4.	0	I get as much satisfaction out of things as I used to
	1	I don't enjoy things the way I used to
	2	I don't get real satisfaction out of anything anymore
	3	I am dissatisfied or bored with everything
5.	0	I don't feel particularly guilty
	1	I feel guilty a good part of the time
	2	I feel quite guilty most of the time
	3	I feel guilty all of the time
6.	0	I don't feel I am being punished
	1	I feel I may be punished
	2	I expect to be punished
	3	I feel I am being punished
7.	0	I don't feel disappointed in myself
	1	I am disappointed in myself
	2	I am disgusted with myself
	3	I hate myself
8.	0	I don't feel I am any worse than anybody else
	1	I am critical of myself for my weaknesses or mistakes
	2	I blame myself all the time for my faults
	3	I blame myself for everything bad that happens
9.	0	I don't have any thoughts of killing myself
	1	I have thoughts of killing myself, but I would not carry them out
	2	I would like to kill myself
	3	I would kill myself if I had the chance
10.	0	I don't cry any more than usual
	1	I cry more now than I used to

	2	I cry all the time now
	3	I used to be able to cry, but now I can't cry even though I want to
11.	0	I am no more irritated by things than I ever was
	1	I am slightly more irritated now than usual
	2	I am quite annoyed or irritated a good deal of the time
	3	I feel irritated all the time
12.	0	I have not lost interest in other people
	1	I am less interested in other people than I used to be
	2	I have lost most of my interest in other people
	3	I have lost all of my interest in other people
13.	0	I make decisions about as well as I ever could
	1	I put off making decisions more than I used to
	2	I have greater difficulty in making decisions more than I used to
	3	I can't make decisions at all anymore
14.	0	I don't feel that I look any worse than I used to
	1	I am worried that I am looking old or unattractive
	2	I feel there are permanent changes in my appearance that make me look unattractive
	3	I believe that I look ugly
15.	0	I can work about as well as before
	1	It takes an extra effort to get started at doing something
	2	I have to push myself very hard to do anything
	3	I can't do any work at all
16.	0	I can sleep as well as usual
	1	I don't sleep as well as I used to
	2	I wake up 1-2 hours earlier than usual and find it hard to get back to sleep
	3	I wake up several hours earlier than I used to and cannot get back to sleep.
17.	0	I don't get more tired than usual
	1	I get tired more easily than I used to
	2	I get tired from doing almost anything
	3	I am too tired to do anything
18.	0	My appetite is no worse than usual
	1	My appetite is not as good as it used to be
	2	My appetite is much worse now
	3	I have no appetite at all anymore
19.	0	I haven't lost much weight, if any, lately
	1	I have lost more than five pounds

	2	I have lost more than ten pounds
	3	I have lost more than fifteen pounds
20.	0	I am no more worried about my health than usual
	1	I am worried about physical problems like aches, pains, upset stomach, or constipation
	2	I am very worried about physical problems and it's hard to think of much else
	3	I am so worried about my physical problems that I cannot think of anything else
21.	0	I have not noticed any recent change in my interest in sex
	1	I am less interested in sex than I used to be
	2	I have almost no interest in sex
	3	I have lost interest in sex completely

## **Beck's Depression Inventory - Scoring**

Add up the score for each of the twenty-one questions by counting the number to the right of each question you marked.

The highest possible total for the whole test would be sixty-three.

This would mean a person circled number three on all twenty-one questions.

Since the lowest possible score for each question is zero, the lowest possible score for the test would be zero.

This would mean a person circles zero on each question.

1-10	Considered normal ups and downs
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
Over 40	Extreme depression

If you have any comments you'd like to make in regard to physical activity, wellbeing or anything else addressed in this questionnaire, please use the text box below.

Long answer text

---

Thank You For Your Time! Please Remember To Press "Submit"!

If you feel the need to speak with anyone about issues that were raised during the questionnaire then please contact [john.murphy274@mail.dcu.ie](mailto:john.murphy274@mail.dcu.ie). We can refer you for further guidance to the National Educational Psychological Service (NEPS) or the counselling service at DCU if required.



## **Appendix C**

### **Peer Reviewed Publications**

## RESEARCH

# Physical Activity and Sports Participation in Irish Adolescents and Associations with Anxiety, Depression and Mental Wellbeing. Findings from the Physical Activity and Wellbeing (Paws) Study

John Murphy\*, Mary Rose Sweeney† and Bronagh McGrane\*

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A cross-sectional study design was used to examine associations between frequency of physical activity and participation in sports with mental wellbeing, and symptoms of depression and anxiety. Surveys were completed in post-primary schools by 5,661 adolescents from the Republic of Ireland. Validated instruments were used to assess frequency of physical activity, participation in sports, mental wellbeing (WEMWS), depressive symptoms (BDI) and anxiety (BAI). A minority of the sample (11.5% of males and 5.3% of females) were found to meet WHO's physical activity guidelines (60 minutes or more each day). Frequency of activity were found to decline with age. Frequency of activity was positively associated with wellbeing and negatively associated with symptoms of anxiety and depression. Males had higher levels of wellbeing and lower levels of anxiety and depressive symptoms across all sub-groups. Adolescents who engaged in sports were found to have higher levels of wellbeing and lower symptoms of anxiety and depression with team sport conferring an additional benefit. Future physical activity recommendations for children and adolescents should include mental as well as physical health benefits.

**Keywords:** Exercise; Team sport; Health; School

## Introduction

It is important to participate regularly in physical activity to improve the likelihood of living a healthy life. To assist people living a healthy life, there are specific physical activity guidelines (Hallal et al., 2006). Children and adolescents aged 5–17 years should accumulate 60 minutes of moderate-to-vigorous physical activity (MVPA) each day according to international recommendations (World Health Organisation, 2010). It has been reported however, that up to 80% of younger adolescents (13–15 years) do not meet the recommendations (Hallal et al., 2012), while only 13% of European adolescents (McMahon et al., 2017), and 10% of Irish adolescents meet the recommendations (Woods et al., 2019). Internationally, physical activity levels have decreased with age across adolescence, with females reporting significantly lower engagement in physical activity than their male counterparts in the majority of countries (Currie et al., 2009).

Conclusive evidence has demonstrated that the physical health of adolescents is enhanced through a higher frequency of physical activity (Janssen & Leblanc, 2010; Strong et al., 2005), there is also widespread belief that physical activity is inherently good for young people in respect of varied psychosocial outcomes, such as self-esteem and cognitive functioning (Biddle & Asare, 2011), with the most evidence about depression and anxiety (Abu-Omar et al., 2004; Dinas et al., 2011; Sieverdes et al., 2011). Suicide, depression, eating disorders and anxiety are some of the conditions that affect young people in disproportionate rates in comparison to many other population groups (Viner & Booy, 2005). McPhie & Rawana (2015) found greater levels of resiliency against symptoms of depression in adolescents who engaged in higher frequencies of physical activity in a longitudinal study. Regular physical activity also appears to be protective against anxiety

## ORIGINAL RESEARCH

# Physical Activity, Mental Health and Wellbeing of Irish Adolescents During Covid-19 Restrictions. A Re-Issue of the Physical Activity and Wellbeing Study (PAWS)

John Murphy<sup>1</sup>, Bronagh McGrane<sup>1</sup> and Mary Rose Sweeney<sup>2</sup>

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Covid-19 restrictions impacted many people's daily lives through infection, fear of infection and restrictions on movement. This re-issue of a questionnaire sought to examine the impact of Covid-19 restrictions on frequency of physical activity, participation in sports, wellbeing and symptoms of anxiety and depression in Irish adolescents. 3,021 adolescents from 61 post-primary schools in the Republic of Ireland completed questionnaires. Consistent with findings from a previous issue of the questionnaire, conducted pre-Covid-19, a minority of adolescents were found to meet the WHO's physical activity guidelines (11.6% of males and 5.2% of females) although there were large decreases in 1<sup>st</sup> year males and females. Adolescents reporting elevated symptoms of depression increased from 39% to 46% with almost 3 in 5 females reporting symptoms of depression ranging from mild to extreme. Highest levels of wellbeing were found in adolescents who participated in 3 or more sports, although there was an 8% reduction in the amount of adolescents participating in 3 or more sports. There were no changes in physical activity levels overall, despite changes within sub-groups and patterns of physical activity. There was a clear increase in symptoms of depression, with females impacted more than males. Previously active individuals were more likely to increase activity and therefore report higher levels of mental health while those who were less active were more likely to decrease activity and report lower mental health. Future interventions should seek to target adolescents currently inactive or with low levels of activity as they are most at risk of further reductions and the associated negative health implications.

**Keywords:** Exercise; Sport; Team Sport; Resilience; Identity; Health; School

## Introduction

The World Health Organisation announced a global pandemic caused by the coronavirus disease (Covid-19) on the 11<sup>th</sup> of March 2020. Covid-19 is an infectious disease caused by a newly discovered coronavirus which is transmitted primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Governments in various countries (including Ireland) implemented national containment strategies to limit the spread of the virus and reduce the risk of national healthcare systems becoming critically overburdened. Physical distancing and self-isolation regulations were implemented to reduce person-to-person transmission of Covid-19, although these regulations may have contributed to other potentially significant public health implications such as loneliness, isolation and the associated decreases in mental health outcomes. As most attention in the early stages of Covid-19 restrictions was understandably focused on public health measures to contain the virus, the focus has since broadened to the wider and longer-term ramifications such as social isolation, delayed help-seeking for other health conditions and reduced opportunities for leisure-time physical activity (Smith et al., 2020; McGrath, Murphy

# “You Get to...” a Qualitative Study of Perceived Influence of Physical Activity and Sport on Mental Wellbeing among Adolescent Girls

John Murphy<sup>1</sup>, Maura Coulter<sup>1</sup>, Mary Rose Sweeney<sup>2</sup>, Bronagh McGrane<sup>1</sup>

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Open Access

## Abstract

Physical activity is well-recognized as a key risk factor for the management and prevention of mental ill-health, including anxiety and depression. The specific volumes, intensities or types of physical activity with the greatest impact on mental health are currently unclear. The current study sought to explore what aspects of physical activity may have positive or negative impacts on mental health and wellbeing. Focus group interviews were conducted with 10 adolescent females, and transcripts were analyzed using thematic analysis. Three higher-order themes, tenets of self-determination theory, were identified; autonomy, competence and relatedness. Single-factor sub-themes such as opportunity, journey to competence and facilitator of connection were identified as multi-factor sub-themes such as fun or enjoyment, and engagement in the activity. The perception of physical activity as an opportunity was identified as a key factor in contributing to positive mental health and wellbeing. It appears that autonomously motivated physical activity experiences provide the greatest levels of satisfaction for adolescents' psychological needs and therefore, they are the most effective method of enhancing mental wellbeing through physical activity. Future physical activity experiences should include an element of choice along with opportunities to engage in social interaction alongside opportunities for progression and achievement, as these appear to provide the best environment to foster positive mental wellbeing in adolescents.

## Keywords

Self-Determination Theory, Team Sport, Resilience, Opportunity, Motivation



ESJ Natural/Life/Medical Sciences

## **Associations Between Self-Reported Sleep, Wellbeing and Physical Activity in Irish Adolescents**

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<https://doi.org/10.19044/esj.2022.v18n8p1>

### **Abstract**

Growing evidence suggests sleep plays an important role in the development of healthy adolescents, with increased interest in the associations between sleep and mental health. Higher duration and quality of sleep has been suggested as a mechanism for increased wellbeing in adolescents. Cross sectional data was collected from 5,661 Irish adolescents. 55% of Irish adolescents reported meeting the guidelines for adolescents of 8-10 hours per night. This was found to decrease with age. Higher duration and quality of sleep was positively associated with wellbeing and negatively associated with symptoms of anxiety and depression. A higher frequency of physical activity was associated with longer duration and higher quality of sleep. 9-10 hours of sleep was associated with the highest levels of wellbeing and lowest symptoms of anxiety and depression. The relationship between physical activity and increased wellbeing may be impacted by physical activity leading to higher

## The effect of a games-based intervention on wellbeing in adolescent girls

Health Education Journal

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### Abstract

**Objective:** To examine the impact of a self-determination theory-informed school-based lunchtime games intervention on wellbeing and symptoms of anxiety and depression among adolescent girls in Ireland.

**Design:** Non-randomised controlled intervention design.

**Method:** This self-determination theory-informed intervention consisted of lunchtime games for girls aged  $13 \pm 0.7$  years, 3 days a week. After a 2-week 'sampling' period, students self-selected to 0, 1, 2 or 3 days of lunchtime games. Intervention and control groups were compared by pre- and post-testing. Participants were included in the intervention design via a survey to ascertain the most popular games and activities at the outset.

**Results:** Participating in games twice a week led to significant decreases ( $p < .01$ ) in symptoms of anxiety and depression while the control group showed significant increases ( $p < .01$ ) in symptoms of anxiety and depression. Mental wellbeing significantly ( $p < .01$ ) increased among those who participated two and three times a week. Increases in mental wellbeing were similar in effect size to increases in self-efficacy.

**Conclusion:** Higher frequencies of physical activity led to increased mental health. Self-efficacy may act as an underlying mechanism for increases in mental health through physical activity.

### Keywords

Anxiety, depression, exercise, mental health, motivation, physical health, self-determination theory

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Original research

## Physical activity, mental health and well-being of adults during initial COVID-19 containment strategies: A multi-country cross-sectional analysis



James Faulkner<sup>a,\*,1</sup>, Wendy J. O'Brien<sup>b,1</sup>, Bronagh McGrane<sup>c,1</sup>, Daniel Wadsworth<sup>d,f,1</sup>, John Batten<sup>a</sup>, Christopher D. Askew<sup>e,f</sup>, Claire Badenhorst<sup>b</sup>, Erin Byrd<sup>g</sup>, Maura Coulter<sup>c</sup>, Nick Draper<sup>h</sup>, Catherine Elliot<sup>i</sup>, Simon Fryer<sup>j</sup>, Michael J. Hamlin<sup>i</sup>, John Jakeman<sup>g</sup>, Kelly A. Mackintosh<sup>k</sup>, Melitta A. McNarry<sup>k</sup>, Andrew Mitchelmore<sup>g</sup>, John Murphy<sup>c</sup>, Helen Ryan-Stewart<sup>a</sup>, Zoe Saynor<sup>l</sup>, Mia Schaumberg<sup>e,f,m</sup>, Keeron Stone<sup>j</sup>, Lee Stoner<sup>n</sup>, Beth Stuart<sup>o</sup>, Danielle Lambrick<sup>p</sup>

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exercise  
depression  
sedentary time

### ABSTRACT

**Objectives:** To assess physical activity (PA), mental health and well-being of adults in the United Kingdom (UK), Ireland, New Zealand and Australia during the initial stages of National governments' Coronavirus disease (COVID-19) containment responses.

**Design:** Observational, cross-sectional.

**Methods:** An online survey was disseminated to adults ( $n = 8,425$ ;  $44.5 \pm 14.8$ y) residing in the UK, Ireland, New Zealand and Australia within the first 2–6 weeks of government-mandated COVID-19 restrictions. Main outcome measures included: Stages of Change scale for exercise behaviour change; International Physical Activity Questionnaire (short-form); World Health Organisation-5 Well-being Index; and the Depression Anxiety and Stress Scale-9.

**Results:** Participants who reported a negative change in exercise behaviour from before initial COVID-19 restrictions to during the initial COVID-19 restrictions demonstrated poorer mental health and well-being compared to those demonstrating either a positive-or no change in their exercise behaviour ( $p < 0.001$ ). Whilst women reported more positive changes in exercise behaviour, young people (18–29y) reported more negative changes (both  $p < 0.001$ ). Individuals who had more positive exercise behaviours reported better mental health and well-being ( $p < 0.001$ ). Although there were no differences in PA between countries, individuals in New Zealand reported better mental health and well-being ( $p < 0.001$ ).

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<sup>1</sup> Country Specific Survey Lead

## **Appendix D**

### **Poster Presentations**



# Exploring The Impact of A School-Based Combined Nutrition Education & Physical Activity Intervention on Health Markers in Irish Adolescents: A Mixed Methods Approach

 **John Murphy 1**, Dr Bronagh McGrane 1, Dr Mary Rose Sweeney 2

1 – School of Arts, Education & Movement, 2 – School of Nursing



## Does Increased Physical Activity and Improved Nutrition Impact Anxiety in Adolescents?

Feel free to leave feedback/suggestions at:  
<https://tinyurl.com/y4sn48th>



[john.murphy274@mail.dcu.ie](mailto:john.murphy274@mail.dcu.ie)



Take a picture to  
download further details



### INTRO

- The WHO has classified physical inactivity as the fourth leading risk factor for global mortality with insufficient physical activity (PA) contributing to 3.2 million deaths worldwide per year (World Health Organisation, 2014).
- Mental illness is expected to account for 15% of the global burden of disease by 2020.
- Only one piece of research (Project Spraoi) has simultaneously investigated dietary behaviours, cardiovascular fitness, nutrition knowledge and health markers in Irish children over time (Merrotty et al., 2018).
- No such study exists among Irish adolescents.
- Those who are physically active are less likely to suffer from mental health problems and may have enhanced cognitive functioning.
- The proposed research will include the design, implementation, impact and process outcomes of a school-based combined nutrition education and PA intervention in Irish adolescents.

### REFERENCES

Browne, S. (2017). Exploring the impact of schools on the quality of diet and physical activity in their students: A mixed methods study in Irish post-primary schools (Doctoral dissertation, Dublin City University).

Merrotty, A., McCarthy, A. L., Hark, J., Lacey, S., & Sappington, T. (2018). Project Spraoi: Dietary Intake, Nutritional Knowledge, Cardiorespiratory Fitness and Health Markers of Irish Primary School Children. *International Journal of Child Health and Nutrition*, 1(2), 68–79.

World Health Organization. (2016). *Global status report on noncommunicable diseases 2016* (No. WHO/MS/NM/16.1). World Health Organization.

### METHODS

1. Initiatives that aim to research or address health behaviours of adolescents need to **place young people at the centre of their design** (Browne, 2017) and so will involve focus groups throughout.
2. Baseline Testing – September 2019
3. Intervention – September 2019 to April 2020
4. Pre-, Mid- & Post- Testing – Objective Markers

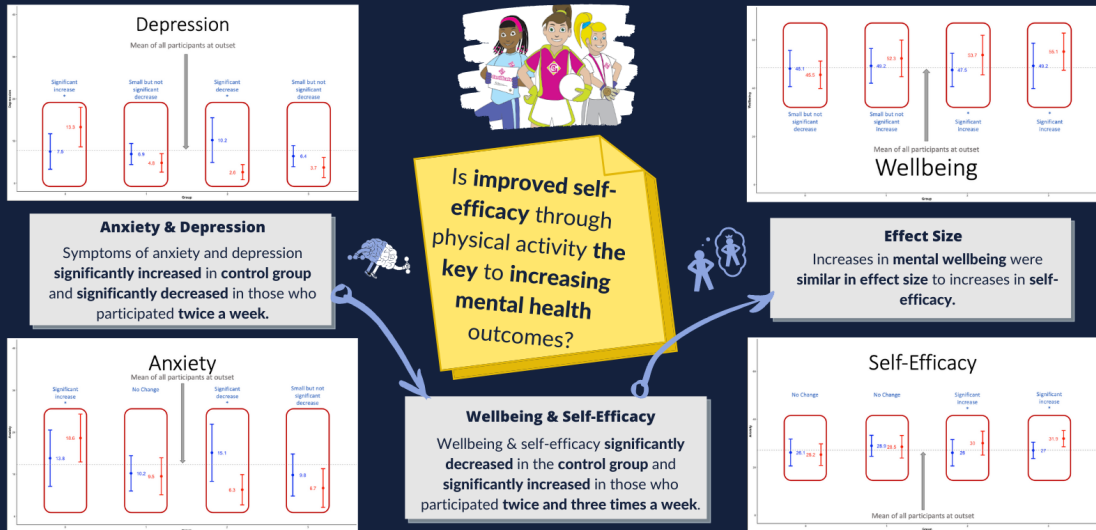


### EXPECTED OUTCOME

- Gathering of baseline data will inform the future direction of the intervention. It is difficult to predict expected outcomes until baselines, both quantitative and qualitative, have been identified and realistic expectations can then be set.

# The impact of a school-based physical activity intervention on mental health outcomes in Irish adolescent females

Murphy, J. (1); Sweeney, M.R. (2); McGrane, B. (1) 1 - School of Arts, Education & Movement, DCU; 2 - School of Nursing, Psychotherapy & Community Health, DCU



# The Effect of a Games-Based Physical Activity Intervention on Wellbeing In Irish Adolescent Females

 **John Murphy 1**, Dr Bronagh McGrane 1, Dr Mary Rose Sweeney 2

1 – School of Arts, Education & Movement, 2 – School of Nursing, Psychotherapy & Community Health



john.murphy274@mail.dcu.ie



Scan here for access to pre-print



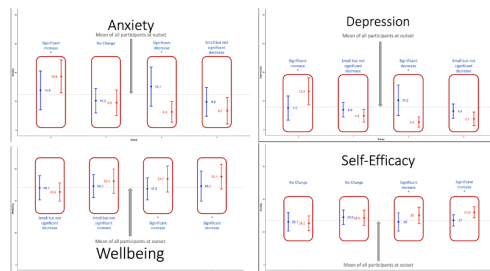
## Improved self-efficacy may act as an underlying mechanism for increases in mental wellbeing through physical activity

### INTRO

- While there is conclusive evidence that the physical health of adolescents is enhanced by frequent physical activity, there is also a widespread belief that physical activity is inherently good for young people in respect of varied psychosocial outcomes (Biddle & Asare, 2011)
- Elevated symptoms of depression and anxiety were reported by 40% of adolescents in Ireland. Females were found to have higher symptoms of depression and anxiety and lower levels of mental wellbeing than males of the same age. (Murphy, Sweeney & McGrane. 2020)

### METHODS

1. This self-determination theory-informed intervention, consisted of lunchtime games 3 days a week.
2. After a one week 'sampling' period, students self-selected to either 0, 1, 2 or 3 days of lunchtime games.
3. Intervention and control groups were compared through pre- and post-testing.
4. Participants were included in the intervention design via a survey to ascertain the most popular games and activities at the outset.



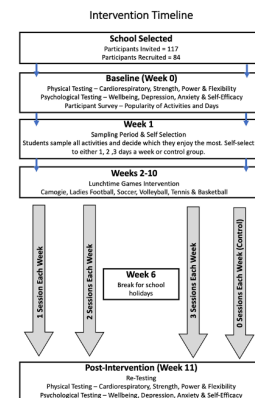
### RESULTS

- After a one week 'sampling' period, students self-selected to either 0 (n = 21), 1 (n = 24), 2 (n = 22) or 3 (n = 18) days of lunchtime games.
- Those who self-selected to 0 acted as the control group. Intervention and control groups were compared through pre- and post-testing of physical fitness and psychosocial outcomes.
- Participants were included in the intervention design via a survey to ascertain the most popular activities at the outset.
- Paired t-tests found no significant differences in any of the physical fitness measures.
- Participating in games twice a week led to significant decreases ( $p < 0.01$ ) in symptoms of anxiety and depression while the control group had significant increases ( $p < 0.01$ ) in symptoms of anxiety and depression.
- Mental wellbeing ( $p < 0.01$ ,  $d = 0.67$ ) and self-efficacy ( $p < 0.01$ ,  $d = 0.76$ ) significantly increased in those who participated two and three times a week

### CONCLUSION

- Higher frequencies of physical activity led to increased mental health. Self-efficacy may act as an underlying mechanism for increases in mental health through physical activity.

### REFERENCES



**Appendix E**  
**Questionnaire Landing Page**



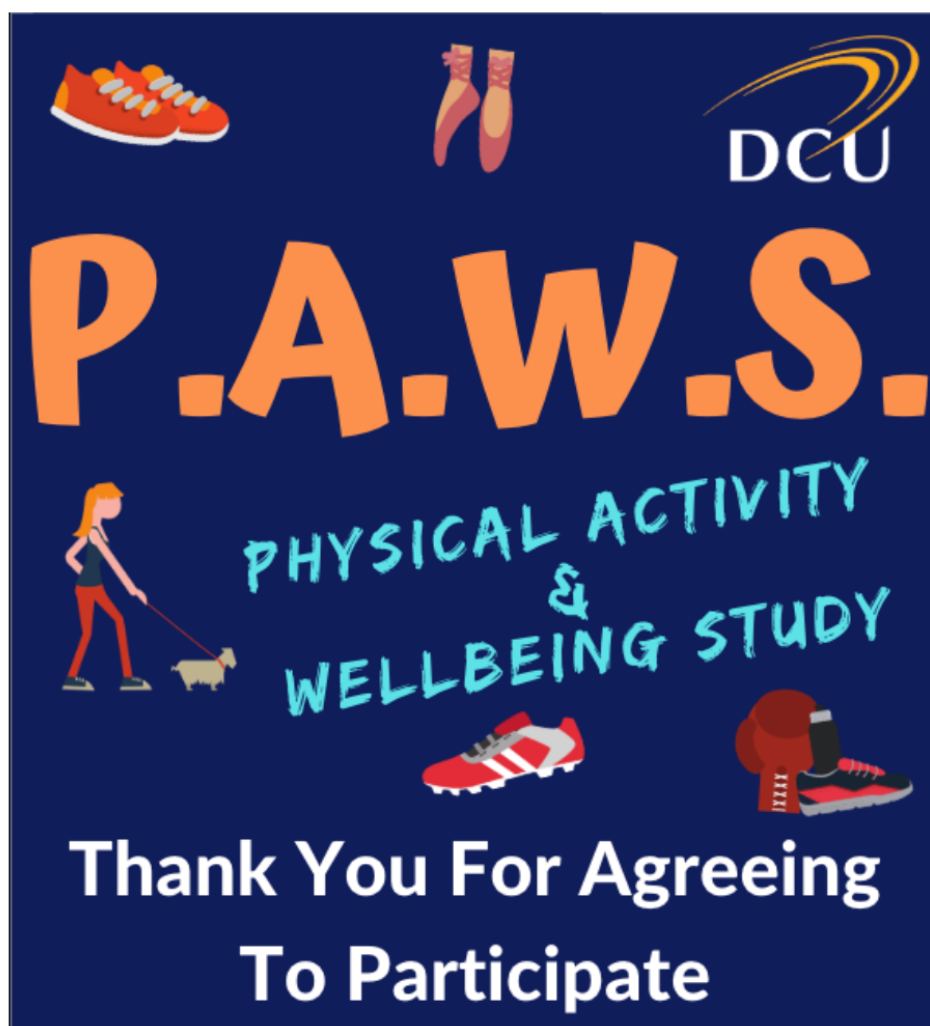
Section 1 of 14

## Sample Questionnaire



Form description

Image title



## **Appendix F**

### **Recruitment Graphic for Questionnaire**



## Physical Activity & Wellbeing Study



# PAWS

Exploring the relationship between physical activity and  
mental wellbeing in Irish adolescents



Fill in your details at the below link  
or email [john.murphy274@mail.dcu.ie](mailto:john.murphy274@mail.dcu.ie)

## **Appendix G**

### **Consent Forms & Information Sheets**





School of Arts, Education & Movement  
**Consent Form - Parents**

Dear Parent,

Please find overleaf a consent form for your child's participation in a Physical Activity and Wellbeing Study titled "P.A.W.S.". This study is being carried out by Dublin City University in your child's school. The study aims to gather information on the physical activity and mental wellbeing levels of students in Ireland.

The study involves a lunchtime games programme that is being run in your child's school. The research team want to see if lunchtime games have an effect on fitness levels and/or mental wellbeing of the students who participate. Fitness (strength, power, flexibility and cardiorespiratory endurance) will be assessed through the normal tests carried out in physical education (PE) class. Wellbeing will be assessed through an online questionnaire.

Information gathered on your child will not be shown individually to anyone – it will be combined with information from lots of other students and as such no-one will have access to an individual child's information. Information gathered on the group of students involved in the study will be made available to parents through the school once the study has been completed.

In order for your child to participate in this study, please read the attached form. If you wish your child to participate in the study, please sign and return the form.

Thank you for your time.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'BMcGrane'.

Dr Bronagh McGrane  
(MSc)

A handwritten signature in blue ink, reading 'Dr. Mary Rose Sweeney'.

Dr Mary Rose Sweeney

A handwritten signature in black ink, reading 'John Murphy'.

John Murphy

**What will happen in the study:**

- Students will be given a unique participant ID number so that all information collected will be anonymous.
- Students will be asked to complete a questionnaire in class at the beginning and end of the games programme. The questionnaire aims to determine student's levels of participation in physical activity and sport, and levels of mental well-being.
- Students will take part in physical fitness measures such as jump height, BMI, grip strength and long jump (these are the tests normally carried out in PE class each year anyway).
- Students with no written permission can still take part in as many games as they wish.
- Students can stop or take a break from playing games at any stage.
- Some students (4-8) will be invited to participate in focus groups when the games programme ends. These will be led by one of the research team and aim to find out what was enjoyable or not about the games.

I have read and understood the information in this form. I have read and explained the information in the form to my child. I understand that signing and returning this form will include my child in this study.

**ACTION: To advise the research team of your decision to include your child in the study please sign and return this form to your child's teacher for attention of Mr John Murphy.**

Parent/Guardian Signature: \_\_\_\_\_

Name in Block Capitals: : \_\_\_\_\_



School of Arts, Education & Movement  
**Information Sheet**

**Title:** Physical Activity & Wellbeing Study

**Clarification of the purpose of the research**

Our previous research has found that 12% of males and 5% of females meet WHO's physical activity guidelines. Adolescents with higher levels of physical activity have higher levels of wellbeing with those involved in sport and team sport having even higher wellbeing.

The context of physical activity (why you're active, who you're active with and the type of activity) has a big impact on the mental benefits of being active. We are seeking to identify the specific contexts of physical activity that have the greatest positive impact on mental wellbeing in Irish adolescents.

**What We Propose To Do:**

- Conduct focus groups with 3 separate groups of students
  - Group 1 – Adolescents who participate in team sport
  - Group 2 – Adolescents who are active but do not participate in team sport
  - Group 3 – Adolescents who identify as "inactive"
- Each participant will be asked to bring an object that represents physical activity (or being active) and a photo that represents mental wellbeing.
- Participants will be asked to discuss any connections between the two items they bring and the broader connections between physical activity and mental wellbeing.
- Focus group interviews will be conducted by the lead researcher (John Murphy) who has been fully trained in focus group interviewing and has conducted numerous interviews with adolescents and adults in the past.
- The interviews will be recorded on a password protected laptop.
- Interviews will be transcribed to a Word document within one week of recording.
- Transcripts will be completely anonymised (fake names) and the recordings will be destroyed once transcribed.

If you are interested in being part of this research or have any follow-up questions please contact [john.murphy274@mail.dcu.ie](mailto:john.murphy274@mail.dcu.ie)

Thanks for your time.  
Yours sincerely,

A handwritten signature in dark ink, appearing to read 'B McG'.

Dr Bronagh McGrane

A handwritten signature in dark ink, appearing to read 'Dr. Mary Rose Sweeney'.

Dr Mary Rose Sweeney

A handwritten signature in dark ink, appearing to read 'John Murphy'.

John Murphy



School of Arts, Education & Movement  
**Focus Group - Principal Consent Form**

**Title:** Physical Activity & Wellbeing Study

**Clarification of the purpose of the research**

Our previous research has found that 12% of males and 5% of females meet WHO's physical activity guidelines. Adolescents with higher levels of physical activity have higher levels of wellbeing with those involved in sport and team sport having even higher wellbeing.

The context of physical activity (why you're active, who you're active with and the type of activity) has a big impact on the mental benefits of being active. We are seeking to identify the specific contexts of physical activity that have the greatest positive impact on mental wellbeing in Irish adolescents.

**What will happen in the study:**

- The focus group will happen in groups of 4-6 students.
- Participants will be asked to bring an object that represents being active.
- Participants will be asked to bring a photo that represents mental wellbeing.
- Any identifiable features, such as faces in photos, will be fully anonymised in future publications.
- Participants will be asked to speak about the connection (or lack of) between the two things they have brought.
- Participants will be asked about how physical activity, sport and team sport does or does not impact wellbeing.
- The interviews will be recorded on a password protected laptop.
- Interviews will be transcribed to a Word document within one week of recording.
- Transcripts will be completely anonymised (fake names) and the recordings will be destroyed once transcribed.

Thanks for your time.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Bronagh McGrane'.

Dr Bronagh McGrane

A handwritten signature in blue ink, appearing to read 'Dr. Mary Rose Sweeney'.

Dr Mary Rose Sweeney

A handwritten signature in black ink, appearing to read 'John Murphy'.

John Murphy



School of Arts, Education & Movement  
**Focus Group - Parent Consent Form**

**Title:** Physical Activity & Wellbeing Study

**Clarification of the purpose of the research**

Our previous research has found that 12% of males and 5% of females meet WHO's physical activity guidelines. Adolescents with higher levels of physical activity have higher levels of wellbeing with those involved in sport and team sport having even higher wellbeing.

The context of physical activity (why you're active, who you're active with and the type of activity) has a big impact on the mental benefits of being active. We are seeking to identify the specific contexts of physical activity that have the greatest positive impact on mental wellbeing in Irish adolescents.

**What will happen in the study:**

- The focus group will happen in groups of 4-6 students.
- Participants can self-select to 1 of 3 groups:
  - Group A – Regularly engage in team sport
  - Group B – Active as individuals but not in team sport
  - Group C – Active in school but not outside of school
- Participants will be asked to **bring an object that represents being active.**
- Participants will be asked to **bring a photo that represents mental wellbeing.**
- Participants will be asked to speak about the connection (or lack of) between the two things they have brought.
- Participants will be asked about how physical activity, sport and team sport does or does not impact wellbeing.
- The interviews will be recorded on a password protected laptop.
- Interviews will be transcribed to a Word document within one week of recording.
- Transcripts will be completely anonymised (fake names) and the recordings will be destroyed once transcribed.

Thanks for your time.

Yours sincerely,

Dr Bronagh McGrane

Dr Mary Rose Sweeney

John Murphy

**I. Confirmation of requirements as highlighted in Plain Language Statement**

**Parent/Guardian: please complete the following (Circle Yes or No for each question)**

<i>Do you understand the information provided?</i>	<i>Yes</i>	<i>No</i>
<i>Have you had an opportunity to ask questions and discuss the study?</i>	<i>Yes</i>	<i>No</i>
<i>Have you received satisfactory answers to all your questions</i>	<i>Yes</i>	<i>No</i>
<i>Do you agree to having the interviews recorded?</i>	<i>Yes</i>	<i>No</i>

Involvement in the research is completely voluntary. Participants may choose to withdraw from the study at any time. There shall be no penalty for withdrawing before all stages of the research project have been completed. Confidentiality is an important issue during data collection. Participants' identity, or other personal information, will not be revealed or published. All information gathered will be stored in a secure file and saved in a password protected file in a computer at DCU. The investigators alone will have access to the data. Confidentiality of information provided can only be protected within the limitations of the law. It is possible for data to be subject to subpoena, freedom of information claim or mandated reporting by some professions.

I have read and understood the information in this form. My questions and concerns have been answered by the researchers, and I have a copy of this consent form. Therefore, I consent for my school to take part in this research project.

**Parent/Guardian's Signature:**

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**Name in Block Capitals:**

---

**Witness:**

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**Date:**

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