Changes in Quality of Life, Gaming Behavior, and Physical Activity and Their Interrelationships During the Initial Stages of the Pandemic

– A Longitudinal Study Among Norwegian University Students

Mathilde Rønnestad

Master Thesis in Health Promotion and Health Psychology
Institute for Health, Environment, and Equality (HEMIL)

Faculty of Psychology

University of Bergen

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Preface

Dear reader,

The writing of this preface marks the end of my five years as a student. This past year has been challenging at times but, most of all, rewarding and highly educational. When I started this master's program in 2021, the pandemic still impacted life as I knew it. Thus, I identified early in the process that I wanted to study the pandemic and how it impacted health aspects in a health promotional context. As a student myself, this population group was particularly interesting for me. I was given the incredible opportunity of working with the National Institute of Public Health in the Department of health promotion. I am very grateful for the hospitality and warm welcome I received here. I also wish to extend gratitude to all participants of the SPoT study who devoted their time to this important research project.

I sincerely thank my advisors Associate Professor Ellen Haug (UoB) and Senior Researcher Robert Smith (NIPH) for constructive feedback and systematic guidance throughout the writing process. When I have wanted to shut down STATA and run away from my computer, you have made the task comprehensible and achievable. I am privileged and grateful to have two such intelligent and encouraging advisors.

Periods of fluctuating motivation were made better by peers, friends, and family, so thank you all. However, this thesis has reminded me that taking care of your physical and mental health is important. So, the past two semesters have also been filled with pleasant times with good friends between statistics and writing sessions.

I hope you find this thesis enjoyable and educational. Happy reading!

Mathilde Rønnestad,
Bergen, May 2023

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Abstract

Background: There is limited knowledge about longitudinal trends and the interrelations between problematic gaming, physical activity, and quality of life among university students during the Covid-19 pandemic. As society was faced with unprecedented social restrictions, these aspects may have developed in an unfavorable manner, which is important to address from a public health perspective.

Objective: To contribute essential knowledge regarding the development of problematic gaming, physical activity, and quality of life in the initial stages of the pandemic among Norwegian students and their temporal interrelations.

Method: This thesis derives from the 'Students' Psychological Health Over Time' study – a joint effort from the Norwegian Institute of Public Health and the University of Bergen. Linear mixed methods examined the development from January 2020 to November 2020 and gender differences. Cross-lagged analyses obtained the temporal interrelations across time and assessed gender differences within these.

Findings: The sample exhibited decreased physical activity and quality of life over time. Men reported reduced problematic gaming. There were mutual negative temporal associations between physical activity and problematic gaming. There was a negative association between problematic gaming at t – 1 and quality of life at t. This association lost statistical significance after adjusting for covariates age, gender, socioeconomic status, and partner status. Quality of life was a stronger association for later problematic gaming behavior in men than women.

Conclusion: The findings highlight negative development in physical activity and quality of life, some gender differences, and temporal interrelations in the initial phases of the pandemic. These changes must be accounted for when implementing measures to facilitate healthy development in university students.

Keywords: Covid-19 pandemic, quality of life, problematic gaming behavior, physical activity, university students, longitudinal study

Sammendrag

Bakgrunn: Det er begrenset kunnskap om longitudinelle trender samt forholdene mellom problematisk dataspill atferd, fysisk aktivitet og livskvalitet blant universitetsstudenter under Covid-19 pandemien. Da samfunnet ble rammet av ekstraordinære sosiale restriksjoner kan det ha medført uheldige utviklinger av helseaspekter, som er viktig å belyse i et folkehelseperspektiv.

Formål: Målet for inneværende studie er å bidra med viktig kunnskap om utvikling av problematisk dataspill atferd, fysisk aktivitet og livskvalitet i de initiale fasene av pandemien blant norske studenter og prospektive sammenhenger mellom variablene.

Metode: Denne studien utledes fra 'Studentenes Psykiske Helse Over Tid' studien – et samarbeid mellom Folkehelseinstituttet og Universitetet i Bergen. 'Linear mixed' modeller utforsket utviklingen fra januar 2020 til november 2020 og potensielle kjønnsforskjeller. 'Cross-lagged' analyser utforsket prospektive sammenhenger mellom variablene over tid samt om disse varierte mellom kjønn.

Resultater: Utvalget rapporterte nedgang i fysisk aktivitet og livskvalitet over tid. Menn rapporterte redusert problematisk dataspill atferd. Det var en gjensidig negativ assosiasjon mellom fysisk aktivitet og problematisk dataspill atferd. Det var en negativ assosiasjon mellom problematisk dataspill atferd ved tidspunkt t – 1 og livskvalitet ved tidspunkt t. Denne assosiasjonen mistet statistisk signifikans etter å justere for kontroll variablene alder, kjønn, sivilstatus og sosioøkonomisk status. Livskvalitet viste en markant større assosiasjon for problematisk dataspill atferd ved senere tidspunkt blant menn enn kvinner.

Konklusjon: Funnene belyser negativ utvikling innen fysisk aktivitet og livskvalitet, enkelte kjønnsforskjeller samt prospektive assossiasjoner i de innledende fasene av pandemien. Forandringene må tas hensyn til ved implementering av tiltak som skal fremme sunn utvikling blant universitetsstudenter.

Nøkkelord: Covid-19 pandemi, livskvalitet, problematisk dataspill atferd, fysisk aktivitet og universitetsstudenter, longitudinell studie

List of Abbreviations

In alphabetical order:

HR-QoL – Health-related quality of life

IGD – Internet gaming disorder

MVPA – Moderate to vigorous physical activity

NIPH – National Institute of Public Health

NSD * – National Centre of Research Data

OECD – Organization for Economic Co-operation and Development

QoL – Quality of life

SPoT – 'Students' psychological health over time'

SSB – Statistics Norway

UoB – University of Bergen

WHO – World Health Organization

YPAP – Youth Physical Activity Promotion

* Disclaimer. The NSD is no longer an active agency. From January 1, 2022, NSD was integrated as a part of Sikt – the Knowledge sector's service provider (Sikt – Kunnskapssektorens tjenesteleverandør) (Hansen, 2022). However, at the time the SPoT study was developed, the operating agency was NSD, hence why this thesis refers to this abbreviation.

1 Introduction

The index case of the later worldwide Covid-19 pandemic was confirmed in China on December 8, 2019 (Tjernshaugen et al., 2023). The illness, caused by the SARS-CoV-2 virus, was declared a global public health crisis on January 30, 2020. WHO further acknowledged the virus outbreak as a pandemic in March 2020. As a response, the Norwegian government was instigated to implement the strictest preventative societal measures since World War II (Tjernshaugen et al., 2023).

The initial lockdown in Norway, initiated on March 12, 2020, resulted in individuals spending more time inside and socially isolated (Bekkhus et al., 2020). Studies suggest that the restrictions led to amplified psychological issues in the population, where students were disproportionately negatively affected by the measures (Nes et al., 2020a). The recently published white paper on public health highlights that many of the health consequences from the pandemic derived from the restrictions and may have long-lasting impacts on individuals' health (Meld. St.15 (2022-2023), p. 16). On May 5, 2023, the WHO declared that the virus no longer qualifies as a global health crisis (Rigby, 2023), and all social restrictions are currently lifted in Norway. The broader public health consequences may be substantial and must be adequately considered. It is necessary to assess the consequences these measures may have imposed on public health. Most students' lives drastically changed during this period, making them a particularly relevant group to study. Generally, university students are a relevant population group to research within health promotion as behaviors in this phase may perpetuate in later life phases (Abrantes et al., 2021). The present study aims to explore three variables: QoL, physical activity, and problematic gaming behavior.

An individual’s QoL could be impacted in various ways by the strict social restrictions implemented during the pandemic. The risk of infection could lead people to view others as a potential threat, thus creating avoidance behavior. Individuals who were willingly socially isolated to adhere to the social restrictions were still deprived of social connectedness (Keller et al., 2023). Humans have an intrinsic yearning to connect and may experience feelings of loneliness when this need for social connection is not fulfilled. Over time, social isolation and loneliness may negatively impact QoL (Keller et al., 2023). There has been reported a worsening of QoL and heightened levels of depression and anxiety during the pandemic

among students (Kaparounaki et al., 2020; Long et al., 2022). These concerning trends may be related to the social measures and lockdowns. Students were faced with online lectures and lost several important social arenas. There were limited options for social and recreational activities. Many were also laid off from work, thus losing important income, which could result in a challenging economic situation (Kjøs et al., 2021, p. 27; Sivertsen, 2021). However, the implemented social restrictions may have affected QoL within population groups differently.

Individuals from Bergen and Oslo were seemingly disproportionately negatively affected in their QoL as the national and regional restrictions were the strictest in these areas (Nes et al., 2020b). Findings suggest that students experienced reduced QoL and increased loneliness more than the overall population (Nes et al., 2020b). Individuals aged 18 to 24 also perceived less meaning in life in 2020 and 2021 than the population means (Nes et al., 2020b, 2021). There were generally reported only minor gender differences in QoL (Gram, 2023; Nes et al., 2020b; Rønning, 2021a). The reported decline in QoL may have impacted other areas of life, such as physical activity levels.

It is well-established that physical activity has several health benefits, including increasing QoL. Moreover, physical inactivity is a threat to public health (Herbert et al., 2020; Devita & Müller, 2020). Physical activity improves physical and mental health, and mood (Abrantes et al., 2021; Marquez et al., 2020; Murphy et al., 2021; Knight et al., 2022; Welk, 1999), as well as prevents disease and symptoms of depression and anxiety (Herbert et al., 2020). It also provides an essential social arena (Wankel & Berger, 2018). Moreover, sedentary behavior is known to have a range of adverse health effects, one being reducing the individuals' QoL (Cheval et al., 2021). An increased proportion of the population who stated never to exercise also reported low QoL (SSB, 2020). During the pandemic, WHO (2020a) and the Norwegian government (Ekelund et al., 2022) endorsed that the population remained physically active and achieved the recommended physical activity levels. However, gyms, sports venues, and recreation facilities were periodically unavailable during the pandemic, severely limiting the possibility of engaging in physical activity (Tjernshaugen et al., 2023).

Longitudinal studies suggests a decline in physical activity in university students during the initial phases of the pandemic (Imaz-Aramburu et al., 2021; López-Valenciano et al., 2021; Larsson et al., 2022). Data from Norwegian adults show that 18–24-year old's had the most

substantial reduction in their physical activity levels during the pandemic (FHI, 2021). A recent NIPH study shows men are slightly more physically active than women (Hansen et al., 2023), but there reported relatively low gender differences within the overall student population (Sivertsen, 2021). The social measures have likely also affected other aspects of movement behavior.

There has been reported increased sedentary behavior, such as gaming, during the pandemic (Haug et al., 2022;). This complies with gaming activity skyrocketing globally during the pandemic (Lufkin, 2020; Nielsen, 2020). Longitudinal data have shown that university students increased their time playing video games during the pandemic (Balhara et al., 2020). Problematic gaming behavior and gaming addiction also reportedly increased in university students during the pandemic (Balhara et al., 2020; Wang et al., 2023), and men were more affected (Han et al., 2022; Wang et al., 2023). Thus, the national restrictions may have exacerbated the already prominent issue of physical inactivity and sedentary behaviors in the population (Knight et al., 2022). This can further impact other areas of health.

Some research highlights gaming's positive impact on individuals' QoL during the pandemic (André et al., 2020; Barr & Copeland-Stewart, 2022). Gaming seemingly gave individuals cognitive stimulation, a feeling of control, achievement, purpose, and normality. The social aspect of gaming also enabled the respondents to combat loneliness and socialize with family and friends (Barr & Copeland-Stewart, 2022). However, gaming addiction and pathological gaming behavior were associated to adverse effects on physical, social, and mental well-being during the pandemic (Fazeli et al., 2020; Lemmens et al., 2011; Wang et al., 2023; Xu et al., 2021).

Problematic gaming, physical activity, and QoL are highly relevant subjects for health promoters to research as they may influence both physical and mental health in individuals. Understanding how these variables may have developed during the early stages of the pandemic and their interrelations are important considerations when developing future health promotional interventions and strategies. This study will examine the changes in physical activity, subjective QoL, and problematic gaming behavior from January 2020 to November 2020 among students at the University of Bergen and their interrelations. Thus, the trends before and after the initial lockdown are assessed. Gender differences are also examined for development and interrelations over time.

1.1 The Thesis' Structure

There are eight main chapters in this thesis. Chapter one contextualized and presented background information for the topics which will be addressed and discussed. Chapter two will put forth definitions of relevant concepts and terminology. In chapter three, the theoretical framework this thesis derives from is elaborated. Chapter four first assesses how relevant literature was found before presenting existing research on the included subjects. Further, the methodological considerations and research process are addressed in chapter five. The findings from the present study are presented in chapter six. Chapter seven incorporates previous literature and relevant theoretical premises to discuss and elucidate the study's findings. Methodological considerations and implications for future research and health promotion are also deliberated in this section. Finally, chapter eight puts forth a summary of the study.

2 Definitions

This section will present definitions of relevant concepts for this thesis. First, the different aspects of quality of life, physical activity, and gaming will be elaborated. The student population will be described to explain a typical university student's life situation and circumstances. Finally, a brief description of the Covid-19 pandemic will contextualize this study.

2.1 Quality of Life

QoL concerns "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" (WHO, 2012). QoL is a complex and multifaceted concept interpreted in various ways. The concept of QoL encompasses an individual's satisfaction and enjoyment with their daily activities and life (Levola et al., 2018). Psychological well-being and a positive state of mind are measures of a high QoL. Well-being, mental health, and QoL are commonly used interchangeably as they are similar concepts and share common traits (Helsedirektoratet, 2014, p. 3; Meld. St. 19 (2018-2019), p. 69). Within psychology and health sciences, high QoL includes happiness, meaning, life satisfaction, and the absence of negative emotions and psychological issues (Nes et al., 2021). Symptoms of anxiety and depression are highly related to low QoL (Brenes, 2007). Loneliness also negatively impacts QoL and well-being (Zahedi et al., 2022; Weber et al., 2022).

2.1.1 The Different Aspects of QoL

There is a distinction between objective and subjective QoL. Subjective QoL regards how one's life is experienced by the individual (Nes et al., 2021). This aspect of QoL is assessed in this thesis. It encompasses three dimensions: evaluations of life (e.g., life satisfaction), functioning in everyday life (e.g., meaningfulness) as well as positive and negative emotions. Poor mental health appears to have severe repercussions and is heavily correlated to low subjective QoL (Nes et al., 2018). The components within objective QoL are measurable social, economic, or environmental indicators and dimensions of the individual´s life (Boelhouwer & Noll, 2014). This will not be further elaborated on as it is not measured in this thesis.

2.1.2 Health-Related QoL

HR-QoL is also closely related to QoL but is not well defined (Ferrans et al., 2005). The terms are often used interchangeably. It incorporates QoL aspects that undoubtedly affect mental or physical health. The non-health features of QoL are not incorporated, such as political, economic, and societal circumstances (Ferrans et al., 2005).

2.2 Physical Activity: Definition and Recommendations

Physical activity is defined by the WHO (2022) "as any bodily movement produced by skeletal muscles that requires energy expenditure." It includes all movement for transportation, work, or leisure time. Common leisure physical activities include sports, cycling, running, walking, and playing at various intensities and skill levels (WHO, 2022). Physical activity can be executed at a light, moderate, or high intensity (Helsedirektoratet, 2022). To gain health benefits, adults aged 18 to 64 are recommended to do at least 150 to 300 minutes weekly of physical activity with moderate intensity or 75 to 150 minutes with high-intensity activities or a combination of moderate and high intensity. However, regardless of intensity, any amount is better than none (Helsedirektoratet, 2022). Physical inactivity is defined as not meeting the present recommendations, and more than 1.4 billion adults globally are considered unsatisfactorily active (WHO, 2020b). University students are typically prone to insufficient physical activity (Larsson et al., 2022). Individuals in the age group 20-34 have reported the lowest percentage of achieving the recommendations (Hansen et al., 2015, p. 50).

A recent study from the Norwegian School of Sports Sciences and the NIPH shows that only 30% of adults achieve the WHO recommendations (Hansen et al., 2023, pp. 19-34). Males and children from families with high socioeconomic status are generally more physically active. Walking is the most common physical activity for men and women across all age groups. Women generally engage in more light activity while men partake in more moderate or high intensity physical activities (Hansen et al., 2023, pp. 19-34).

2.2.1 Exercise

Exercise is a subcategory of planned, structured, repetitive, and purposeful physical activity that aims to improve or maintain one or more components of fitness (WHO, 2020b). Exercise generally refers to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance, or health (WHO, 2020b). In

the present study, the subjects were presented with a definition of exercise to assess physical activity, see section 5.5.

2.3 Gaming Behavior

The definition of gaming is playing games on various forms of interactive electronic outlets. Gaming has become an established leisure time activity in Norway, where the primary platforms are mobile phones, consoles, pc, and tablets (Kulturdepartementet, 2019). There are known social, motivational, cognitive, and emotional benefits to gaming (Granic et al., 2014). Playing video games has become increasingly popular in recent years (WHO, 2017), and numbers reached an all-time high during the pandemic (Lufkin, 2020). SSB report that 35% of the Norwegian population played digital games daily in 2020 and men spent more time gaming than women (Schiro, 2020).

There are different variations of gaming behavior. There is a distinction between non-problematic, highly engaged-, pathological-, and addicted gamers (André et al., 2020; Lemmens et al., 2009). Increased gaming activity has been identified as a risk factor for developing pathological or addictive gaming behavior (Lemmens et al., 2009, 2011; Wang et al., 2023). Addicted gamers are also excepted to spend more time playing video games (Lemmens et al., 2009). The Gaming Addiction Scale for Adolescents (GAS) is one of the most used measures to evaluate gaming addiction (André et al., 2020; Brunborg et al., 2015; Lemmens et al., 2009) and was applied in the present study. The shortened version of this scale comprises seven criteria for addition, including withdrawal, conflict, problems, relapse, salience, tolerance, and mood modification (GAS-7) (André et al., 2020; Brunborg et al., 2015).

Charlton & Danforth (2007, 2010) aimed to distinguish between gaming engagement and addiction. They developed the CORE-4 approach to addicted gaming behavior by testing the structural validity of the addiction criteria through factorial analysis. It was proved appropriate to make a distinction between peripheral and core criteria. According to the CORE-4 approach, the four core criteria for gaming addiction are withdrawal, conflict, problems, and relapse. The peripheral criteria are mood modification, tolerance, and salience (Charlton & Danforth, 2007; 2010). The CORE-4 approach was not explicitly applied in this thesis. However, it is helpful to understand the various distinctions of gaming behavior often used in previous research and literature.

2.3.1 Highly Engaged Gaming Behavior

A person who fulfills the three peripheral criteria but not any of the four core criteria.

2.3.2 Pathological Gaming Behavior

If the person endorsed two or three of the core criteria, he or she is a pathological gamer.

2.3.3 Addicted Gaming Behavior

An addicted gamer will meet all four core criteria. This is, however, not a clinical diagnosis (Charlton & Danforth, 2007; 2010).

2.3.4 Internet Gaming Disorder

The American Psychiatric Association recently recognized IGD as a tentative disorder in the 11th edition of the International Classification of Diseases (ICD-11) (WHO, 2020c). This clinical diagnosis is associated with a pattern of gaming that impairs social, occupational, personal, family, or educational domains of the individual's life. The behavior must be evident for twelve months (WHO, 2020c).

2.4 Sedentary Behavior and Recommendations

Sedentary behaviors include activities that expedite energy by 1.5 METS or lower while awake, lying, sitting, or reclining (WHO, 2020b). Examples include desk-based office work or driving a car. Sedentary screen time includes engaging in screen-time entertainment, such as gaming, through mobile devices, computers, or TV. However, it does not include games where the person is required to move or engage in physical activity, e.g., augmented reality gaming. WHO (2020b) recommends that adults aged 18 to 64 generally limit their time spent on sedentary behavior but do not have exact time recommendation guidelines. University students were already, before the pandemic, a group that spent much time engaging in sedentary behavior (Larsson et al., 2022).

2.5 The Student Population: Characteristics and Occupational Life

Being a student comes with unique characteristics. Student life is often a vulnerable period for the individual and represents a transition from late adolescence into early adulthood, where they experience increased independence (Erevik et al., 2017). Student life has many changes and challenges, including financial, residential, emotional, and social issues (Grøtan et al., 2019). Many live alone for the first time, and twelve percent of Norwegian students live alone (Keute, 2018). Student life is associated with stress and increased demands, which can result

in mental distress. Students also typically take autonomy over their health behaviors during this period (Grøtan et al., 2019). Many students work besides their studies. In 2021, 66% of full-time students had a part-time job, according to SSB (Bergesen, 2022). Students typically work in hospitality or retail, which were prone to layoffs during the pandemic due to national and regional guidelines (Grini et al., 2021, p. 12). University students were reportedly disproportionally economically affected by the pandemic (Gewalt et al., 2022).

In 2020, there were 306 400 students in Norway. This group is an increasingly large proportion of the population (Nygård, 2021). Many students' lives differ from other groups in the population, which may impact their health and well-being. To have a rewarding student life, they must be physically and psychologically content, but there are some concerning trends students' mental health levels (Sivertsen & Johansen, 2022). This has also been highlighted in recent Norwegian white papers, which emphasize the importance of mental health in students at a national level (Meld. St.15 (2022-2023), p. 75; Meld. St. 20 (2018-2019), p. 38).

2.6 The Covid-19 Pandemic Timeline in Norway: The First Year

The first case of Covid-19 was confirmed in Norway on February 26, 2020 (Tjernshaugen et al., 2023). The first death in Norway was confirmed on March 12, 2020, when the government initiated the first nationwide lockdown (Regjeringen, n.y). The social restrictions led to reduced infection rates and on 15 June 2020, social limitations were lightened. Social arenas and recreational facilities reopened but were required to keep preventative measures. In the autumn of 2020, the infection rates increased once again, and municipality measures replaced national guidelines. However, on 28 October 2020, strict national restrictions were reimplemented due to an alarming infection rate. The second national lockdown was then initiated in January 2021 (Regjeringen, n.y).

3. Theoretical framework

Section three will present relevant theories and perspectives to contextualize the variables within the health promotional field. The social determinants of health and the self-determination model represent relevant frameworks and theories within the health promotional field that are useful for understanding the development of these variables within the context of the pandemic. The YPAP model also poses a relevant framework for assessing physical activity. The structured day's hypothesis and the displacement hypothesis are applicable theories within the 'time-filled perspective' that aim to explain the interrelationship between sedentary behavior and physical activity.

3.1 The Social Determinants of Health

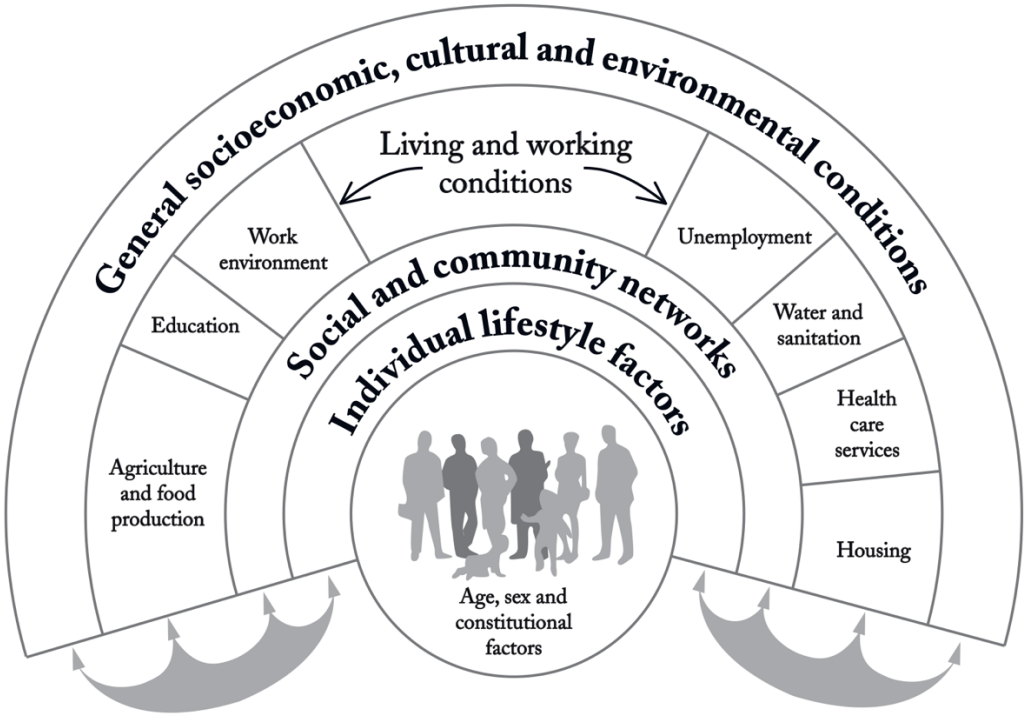
An individual's health, QoL, and well-being are influenced by many factors, both within and beyond their control. These factors are known as the social determinants of health, and they can either promote, protect, or threaten health (Dahlgren & Whitehead, 1999). The WHO stated that these determinants are molded by the conditions in which individuals are born, live, grow, and work (Wilkinson & Marmot, 1998). Society has sets of systems and forces that shape and condition daily life. These include social norms, political systems, economic policies, development agendas, etc. (Wilkinson & Marmot, 1998). There are different levels of determinants. At the core are individual constitutional factors. The other levels include individual lifestyle factors, community, social networks, living and working conditions, and general cultural, environmental, and socioeconomic conditions (Dahlgren & Whitehead, 1999, p. 11) (See Figure 1). The health model conceptualizes these determinants and how the levels are embedded. All levels may influence an individual's health. Moreover, all levels, besides the core individual characteristics, may be influenced by political policies (Dahlgren & Whitehead, 2006, p. 21; Naidoo & Wills, 2016, p. 22).

At the core of this health model are individual characteristics that are largely fixed, such as gender, age, and race (Dahlgren & Whitehead, 1999, p. 11, 2006, p. 21). The second level includes individual lifestyle factors and behaviors, e.g., physical activity levels. Further, social networks are prompted as health determinants. This includes interactions with and influence by peers and the immediate surrounding community. The third layer of the model state that health is influenced by the individual's education, work environment, and essential services and goods in their society and community. Lastly, general environmental, cultural, and

socioeconomic conditions prevail in overall society as a mediator for health in the general population (Dahlgren & Whitehead, 1999, p. 11, 2006, p. 21).

Figure 1

The Social Determinants of Health



From (Dahlgren & Whitehead, 2006)

3.1.1 The Social Determinants of Health in Light of the Pandemic

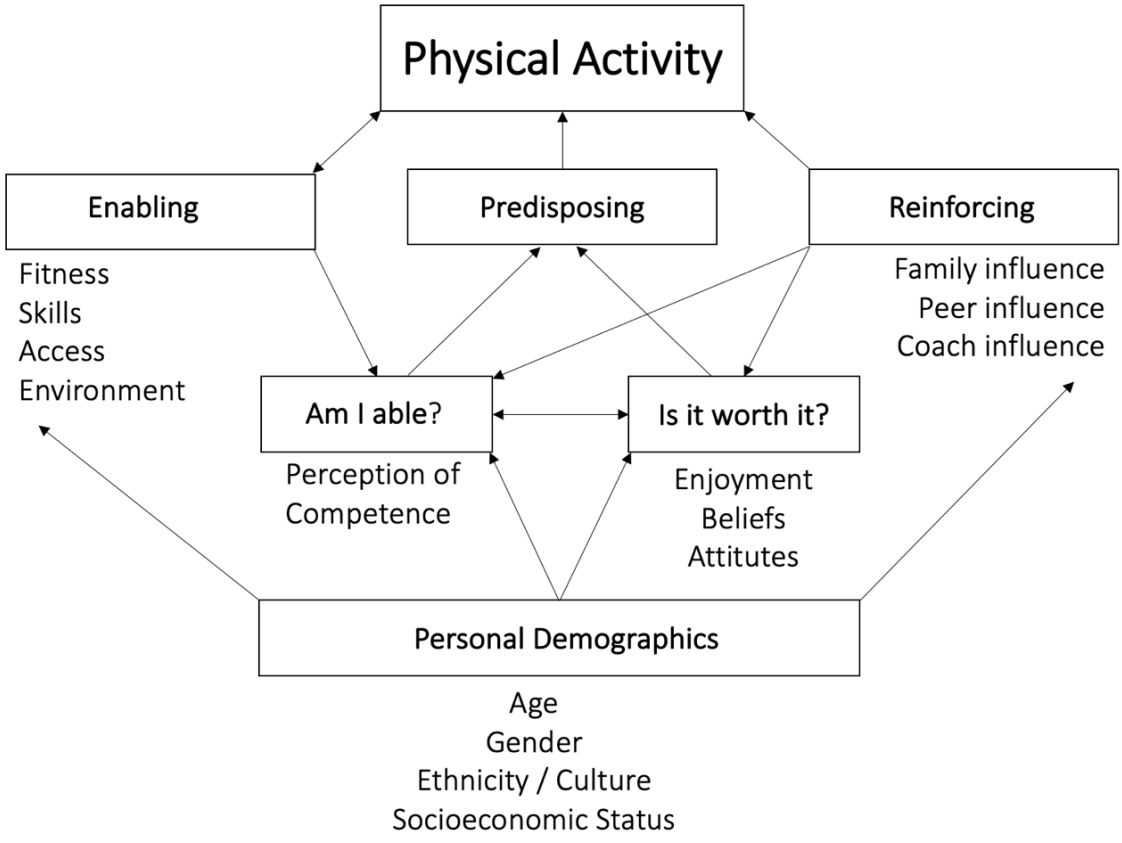
The Covid-19 pandemic resulted in a multitude of changes in society during the social restrictions (Muller et al., 2022). The social determinants of health have been applied as a theoretical framework to understand better students' experiences during the pandemic and how best to support them in the wake of the pandemic. Besides the individual core characteristics, strict social restrictions could potentially affect all levels. The pandemic practically deteriorated every other social determinant in the model (Muller et al., 2022). Some examples of how students were affected include changes in the work environment and education due to many losing their jobs and online lectures (Kjøs et al., 2021, p. 27). The social and community networks were also heavily impacted by the restrictions with social distancing policies limiting interactions (Muller et al., 2022). Another relevant framework that elucidates behavior in light of, among others, social, environmental, and individual factors is the YPAP model.

3.2 The Youth Physical Activity Promotion

The YPAP model is a socioecological framework described as a "conceptual bridge between theory and practice" (Welk, 1999) to identify actionable determinants that support engagement in physical activity in youth. The YPAP model has also been applied to university students and was proven robust even during the pandemic (Druică, 2021). The model is a comprehensive theoretical framework that examined the interaction of enabling, predisposing, and reinforcing factors upon physical activity in youth (Welk, 1999). The main categories of determinants that influence this behavior are demographic, biological, psychological, social/cultural, and environmental characteristics. The YPAP model suggests that all these levels of influence may indirectly or directly impact behavior. The demographic component includes socioeconomic status, geographic location, and race. The biological aspect encompasses age, gender, and physical ability. Motivation, attitudes, and mental health are psychological characteristics. The social/cultural aspect comprises social customs, peer influence, and values. The environmental factor includes accessibility and availability of recreation facilities, physical activity resources, and safety concerns (Welk, 1999).

Figure 2.

Visualization of the Youth Physical Activity Promotion Framework



From (Haugen, 2015). Illustrated by the author of the current study.

The two dimensions of predisposing factors are worth and ability. Worth is the individual finding a sense of enjoyment during exercise. Ability includes self-efficacy and competence (Haugen, 2015). Druică et al. (2021) found that the dimensions of worth and ability mediate between physical activity and the reinforcing and enabling aspects in university students during the pandemic. Interventions targeting the enabling and reinforcing domains would not directly influence exercise. However, such interventions may develop the worth and ability factors, which could increase future physical activity. (Druică et al., 2021). A study assessed the gender differences within the factors in the YPAP model (Wenthe et al., 2009). Friend and family support were identified to have the strongest associations with male MVPA. Female MVPA displayed only one small significant association: family support. Thus, the reinforcing domain appeared to be a stronger predictor for male MVPA (Wenthe et al., 2009).

Perception of competence (predisposing) and social influence (reinforcing) factors are among others identified in the YPAP model as important domains for behavior change within physical activity. These factors are also identified in psychological model in the health promotion field, the self-determination theory.

3.3 The Self-Determination Theory

A human being is born inherently proactive and curious toward behaviors that facilitate rewards and support the individual's intrinsic motivation (Ryan & Deci, 2017, p. 4). The self-determination theory is a psychological model that introduced a theoretical framework emphasizing the importance of autonomy and intrinsic motivation for promoting well-being and behavior change (Deci & Ryan, 1985, p. 3; Ryan & Deci, 2000). Intrinsic motivation is also highlighted as a psychological component in the YPAP model (Welk, 1999). The self-determination theory regards why an individual will exhibit a specific action and how the environment and behavior will impact their development and well-being (Deci & Ryan, 1985, p. 3, 2000; Ryan & Deci, 2017, p. 3).

The framework posits three basic psychological needs in individuals: relatedness, autonomy, and competence (Ryan & Deci, 2000). Autonomy is the need to feel in control of one's experiences and actions. Relatedness refers to the basic human need for social connection and belonging. Competence is the need to feel both effective and capable in the behavior. According to this model, these are crucial domains of shaping behavior and motivation. The theory further highlights that when these three psychological needs are fulfilled, the individual may thrive and improve their well-being (Ryan & Deci, 2000). Unfulfilled needs have also

been found to be associated with a decline in physical activity (Gunnell et al., 2016). Research suggests that the aspects of the self-determination theory could be affected by social restrictions during the pandemic (Randall et al., 2022).

The self-determination theory was developed to understand better the factors that influence and promote health-promoting behavior (Deci & Ryan, 2012). According to this model, there are internal (intrinsic) and external (extrinsic) forces of motivation (Ryan & Deci, 2000). Intrinsic motivation refers to an individual finding a behavior motivating based on finding it inherently interesting, satisfying, or enjoyable. Extrinsic motivation includes external motivational forces for the behavior, such as rewards or social pressure. Intrinsic motivation is more likely to promote well-being, sustained behavior change, and optimal functioning as it satisfies the three basic psychological needs. Environmental and social aspects may also hinder or support individuals' basic psychological needs and intrinsic motivation. If the social environment supports autonomy, choices, and opportunities for relatedness and competence, it will more likely foster well-being and intrinsic motivation in the individual (Ryan & Deci, 2000). Furthermore, well-being may influence the psychological needs. Depression has been hypothesized to lower feelings of competence, autonomy, and relatedness (Gunnell et al., 2016).

The self-determination model suggests that intrinsic motivation is the core underlying motivation for physical activity and computer games (Ryan et al., 2006). A study applied the self-determination approach to assess gender differences within the forces of motivation for physical activity in university students (Lauderdale et al., 2015). Male students were identified to be more likely motivated by extrinsic forces, while females were more motivated by intrinsic factors.

3.4 Time-Filled Perspective on the Relationship Between Gaming & Physical Activity

The structured days hypothesis draws from the “time-filled perspective,” meaning time spent engaging in favorable behaviors cannot be spent doing unfavorable activities (Brazendale et al., 2017). The hypothesis derives from the premise that a structured day demotes sedentary behavior and screen time among youth in school. The structured day is also hypothesized to increase physical activity. A consistent routine or structure, such as education and organized activities, is hypothesized to positively impact obesogenic behavior in youth (Brazendale et al., 2017).

Another relevant hypothesis is the displacement hypothesis. This states that the quantity of time spent devoted to screen activities can displace spent engaging in physical activity as there is less available time (Haug et al., 2022; Hygen et al., 2022; Kwok et al., 2021; Neuman, 1988). Time is a zero-sum phenomenon. There are only 24 hours per day, and time spent on a particular activity, e.g., video games, must replace time spent engaging in other activities (Nie & Hillygus, 2002). A meta-analysis of primary studies conducted before the Covid-19 pandemic found a small but negative association between physical activity and sedentary behaviors, but they did not directly displace each other (Pearson et al., 2014). As gaming reached all-time high levels during the pandemic (Nielsen, 2020), this may have altered the relationship between sedentary behavior and physical activity.

4 Literature Review

A literature review aims to summarize the literature on any chosen topic so that the reader does not need to access all individual research reports. Literature reviews enable research to be regarded within its specific context and amid similar research to systematically evaluate its impact (Aveyard, 2014, p. 8). A literature review will often elucidate various knowledge gaps and inconsistencies, providing the researcher with an appropriate topic to study (Punch, 2014, p. 95). Section four presents previously published research regarding QoL, physical activity, and gaming, primarily among university students during the pandemic, to substantiate the topcis. First, the approach to identify the most relevant research will be presented. The databases used, search words, and search processes will be presented before the accumulated scientific literature is systematically presented. Finally, the purpose of this study and the research questions are put forth.

4.1 Search Process

The search was initially restricted to longitudinal studies regarding Norwegian university students during the pandemic. Due to sparse results, the search was expanded to cross-sectional studies and various age groups and nationalities. Other closely related topics, such as sedentary behavior, mental health, well-being, and other aspects of gaming behavior, were also included due to limited results on the specific variables.

All included articles are from peer-reviewed journals from the University of Bergen´s library service. Searches were conducted in Medline (Ovid), PubMed, APA PsycINFO, Web of Science, and Cinahl. Additional searches were done in Google Scholar as it searches in full text and can accumulate other articles. Articles were also found through the reference lists of already selected articles. The titles were first evaluated to identify the most relevant articles before the most relevant abstracts were read. After reading through seemingly relevant articles, some were included in the literature review, and others were excluded due to a lack of relevance to the research questions. All articles but one were published between 2020 and 2023. One article from 2018 was included regarding an interrelation. This has been deemed acceptable as these associations are not exclusive to the pandemic and the publication is still relatively recent.

Table 1

Search terms used in the literature search to examine the included variables.

Physical Activity	Gaming Behavior	Quality of Life
«Physical activit*»	«Gaming behavior*»	«Quality of life»
«Exercise»	«Gaming addiction*»	«QoL»
«MVPA»	«Pathological gaming»	«Subjective well-being»
«Fitness»	«Problem gaming»	«HR-QoL»
«Physical fitness»	«Problematic gaming»	«Well-being»
«Sport*»	«Gaming disorder»	«Mental health»
«Leisure time»	«Internet gaming disorder»	«Life satisfaction»
«Gym*»	«Internet gaming addiction»	«Mental well-being»
	«Internet addiction»	«Psychological well-being»
	«Video game*»	«Anxiety»
	«Game play»	«Depression»
	«GAS»	«Health-related quality of life»
	«GAS-7»	«Loneliness»
	«GASA»	
	«Sedentary behavior*»	

Table 1.1

Search words used in the literature search for other relevant aspects.

Population	Time Frame	Study Design
«University student*»	«Covid-19 pandemic»	«Longitudinal design*»
«College student*»	«Covid-19»	«Longitudinal stud*»
«Student*»	«Pandemic»	«Cohort stud*»
«Young adult*»	«Coronavirus»	«Cohort design*»
«Adolescent*»	«SARS-CoV-19»	«Three-wave study»
«Youth*»	«Lockdown»	«Two-wave study»
«University»	«Quarantine»	
«College»		

Search words were combined with Boolean operations by applying the databases' option for 'advanced search.' Search terms in Table 1 and 1.1 listed vertically were conjoined with "OR," while those listed horizontally were combined with "AND." The searches were initially done on all variables, while combined with the population, study design, and time frame. An example of a search is: "Physical activit*" **OR** "Exercise" **AND** "Quality of life"

OR “Life satisfaction” **AND** “University student*” **OR** “College student*” **AND** “Longitudinal” **OR** “Cohort study” **AND** “Covid-19” **OR** “Pandemic”. Where applicable, truncation by using “*” was used to include all term variations. Student* was, for instance, used to incorporate both “student” and “students” in the search. Terms were searched for as subject headings and keywords.

Due to limited results when combining the variables with the target population (university students), searches were also conducted by combining the variables with young adults/youth/adolescents. The variables were also searched for without the population group entirely to expand the results further. When doing this, each article was evaluated regarding relevance to the population in this thesis. Studies including subjects aged 18-24 were particularly interesting as many students reside within this age range.

4.2 Changes in Physical Activity During the Pandemic

The changes in physical activity during the pandemic will be elucidated through longitudinal trends in the students population, longitudinal trends in the adult population, and Norwegian cross-sectional studies. For all subsections in this chapter, gender differences will be put forth in the studies that examined them.

4.2.1 Longitudinal Trends in Physical Activity in University Students

Larsson et al. (2022) conducted a longitudinal cohort study including 1877 Swedish university students. The mean age was 26,5 years, and 83% of the participants were women. The authors examined lifestyle behaviors, such as weekly minutes of exercise and daily activities, e.g., walking and cycling, before and during the first six months of the pandemic. The subjects were sent electronic surveys throughout one year, from August 2019 to September 2020, with a baseline questionnaire and two follow-up surveys. Follow-up 1 (FU1) was conducted between March and June 2020, and follow-up 2 (FU2) was conducted between June and September 2020. To assess physical activity, the subjects were asked how many minutes per week they spent exercising and how much time they spent engaging in daily activities, such as cycling and walking. The results showed a decrease in weekly exercise from baseline to FU1 and a further decline from FU1 to FU2. There was an increase in daily activities, such as walking or cycling, from baseline to FU2 (Larsson et al., 2022).

Imaz-Aramburu et al. (2021) conducted a longitudinal study on physical activity from September 2019 to October 2020 among 267 Spanish health science university students. The

mean age in the sample was 20.19 years, with 76% female participants. Physical activity was assessed by asking subjects frequency and intensity of engagement in the last seven days. Moderate and vigorous activity was explored separately. The authors found that the percentage that did not engage in physical activity did increase slightly. However, physical activity levels increased for those who were occasionally physically active before the pandemic (Imaz-Aramburu et al., 2021).

López-Valenciano et al. (2021) conducted a systematic review of the pandemic´s impact on university students' physical activity engagement in the early stages of the pandemic. All included studies had to report physical activity levels pre and during the pandemic. Ten studies were included with a total sample of more than 3500 students. Mean ages ranged from 20 to 26.9 years. Both cross-sectional and longitudinal studies were included, of which four had a longitudinal design. All ten studies used questionnaires, and one of the longitudinal studies also used an objective tool (an accelerometer). The studies examined various aspects, but the majority assessed participation in mild, moderate, and vigorous physical activity per week. Nine studies reported a decline in physical activity levels, but more studies reported a decline in vigorous physical activity than mild activities. The review suggests that all intensities, and overall levels of physical activity, declined in university students during the pandemic confinements in countries across the world. The review found that if the participant met the recommended physical activity levels before the virus outbreak, they generally upheld these levels during confinement (López-Valenciano et al., 2021).

4.2.2 Longitudinal Trends in Physical Activity in the Adult Population

A two-wave longitudinal observational study was conducted regarding changes in physical activity and sedentary behavior during the Covid-19 lockdown (Cheval et al., 2021). A total of 272 adult subjects from France and Switzerland participated in two waves, and 110 completed both questionnaires. The surveys assessed physical activity and sedentary behavior during leisure time and commuting. The age ranged from 22 to 58, and 68% were women. T1 was instigated on March 30, two weeks after lockdown initiation in France and Switzerland. T2 was launched on April 13, 2020, during the fourth week of lockdown. The authors found that the lockdown caused an increase in sedentary behavior as well as a decline in vigorous physical activity. However, there was found an increase in moderate physical activity and walking. Women were found to have a more noticeable increase in moderate physical activity than men but also spent less time on vigorous physical activity (Cheval et al., 2021).

One British longitudinal study with 1947 adults assessed physical activity engagement from 23 April 2020 to 30 January 2021 (Mitchell et al., 2022). The mean age was 50.61 (SD = 14.66), and 70% were female. Physical activity was measured by frequency, intensity, and duration of weekly sessions. The results showed that one in five subjects achieved the recommended physical activity levels during the first lockdown in the UK (April to June 2020). From June to July 2020, the results were roughly the same. Physical activity levels dropped during the second lockdown and in periods of eased restrictions. The trends were similar for MVPA and muscle-strengthening activities. The authors found that better QoL, pre-Covid-19 physical activity levels, and higher socioeconomic status were associated with achieving the recommended levels from WHO (2020b). Women had a significant negative correlation between maintaining MVPA and muscle-strengthening activities. Females were identified as having negative associations with a decline in physical activity during the pandemic (Mitchell et al., 2022).

A study from England examined the longitudinal trends in physical activity during and after the initial lockdown (Bu et al., 2021). The weighted sample comprised 35.915 adults, of which 51% were women, and were followed up from March 24, 2020, to August 23, 2020. England was under lockdown in March, but only lighter restrictions were implemented in August. Roughly 20% of the sample were between 18-29 years. The authors explored heterogeneity in physical activity trends in this period. Weekly surveys assessed the subjects' time engaging in gentle, moderate, or high-intensity physical activity. The study found a decline in physical activity during the initial phases of the pandemic. The analyses displayed that 62% of the sample reported little change, while 29% displayed reduced physical activity levels during this study. Individuals who were older, not living alone, from a higher socioeconomic status, and more educated were found to be more physically active. The authors found no gender differences (Bu et al., 2021).

4.2.3 Norwegian Cross-Sectional Findings on Physical Activity Levels

In the yearly national public health survey (Den nasjonale folkehelseundersøkelsen) conducted in Norway in October 2020, 8,852 randomly selected adults over 18 participated (FHI, 2021). Physical activity levels were measured by each session's frequency, duration, and intensity during occupational and leisure time. The participants were asked to compare their physical activity levels with those before the pandemic. The data showed that the age

group between 18-24 years reported the most significant alteration in their physical activity levels. A total of 44% reported being less physically active than before the pandemic. There was no difference between the genders (FHI, 2021).

A cross-sectional study (Kan3) aimed to examine trends in physical activity among adults from 2020 to 2022 (Hansen et al., 2023). The study was a cooperation between the NIPH and the Norwegian School of Sports Sciences. The study has been conducted twice prior, in 2008-2009 and 2014-2015. A total of 3006 individuals between ages 20 and 80 participated. The mean age was 52 (SD = 16). There was a slight majority of female subjects (58%). Physical activity was objectively measured by ActiGraph (an accelerometer) over eight consecutive days. Eighty percent of the sample were sedentary for eight to ten hours daily. Only 30% of the sample were sufficiently physically active, according to the WHO recommendations. Significantly more men achieved these levels compared to women. The authors conclude that the pandemic likely had a minor overall effect on physical activity in adults in light of the two previous Kan studies (Kan1 and Kan2) (Hansen et al., 2023).

4.3 Changes in Quality of Life During the Pandemic

No study assessing QoL explicitly among university students with a longitudinal design in the context of the pandemic was found. Therefore, longitudinal studies examining various age groups are included as well as Norwegian cross-sectional studies.

4.3.1 Longitudinal Trends in Quality of Life

Long et al. (2022) conducted a one-year longitudinal study during the pandemic assessing HR-QoL and mental well-being and the associations with health-related determinants. There were 16.683 respondents at t1, April-May 2020, but only 6765 completed the questionnaire again at t2, May-June 2021, making this the final sample. Participants were from the USA, UK, Netherlands, Greece, and Italy. The age ranged from 18 to 75, and 3% of the subjects were between 18 and 24. The same percentage reported that they were students. There was a slight majority of female participants (52%). HR-QoL was assessed through five dimensions: anxiety/depression, usual activities, discomfort/pain, self-care, and mobility that specific day. The authors highlight several determinants that impacted HR-QoL, such as job loss, income, socioeconomic status, and age. The findings showed significant associations between these determinants and the change in HR-QoL. In total, 31% of the sample experienced a deterioration of HR-QoL from t1 to t2. The authors further suggest that the effects of the

pandemic on HR-QoL have persisted. There were some variations within countries which the authors argue may be due to the variances in government measures. Significant associations were found between socioeconomic determinants, such as income and work, and HR-QoL. No relationship was found between age or gender and mental well-being (Long et al., 2022).

A two-wave longitudinal study explored QoL and mental health in German children and adolescents aged 7-17 (Ravens-Sieberer et al., 2021). A total of 1923 subjects were included in the survey. T1 was conducted in May – June 2020, and t2 was from December 2020 – January 2021. HR-QoL was assessed through psychological well-being, physical well-being, social support and peers, school environment, parent relations, and autonomy (KIDSCREEN-27). The HR-QoL levels in the sample were lower at t1 compared to pre-pandemic data. At t2, the levels deteriorated even further. The sample also experienced significantly more mental health problems, such as depressive and anxiety symptoms, emotional problems, and psychosomatic issues. Girls were found to have fewer mental health problems than boys (Ravens-Sieberer et al., 2021).

A longitudinal study from Norway assessed HR-QoL among youth during the pandemic (Lehmann et al., 2022). There were 2997 participants with a mean age of 16 (SD 1.7). The information was collected in two waves. T1 was from April 27 to May 11, 2020. T2 lasted from December 16, 2020, to January 10, 2021. HR-QoL was measured through KIDSCREEN-27 in this study. The findings indicated a decline in overall QoL at T1 compared to Swedish and European pre-pandemic norms, apart from parent relations and autonomy. Girls reported lower scores on all subscales than boys. From T1 to T2, scores on psychological and physical well-being subscales declined substantially. The subjects most worried about becoming infected had a more pronounced decline in physical well-being (Lehmann et al., 2022).

A longitudinal study from Brazil examined the pandemic´s impact on HR-QoL in high school students (Genta et al., 2021). The students completed questionnaires one year before the first lockdown in March 2019. Later, in June 2020, the participants answered the same questionnaires. There were 193 subjects in the original sample, but only 94 students completed both questionnaires. The mean age was 15 (SD = 1), and 64% were female. HR-QoL was examined through psychological, social, environmental, and physical domains. The authors found a worsening of the psychological and physical aspects in the participants.

Meanwhile, the environmental aspect improved, encompassing recreation, transportation, air pollution, noise, safety, and opportunities to acquire new knowledge and skills (Genta et al., 2021).

4.3.2 Norwegian Cross-Sectional Findings Regarding Quality of Life

Due to the extraordinary circumstances during the pandemic, the NIPH conducted an additional survey in 2021 assessing 62.498 students' perceived health and well-being (Sivertsen, 2021). This is the SHoT-study – 'students' health over time' – which has been conducted in Norway every four years since 2014. The participants were full-time students attending universities throughout country. The age ranged from 18 to 35. There were a majority of female participants (65.7%). This study found a decline in QoL compared to previous SHoT studies with only 34% reporting high levels (Sivertsen, 2018).

A national survey by SSB examining QoL was conducted in March 2020 and is now conducted yearly (Rønning, 2021a). These studies include adults over the age of 18. Subjective QoL was assessed through participants' satisfaction with their physical and mental health, leisure time, financial situation, and overall life. Feelings of optimism, purpose, social relations, and a balance between negative and positive feelings were also measured. The subjective QoL in the general population was reportedly lower in 2021 compared with 2020. Groups that reported significantly lower levels of subjective QoL than the general population include students aged 18-24. These studies have found an increase in low life satisfaction from 2020 (22%), 2021 (28%) (Rønning, 2021b), to 2022 (28,4%) (Gram, 2023). Students were the group with the most significant decline in life satisfaction. The study from 2022 found that the age group 18-24 remained the least satisfied with their lives. Students report higher levels of loneliness than the population means (Gram, 2023; Rønning, 2021b). Low socioeconomic status and being single were found to be factors associated with low levels of QoL (Rønning, 2021a).

A cross-sectional study was conducted by the NIPH to evaluate QoL and mental health during the pandemic from November to December 2020 (Nes et al., 2020b). There were 26.000 respondents aged 18 and older. Compared to the reported levels from 2019 from a similar study, subjects who reported poor QoL had increased from 16% to 24% in 2020. Women and men were found to have approximately the same QoL levels. Those living in Bergen and Oslo

with the most invasive guidelines were significantly negatively psychologically impacted (Nes et al., 2020b)

4.4 Changes in Mental Health and Well-Being During the Pandemic

Strong associations exist between subjective QoL, mental health, and well-being (Nes et al., 2018). Several longitudinal studies were found regarding university students on mental health and well-being during the pandemic. Due to limited results on QoL, the following articles were included further to contextualize the notion of longitudinal trends in QoL during the pandemic.

4.4.1 Longitudinal Trends in Mental Health and Well-being in University Students

Barbieri et al. (2021) conducted a longitudinal study to explore American students' mental health and lifestyle habits from spring 2019 to spring 2021. The sample comprised 1179 subjects. The mean age was 19. The authors assessed mental health through anxiety and depressive symptoms. They found the pandemic to have persistent negative impacts on mental health one year after its outbreak. It was found that almost half of the participants were at risk for clinical depression. This represents a 36% increase compared to before the virus outbreak (Barbieri et al., 2021).

Another longitudinal study from Britan conducted from October 2019 to October 2020 assessed self-reported changes in mental health and movement behaviors among 255 university students (Savage et al., 2021). There were more female participants (75.7%). The mean age was 19.34 (SD 4). The study explored mental health through stress levels and feelings, including self-esteem, purpose, optimism, positive emotions, and social support. The study found that poor mental health at the outbreak of the pandemic had sustained among university students significantly more compared to the overall population. The authors argue that this may be due to the student's unique financial, social, and academic circumstances, making them not adapt as well. Nine months after the first confirmed case of Covid-19 in the UK, the authors found reduced mental well-being and increased stress levels in university students. There were found no gender differences (Savage et al., 2021).

Buizza et al. (2022) systematically reviewed 17 longitudinal studies with 20.108 university students regarding their mental health during the pandemic. Seven included studies were from the USA, three from China, and two from Italy. Canada, Japan, India, the Netherlands, and

Switzerland all represented one article each. Various aspects of mental health were assessed, but the most common were reporting depressive and anxiety symptoms and perceived stress levels. Most participants were female, with a mean age of 19.6 years across all studies. Most of the studies found a decline in well-being and that mental health worsened during the pandemic and increased symptoms of depression and anxiety. Female students generally reported worse mental health conditions. Buizza et al. (2022) also found increased stressors in students' lives during the pandemic.

A German longitudinal study explored loneliness and mental health among 363 university students during the Covid-19 pandemic (Weber et al., 2022). There was a majority of female participants (68%). T1 was in July 2020, when the restrictions were first easing up in Germany. T2 was conducted in November 2020 during the second lockdown. The authors assessed mental health through anxiety and depressive symptoms. They also reported pandemic-related data, stress levels, loneliness, perceived social support, and negative thinking. It was found that students typically experience worse mental health than the general population, with increasing levels during the pandemic. Levels of symptoms of anxiety and depression did not significantly alter during the pandemic but were prevalent among the students. Feelings of loneliness did, however, increase substantially from T1 to T2. Students with higher levels of loneliness were associated with elevated symptoms of anxiety and depression. Increased levels of depression and anxiety were associated with the female gender, financial worries, living alone, and younger age. Weber et al. (2022) also point out the amplified amount of stressors among university students, both before and during the pandemic, supporting the findings of both Buizza et al. (2022) and Savage et al. (2021).

4.4.2 Longitudinal Trends in Mental Well-Being in Various Age Groups

The development of the mental health symptoms of depression and anxiety was assessed in a Norwegian two-wave longitudinal study from April 2020 to December 2020 (Hagen et al., 2023). The sample included 6017 adults, of which 4680 were women. Roughly 50% of the sample were aged 18-29. Symptoms of anxiety and depression were assessed. The findings demonstrated slight increases in depression and anxiety symptoms. Being a student and a woman were significant risk factors for negative development in mental health (Hagen et al., 2023).

A Norwegian population-based longitudinal study examined mental health in over 100,000 adults for over 20 years (Reme et al., 2022). The study went into the Covid-19 pandemic. Mental health was explored through depression and anxiety symptoms. The authors aimed to assess the socioeconomic impacts on mental health. The mean age was 46.6 years (SD 5.3). The majority of the sample was female (68%). Anxiety and depression symptoms were the measures examined. There were found substantial increases in depressive symptoms during the pandemic, and the incline was equally high across socioeconomic status. Women were also found to be vulnerable to increased depressive symptoms (Reme et al., 2022).

Pierce et al. (2020) examined longitudinal trends in mental health in the United Kingdom before and during the pandemic. Participants were over the age of 16 years, and more than 50 000 individuals participated. The authors assessed mental health through psychological distress levels and depressive and anxiety symptoms. The findings portrayed a deterioration of mental health after the virus outbreak. There were noticeable socioeconomic differences, where those from low-income households displayed higher stress scores. Females and younger individuals (aged 16-24) also displayed higher levels of mental distress. This was also the case for individuals that did not cohabitate with a partner (Pierce et al., 2020).

4.5 Changes in Gaming Behaviors During the Pandemic

Most studies conducted on gaming addiction were regarding children or adolescents and with a cross-sectional design. This section has consequently included studies with younger samples, a cross-sectional design and assessing game time.

4.5.1 Longitudinal Gaming Trends in University Students and Adolescents

A longitudinal study explored gaming behavior and internet gaming disorder (IGD) among college students during lockdown (Balhara et al., 2020). The sample consisted of 128 students, and the mean age was 19.6 years (SD 1.9). Males made up 40% of the sample. The authors assessed IGD through nine items reflecting domains including tolerance, withdrawals, problems, relapse, preoccupation, and mood modification (IGDS-SF9). This scale is theoretically derived from the DSM-5 criteria for pathological gaming. Approximately half of the subjects reported increased gaming habits during the lockdown. Meanwhile, 14.6% decreased their gaming levels. Many students reported gaming to combat pandemic-related stress (Balhara et al., 2020).

Haug et al. (2022) conducted a two-wave longitudinal study in Norway with 2940 adolescents aged 12-19 in 2020. They examined the change in gaming habits and the association with physical inactivity. Gaming behavior was assessed by subjects reporting changes in gaming activity at both time points. Compared to before the national lockdown, 41% of boys reported to game a lot more, and 35% reported to game more at t1 in April 2020. The respective numbers for girls were 14 and 23%. At t2, in December 2020, 20% of boys and 9% of girls reported gaming much more than their time at t1. Thus, for 37% of boys, the trend for gaming across t1 and t2 was "more and increasing," while the respective number for girls was 17%. (Haug et al., 2022). The associations between gaming and physical inactivity will be elaborated on in section 4.6.

4.5.2 Cross-Sectional Findings Regarding Gaming Behavior

Wang et al. (2023) investigated the prevalence of IGD during the pandemic and examined associated risk factors among university students in Macao. The study had a cross-sectional design and included 229 students. Of the sample, 63.8% were female, and the mean age was 24.42 (SD 3.17). IGDS-SF9 was used to explore gaming addiction, as Balhara et al. (2020). More men than women were reported to suffer from IGD (Wang et al., 2023). There was a significant increase after the virus outbreak, and the authors suggested that the social stress caused by the pandemic instigated this escalation. Engaging in video games relived individuals' loneliness by connecting them with friends. Both addicted and non-addicted gamers claimed to use gaming to escape reality. The authors found that men had a higher risk of developing IGD. Increased gaming habits were also a risk factor. The mean age was higher in the IGD group than in the non-addicted group, indicating that higher age increased risk (Wang et al., 2023).

Han et al. (2022) conducted a systematic review examining the pandemic´s impact on gaming addiction in adolescents and children. A total of 18 studies published from 2020 to 2022 were included, where the majority had a cross-sectional design. Participants were all under 19 years of age. The studies explored IGD in various ways, where the most common were scales based on the DSM-5 criteria for pathological gaming. Most studies found increased time spent playing video games and gaming addiction. Males and adolescents scored higher on the game addiction scale. Predisposing risk factors for gaming addiction were anxiety and depression. The authors argue that the increased gaming hours were related to coping mechanisms and avoiding social isolation and loneliness (Han et al., 2022). Another systematic review aimed

to examine internet-based addictive behavior during the pandemic (Masaeli & Farhadi, 2021). Eleven studies were included, of which eight studies examined internet gaming addiction. Both longitudinal and cross-sectional studies were included. There were 16.078 participants with ages ranging from six to 45. The included articles reported an overall increase in internet gaming addiction during the lockdown (Masaeli & Farhadi, 2021).

A Swedish cross-sectional study examined possible changes in gaming addiction among 1501 young people during the third wave of the pandemic in March 2021 (Claesdotter-Knutsson et al., 2022). The sample included individuals over 16 years. Females represented 51.5% of the sample. The authors conducted an online survey analyzing self-reported gaming activity against health and sociodemographic factors. Gaming addiction was assessed in this survey through the Gaming Addiction Scale for Adolescents, also based on the DSM-5 criteria. The final sample was n = 932, as 37.9% were removed as they had never gamed before or during the pandemic. According to this study, 38% reported gaming more since the virus outbreak. In the 16-24 and 25-39 age groups, 57% and 51% reported increased gaming, respectively. It was found that spending more time at home was found positively correlated to increased gaming. Disposable income, age, employment status, and exercise habits were significant confounders within the 25-39 group (Claesdotter-Knutsson et al., 2022). Another cross-sectional study supported the increase in gaming time. The previously mentioned SHoT-study (Sivertsen, 2021) found that Norwegian students increased their time spent gaming during the Covid-19 pandemic. Moreover, more male students exhibited heightened levels of game play. All included age groups reported more or less the same increase (Sivertsen, 2021).

4.6 Associations Between Physical Activity and Problematic Gaming Behavior

The following section includes studies assessing the association between physical activity and gaming behavior during the pandemic. Although the current study aims to assess these interrelations during the pandemic, the association is not exclusive to this period. The relationship between physical activity and problematic gaming behavior in university-age students has yet to be significantly explored and amounted to limited results. Thus, various age groups and cross-sectional studies are also included.

4.6.1 Associations Between Physical Activity and Pathological Gaming Behavior

A three-month longitudinal study from Hong Kong investigated how addicted internet gaming impacted physical activity, sleep, and QoL among university students (Kwok et al., 2020).

There were 15 participants, of which four were male, with ages ranging from 18 to 35 (mean age = 26,87). The physical activity levels were monitored through Actigraph GT9X, while gaming addiction levels were self-reported through the IGDS-SF9 questionnaire. The authors found a significant negative correlation between objectively measured physical activity and self-reported addictive gaming and time spent gaming (Kwok et al., 2020).

Another cross-sectional study from Bangladesh assessed risk factors associated with internet addiction, including online gaming (Hassan et al., 2020). The sample included 454 young adults aged 19-35. Of the sample, 27.1% displayed addictive behaviors, affecting most males. The authors found a significant association between internet addiction and the recommended amount of physical activity. Males were more prone to internet addiction, but there were found no gender differences in the relationship between internet addiction and physical activity. High socioeconomic status was also inversely associated with gaming addiction. Not living alone could potentially protect against problematic internet use (Hassan et al., 2020).

4.6.2 Associations Between Physical Activity and Gaming

Haug et al. (2022) found in their previously mentioned longitudinal study that increased gaming levels at t1 and t2 were associated with physical inactivity at t1. There was observed increased gaming habits among many participants, particularly boys, which was found to be associated with physical inactivity during the first phase of the pandemic (Haug et al., 2022). A Norwegian longitudinal study was conducted on children aged 8 to 14 regarding levels of physical activity and gaming (Hygen et al., 2022). The study found that increased gaming resulted in reduced levels of MVPA, but the trend was only found in males. Moreover, increased MVPA leading to decreased gaming activity was also solely applied to males (Hygen et al., 2022).

Peterson et al. (2018) conducted a cross-sectional study with 94 students from an American university, of which 51% were males. The authors examined objectively measured physical activity and sedentary behavior in 18–20-year-old students. An accelerometer was used to measure these levels. The most common sedentary behaviors included video gaming and computers. It was found that students with high amounts of MVPA might also report high amounts of sedentary behavior (Peterson et al., 2018). Another cross-sectional study was conducted on 726 first-year university students in Chile regarding the relationship between self-reported screen time, physical activity, and QoL (Lavados-Romo et al., 2021). The

participants were 18-24 years old. Screen time was measured through self-reported hours during leisure time. Frequency, duration, and intensity of physical activity in the last seven days were also reported. Men displayed higher levels of both screen-time exposure and physical activity. Those with the lowest screen time were more adherent to following the recommendations for physical activity. The correlation was consistent regardless of physical activity levels, gender, or socioeconomic status (Lavados-Romo et al., 2021).

4.7 Associations Between Physical Activity and Quality of Life

A Norwegian longitudinal study by Havnen & Ernstsen (2022) examined if a change in self-reported physical activity levels (IPAQ) during the initial phase of the pandemic could predict the severity of symptoms of depression and anxiety six months later. The study investigated physically active adults. A total of 855 subjects were included (32.6% female). It was found that individuals who reported increased physical activity at baseline had a higher risk of anxiety symptoms six months later. This was also the case for depression symptoms, but solely for women (Havnen & Ernstsen, 2022).

Abrantes et al. (2021) conducted a systematic review of thirty cross-sectional studies from various countries to explore the relationship between physical activity and QoL among college students. The studies were conducted before the pandemic, and 19.731 students participated. A positive relationship was found between QoL and physical activity in most studies, indicating that students who engaged in more physical activity displayed higher levels of QoL. No gender differences were reported in the studies (Abrantes et al., 2021).

A study by Kekäläinen et al. (2020) aimed to investigate the longitudinal and cross-sectional associations between mental well-being, physical activity, and subjective health in 303 middle-aged Finnish adults. The study followed the participants from around eight years old up to age 50 with intervals of six to eight years. The physical component was measured by one question assessing their exercise during leisure time. Mental well-being was assessed through social, emotional, and psychological dimensions. Physical activity was shown to be related to present mental well-being. Over time, higher levels of mental well-being appeared to be a resource in promoting and predicting participation in physical activity in both genders (Kekäläinen et al., 2020).

An Irish cross-sectional study conducted in November 2020 explored the impact of Covid-19 restrictions on well-being and physical activity in adolescents (Muprhy et al., 2021). The sample consisted of 3021 individuals, with 54.9% girls. The ages ranged from 12 to 19, with a mean age of 14.5 (SD 1.6). This study measured only moderate to vigorous physical activity. Psychological well-being and symptoms of depression and anxiety assessed mental well-being in the participants. The authors found no overall change in the frequency of physical activity in the sample. There were found increased levels in symptoms of depression, particularly in girls, and no notable differences in well-being and anxiety symptoms for both genders. Achieving the recommended physical activity levels on more days was associated with lower symptoms of depression and anxiety and higher levels of well-being, both in girls and boys (Murphy et al., 2021).

4.8 Associations Between Quality of Life and Problematic Gaming Behavior

The temporal interrelation between problematic gaming behavior and QoL has not been greatly explored with a longitudinal design among university students. Consequently, there are cross-sectional studies and other age groups included in this section. Moreover, due to sparse literature, there are included studies examining the association between game time and QoL to further elucidate the interrelation.

4.8.1 Associations Between Quality of Life and Internet Gaming Disorder

A longitudinal study examined anxiety and depression symptoms related to IGD before and during the pandemic in Chinese children and adolescents (Teng et al., 2021). The sample included 1778 subjects, with approximately 50% of each gender. The two-wave study collected data from October to November 2019 (t1) and April to May 2020 (t2). The study applied the IGDS9-SF to examine IGD. The authors used a cross-lagged panel model. The results showed increased video game engagement and IGD for adolescents at t2. The authors also found that if the subject experienced symptoms of anxiety and depression before the virus outbreak, it could predict the use of video games and the severity of IGD during the pandemic. Boys were more likely to engage in video games and later experience IGD. Boys had a more robust prediction between anxiety and depression symptoms at t1 and IGD at t2 than girls (Teng et al., 2021).

Fazeli et al. (2020) researched mediating factors between QoL and IGD among adolescents during the virus outbreak in Iran. The cross-sectional study included 1512 subjects aged 13 to

18 (56.4% male). IGD was assessed through the IGDS9-SF. Fifteen questions exploring domains including social, emotional, and physical functioning measured QoL. Levels of stress and symptoms of anxiety and depression were also reported. Despite gaming having the potential to improve health, problematic or addictive gaming behavior was found to be associated with psychological health issues such as depression, loneliness, and anxiety. The benefits of gaming were, therefore, highly dependent on the duration and frequency of gaming. IGD was positively correlated to various psychological issues, such as depression, stress, and anxiety (Fazeli et al., 2020). Masaeli & Farhadi (2021) highlighted in their systematic review mentioned in section 4.5.2 that gaming helped the participants manage stress related to the pandemic. However, it was found that psychological problems such as loneliness might appear due to excessive gaming (Masaeli & Farhadi et al., 2021), supporting the study from Fazeli et al. (2020).

4.8.2 Associations between Quality of Life and Gaming Time

Barr & Copeland-Stewart (2022) conducted an online survey examining how video game activity impacted subjects' mental well-being during the pandemic. There were 781 participants, all older than 16, of which 50% fell in the 16-24 age range. Students were the largest group included in the study, with 46,5% of the sample, although this includes a smaller portion of high school students. The authors assessed gaming activity through open-ended questions and whether the pandemic had impacted their gaming behavior and further how it impacted their well-being. The study found that 71% reported increased gaming time during the pandemic and 40% played every day after the Covid-19 outbreak. Subjects reported increased gaming habits to cope and reduce stress and anxiety. It was also mentioned that it gave them cognitive stimulation, a feeling of control, achievement, purpose, and a sense of normality. The social aspect of gaming also enabled the respondents to combat loneliness and socialize with family and friends. Gaming overall positively impacted the subject's perceived well-being during the Covid-19 pandemic, with 58% reporting positive modifications. The majority perceived that gaming positively impacted their well-being (Barr & Copeland-Stewart, 2022). However, other cross-sectional studies contradiction these findings.

The previously mentioned study by Claesdotter-Knutsson et al. (2022) found that increased gaming habits were positively correlated to psychological distress during the pandemic. This association was supported by a study from the UK exploring the association between mental health and screen time in adults self-isolating during March 2020 (Smith et al., 2020). The

sample included 932 adults 18 years and above, of which 36.1% were men. A positive correlation was found between poor mental health and increased screen time. Being younger, unmarried, single, and less physically active were factors associated with increased screen time per day in both genders (Smith et al., 2020).

4.9 Summary of Literature Review

Gaming is an increasingly popular activity, and studies found increased gaming activity and problematic or addicted gaming behavior after the virus outbreak. Spending more time at home during social restrictions has been found associated with increased gaming, which further was a risk factor for developing a gaming addiction. Gaming can have health-promoting properties, such as improving QoL and mental health and providing cognitive stimulation. In the context of the pandemic, gaming can relieve stress and anxiety and give individuals feelings of normality, control, purpose, and achievement. However, excessive gaming tends to have negative consequences for the individual. Mainly men were reportedly affected by gaming addiction. Pathological or addictive gaming may cause psychological, social, and physical issues and increased sedentary behavior. Additionally, problematic gaming may negatively impact QoL and well-being. Lower levels of QoL may also influence gaming behavior, where lower QoL was associated with increased video game use. Moreover, studies suggest increased sedentary behavior and a decline in physical activity during the pandemic in university students. There was discrepancy in the association between gaming addiction and physical activity, but most studies found a negative relationship between the two behaviors in both directions. Physical activity has several health-promoting aspects, such as improving QoL and mental well-being. Most studies found that QoL and mental well-being deteriorated in the overall population, particularly in university students. This literature review found that students displayed some concerning gaming behavior, physical activity, and QoL trends during the pandemic. Students are generally a vulnerable group in society with increased stressors. The social measures have seemingly impacted problematic gaming behavior, physical activity, and subjective QoL and mediated associations within interrelations between variables.

4.10 The Purpose of This Study

Several studies assess physical activity, QoL, and problematic gaming separately and within interrelations, but there is a lack of longitudinal studies, particularly during the Covid-19 pandemic. Although a particularly vulnerable population group, students are also less represented in research compared to children, adolescents, and adults. To the best of the author's knowledge, no longitudinal study explores the development in, and interrelations between, QoL, physical activity, and problematic gaming behavior and their cross-lagged associations in Norwegian university students during the pandemic. Hence, the current thesis aims to fill this gap in scientific literature and research concerning these topics among university students in the context of Covid-19.

4.11 Research Questions

Based on the aforementioned problem statement, this thesis aims to examine the following research questions:

I. Did the quality of life, physical activity, and problematic gaming behavior change in Norwegian university students during the period January-November 2020?

II. Was the development in these outcomes different for male and female students?

III. What were the cross-lagged associations between quality of life, physical activity, and problematic gaming during this period?

IV. Were these associations similar across genders?

5 Methods

This chapter will present the scientific research design and methodological approach. First, the philosophical approach is evaluated. The SPoT study's sampling, response rate, and data collection will be presented. The variables and how they are incorporated into the study will also be explained. Data management methods will be accounted for. The applied data analyses are elaborated. Quality assurance is an essential aspect of all scientific research. Hence, the study's reliability, validity, objectivity, and the analyses' assumptions will be accounted for in light of the quantitative nature of this work.

5.1 Philosophical Approach to Science

Although typically hidden in today's research, philosophical considerations are essential to the process and must be identified (Creswell & Creswell, 2018, p. 5). This study ensued to examine both the change over time and the interrelations between variables. These concepts are rooted in the philosophical approach of positivism, which was formed during the transition between the 16th and 17th centuries (Green et al., 2019, p. 535; Neuman, 2014, p. 97). Positivism is widely acknowledged as the primary approach of the natural sciences. Positivism involves deduction, which includes moving from general principles to a specific conclusion, rather than induction, which moves in the opposite direction. A deduction is more rigorous and reliable for testing theories, and positivists aim to derive specific predictions that can be tested empirically using objective evidence (Green et al., 2019, p. 535; Neuman, 2014, p. 97). The other major philosophical paradigm is hermeneutics (Dalland, 2020, p. 41; Neuman, 2014, p. 96; Thomassen, 2006, p. 44). This approach is almost solely associated with qualitative research, so it will not be further elaborated.

Today, postpositivism is a more common philosophical approach to research than positivism (Ringdal, 2018, p. 39). Postpositivism was a response to the rigid principles within the positivism paradigm in which an inductive process solely verifies knowledge through systematic observations (Ringdal, 2018, p. 38). The positivist and postpositivist ontological standpoints both consider there to exist an objective reality that can be acknowledged through observation. However, the postpositivist approach differs by accentuating that truth can never be thoroughly comprehended nor discovered (Thomassen, 2006, p. 145). Thus, the postpositivist approach is deterministic and believes knowledge to be probabilistic rather than an absolute truth (Creswell & Creswell, 2018, p. 6).

Research within this paradigm commonly ensues from hypotheses that one can test through controlled studies and compare outcomes to measurable, observable, and quantifiable data (Thomassen, 2006, p. 145). Karl Popper, a prominent figure within the postpositivist field, argued for deductive reasoning in scientific research (Thomassen, 2006, p. 67). Both inductive and deductive reasoning are principal processes through the hypothetico-deductive method, which is associated with postpositivism (Green et al., 2019, p. 535; Ringdal, 2018, p. 45). This approach draws inductive conclusions based on previous research and knowledge before specific assumptions are tested against observable data (Ringdal, 2018, p. 45). The present thesis is based on previous research and the possible temporal effects between variables. This is the inductive part of the method. Research questions were then formed. Finally, statistical analyses were applied to examine the data collected, encompassing the deductive dimension.

The SPoT study has a longitudinal design, and questionnaires were used in the data collection. The conceptions within postpositivism consequently align with the research that this thesis derives from. The longitudinal design is heavily related to the quantitative field. Furthermore, the quantitative method is highly associated with the postpositivist philosophical theory of science (Creswell & Creswell, 2018, p. 6). Quantitative research is often used to identify causality with quantifiable data where knowledge is based on observed effects (Pripp, 2016), which is a central concept within this work. Quantitative research typically enquires about correlations, trends, occurrences, and causal effects by including larger samples where the conclusion is rooted in the statistical analysis of the data (Cozby & Bates, 2019, p. 113).

5.2 Research Design and Methodological Approach

This thesis ensues from the SPoT study conducted by the NIPH. The research has a longitudinal design where the participants were asked to answer short weekly questionnaires from January 2020 to February 2021. The participants were also asked to complete a more comprehensive questionnaire in January 2020 (t1 - baseline), June 2020 (t2), and November 2020 (t3). These time points (t1-t3) make the data this thesis derives from.

Survey research provides the researcher with quantifiable descriptions of a population's opinions, trends, or attitudes by inquiring about a sample from the given population, typically using questionnaires or structured interviews (Creswell & Creswell, 2018, p. 16). Survey

research intends to generalize the data from the sample to the studied population. This includes longitudinal and cross-sectional research (Creswell & Creswell, 2018, p. 16).

An advantage of the longitudinal design is that they are generally more powerful than cross-sectional research (Usami, 2020). The longitudinal design is more applicable when examining temporal trends (Punch, 2014, p. 70), aligning with the aim of the current study. These studies gather data across several time points and are often applied when one aims to inquire about the development of trends over time, which is the purpose of this thesis (Neuman, 2014, pp. 44-49). The longitudinal design can be used for exploratory and descriptive purposes, but surveys are most commonly associated with descriptive research. Unlike experiments, survey research, such as the SPoT study, does not manipulate participants through situations or conditions. It collects data from individuals who are asked the same questions through a questionnaire or an interview. As the data collection occurs across time one can provide a "moving picture" of social relations, events, trends, or people. A disadvantage is the risk of interrupted or incomplete follow-ups from participants and being generally more complex, costly, and complicated to conduct (Neuman, 2014, pp. 44-49).

5.3 Sampling and Response Rate

All students that attended the UoB in January 2020 with Norwegian as their native language were eligible to participate in the SPoT study. The UoB provided the NSD with contact information from all their students at the time. The NSD then drew a random sample of 15 000 students invited to participate in the study. The response rate for the baseline questionnaire was approximately 30% (4150). There was a significant decline in respondents from t1 to t3. The sample dropped to 1869 (t2) and further to 987 (t3), which is approximately 23,8% of respondents of the original sample from baseline.

5.4 Data Collection

The students were requested to complete a comprehensive online baseline questionnaire. This questionnaire covered subjective and objective QoL, mental and physical health, and health-related behaviors. Some demographic measures were also assessed. This questionnaire took approximately 30 minutes to complete. Those who agreed after that received weekly, shorter questionnaires estimated to take less than five minutes until February 2021. Two more comprehensive follow-up questionnaires were conducted in June 2020 and November 2020,

which took circa 20 minutes to complete. The participants received direct links to the questionnaires via SMS and e-mail, with one to two reminders to complete the form.

5.5 Variables and Measures

Variables are measures that may vary or change between individuals, such as physical activity, gaming behaviors, QoL, gender, income, or age (Field, 2018, pp. 9-16). There is often a proposed cause and an outcome in statistical analyses, which can be expressed in variables. The variables quantify the subject of inquiry. The independent variable *predicts* the value of the dependent value; thus they are known as outcome and predictor variables (Field, 2018, pp. 9-16). The three primary variables in the current thesis are subjective QoL, physical activity, and problematic gaming behavior. Gender is considered a variable for questions II and IV. Gender was used as a categorical binary variable with male and female categories. Respondents who did not identify as male or female were excluded from the analyses due to sparse data (n=20). QoL, physical activity, and problematic gaming were used as continuous interval variables as they measured the aspects on continuous scales and not categorically.

5.5.1 Quality of Life

Although there is no distinct definition of QoL, several quantitative measures operationalize the term by assessing various related aspects (Espnes & Smedslund, 2017, p. 277). QoL is becoming more commonly used as a health outcome to evaluate an individual's mental health, well-being, and social and physical functioning (Wu et al., 2017). The present study assesses subjective QoL. The SPoT study applied a minimum list for measuring subjective QoL as proposed by the Norwegian Directory of Health (Nes et al., 2018) (See attachment 1, p. 92). This minimum list encompasses the three dimensions of subjective QoL mentioned in section 2.1.1 and can be incorporated in its entirety in questionnaires exploring this concept. It consists of twelve questions; four are an adjusted version of OECDs (2013) recommended questions to reflect subjective QoL. The eight remaining questions explore emotions in the respective past week. Three consider positive emotions, whereas the last five concern negative ones (Nes et al., 2018). Responses for all twelve questions were coded from 0 (not at all) to 10 (to a high degree). The variable of subjective QoL was calculated by the sum score of all twelve items. Higher scores reflected higher perceived levels of subjective QoL.

5.5.2 Problematic Gaming Behavior

Problematic gaming behavior among the subjects was measured using the GAS-7 scale, where each question represents one of the seven addiction criteria mentioned in section 2.3 (Brunborg et al., 2015; Lemmens et al., 2009). All seven aspects of the GAS scale were represented by one question, except for *problems* with two related questions in the survey. The response options ranged from 1 (never) to 5 (very often). An overall higher sum score indicated more severe and problematic gaming behavior. The GAS-7 scale is typically used to categorically place the subjects in engaged, pathological, or addicted gaming behavior at specific cut-off points (Lemmens et al., 2009). However, this thesis used it as a continuous scale, as Liu et al. (2020) did when examining gaming addiction among university students. Thus, a higher sum score suggests more severe gaming behavior.

As a disclaimer, the term problematic gaming behavior is used throughout the current study when discussing this variable. This instrument measures gaming addiction, but as the continuous scale does not distinguish between the specific categories of gaming behavior, a broader term will be used to discuss high scores.

The questions from the SPoT study regarding gaming behavior translated to English were: "How often in the last six months …"

1. *Salience:* "Did you think of a video game all day?"
2. *Tolerance:* "Did you spend increasingly more time on video games?"
3. *Mood Modification*: "Did you use a video game to avoid thinking of other things?"
4. *Relapse:* "Have others unsuccessfully tried to reduce your game use?"
5. *Withdrawal:* "Did you feel bad when you could not, or was not allowed to, play?"
6. *Conflict:* "Did you get into arguments with others (e.g., parents, friends, or other important people) because you played too much video games?"
7. *Problems:* "Did you avoid engaging in other activities (e.g., school, work, homework, sports, or hobbies) to play video games?"
8. *Problems:* "Did you avoid going to bed to play video games?"

5.5.3 Physical Activity

To assess physical activity, the subjects were presented with a brief definition of exercise: "*With exercise, we mean that you for example go for a walk, go skiing, swim, or take part in a sport".* Physical activity was measured by three questions (the three-item questionnaire)

(Grasdalsmoen et al., 2019) assessing the participants habits for frequency of exercise, the average intensity, and the average hours spent per session. The response categories for frequency of exercise were ‘never’ (0), ‘less than once a week’ (1), ‘once a week’ (2), ‘2-3 times per week’ (3), ‘4-5 times per week’ (4), and ‘almost every day’ (5). The average intensity was assessed by asking the participants how hard they pushed themselves when exercising. The options were ‘I take it easy without breaking into a sweat or losing my breath’ (0), ‘I push myself so hard that I lose my breath and break into a sweat’ (1), or ‘I push myself to near exhaustion’ (2). The participants were also asked how long each session lasted, with possible responses ‘less than 15 minutes’ (0), ‘15-29 minutes’ (1), ‘30 minutes – 1 hour’ (2), ‘more than one hour’ (3). The variable for physical activity was then calculated by a simple algorithm as outlined by Kurtze et al. (2008) on a scale from 0 to 18, with higher scores representing higher quantities, intensity, and duration of physical activity.

5.6 Covariates

Covariates are also known as control variables (Punch, 2014, p. 209). These variables might confound or interfere with the relationship(s) being studied. Thus, when including these variables in the analysis, the effects of these aspects are removed (Punch, 2014, p. 209). In this thesis, age, gender, socioeconomic status, and having a partner were deemed appropriate covariates based on the literature review and previous research. Questions in the study were asked in Norwegian but will be directly translated into English by the author of this thesis.

Age was measured on a continuous scale where participants reported their age numerically. The subjects were asked, ‘Your age,’ and responded accordingly. Participants were also asked, ‘What is your gender?’. They could respond with female (0) or male (1). If they did not want to state their gender, their response was coded ‘2’.

Two appropriate variables in the data file measured socioeconomic status: students’ parental education and their perceived financial status. Subjects were asked, “What is your mother’s/father’s highest completed level of education?”. The responses ranged from primary school (0), high school (1), and university/college (2). The students were also asked, “Has it occurred in the past twelve months that you/your household have had trouble with managing the running expenses, e.g., for food, transportation, or residence?”. Responses were ‘never’ (0), ‘rarely’ (1), ‘sometimes’ (2), or ‘often’ (3).

They were also asked, “What is your relationship status?”. Single was coded ‘0,’ and having a boyfriend/girlfriend was coded ‘1’. If the subject had a cohabitant (*samboer*), their response was coded ‘2,’ and if they were married/registered partners, it was coded ‘3’. No response for all questions regarding the included covariates was coded ‘9’ in the data file, except for age, coded ‘99’.

5.7 Data Management Methods

The data has been checked for inconsistencies and outliers. Missing data were handled using full information maximum likelihood estimation. This means all available information from respondents is used in the analyses, even if they have incomplete data because they did not respond at T2 or T3. Research has demonstrated that this approach to missing data yields more valid results as compared to conventional methods, such as listwise deletion in which only respondents are included who have complete and valid data at all time points (Enders, 2010; Pallant, 2020, p. 219).

5.7.1 Data Management for Test of Reliability

Any negatively worded items had to be reversed before assessing Cronbach´s alpha for subjective QoL and problematic gaming behavior (see section 5.11.1). There were negatively phrased questions in the minimum list for subjective QoL (see attachment 1, p. 92). Questions M3 to M10 asked the respondents to rate to what degree they felt a particular emotion in the past seven days ranging from zero to ten. For instance, M3 refers to ‘Glad’ (happy), and M4 regards ‘Bekymret’ (concerned). Scores on the questions with negative emotions, such as annoyance, lonely, and sadness, had to be reversed so that high values all reflect the same concept, in this case, a high subjective QoL (Pallant, 2020, p. 87). All items that made up the GAS-7 scale were phrased in the same nature, where high scores for each item represented problematic gaming behavior, so none had to be reversed. The author then proceeded to make sum scores of respective variables.

5.8 Effect Sizes and Changes Over Time (Cohen´s *d*)

Effect size is an objective measure of the magnitude of an observed effect and is known as the ‘strength of association’ (Field, 2018, pp. 113-115; Pallant, 2020, p. 218). Statistical significance ($p < 0.05$) in statistics suggests that the relationship is not due to chance but does not tell the researcher about the importance of the observed effect. Effect sizes enable this. Standardized effects of time were calculated by Cohen´s *d* in this study. This effect size

presents the variation between groups regarding standard deviation units. Cohen's *d* was calculated by dividing the unstandardized regression estimate of time by the standard deviation of the dependent variable at baseline. Values of .2, .5, and .8 were considered small, medium, and large effects, respectively (Field, 2020, pp. 113-115; Pallant, 2020, p. 218).

5.9 Data Analyses in this Thesis

Ahead of the specific analyses of the research questions, a basic descriptive analysis of the data was executed to get an overview of the participants. To obtain these statistics, the author used IBM SPSS Statistics 18. The findings from these analyses are presented in section 7.1. For research questions I and II, linear mixed models were used. A cross-lagged panel model was used for research questions III and IV. For these analyses, STATA Network 17 was used. These will be further elaborated on in their respective sections. The graphs in section 6 were illustrated using Prism 9 for MacOS, version 9.5.0 (525), based on the statistical output from STATA.

5.9.1 Linear Mixed Models

Linear mixed models, or multilevel models, are a form of hierarchal regression (UCLA, 2021). The model is an extension of the simple linear regression model by incorporating fixed and random effects, accounting for the correlation among observations within the same group. This analysis is particularly useful and appropriate when the data has a hierarchical structure and is non-independent (UCLA, 2021). The data is allowed to display varying and correlated levels of variability when using this model (IBM, 2021). This analysis enables researchers to model the variance, covariance, and means. Thus, linear mixed models are more powerful and flexible than ordinary hierarchical regression when analyzing longitudinal data. They allow for the estimation of individual-level effects while adjusting for the group-level effects using random effects (IBM, 2021). Robust estimation was used to account for potential non-normality.

In this particular study, dependence across time points was modeled using a random intercept. For research questions I and II, time was coded as 0 (January 2020), 1 (June 2020), and 2 (November 2020) and used continuously as an independent variable. For research question II, there was added an interaction effect between time and gender. This interaction effect allows the researcher to explore whether the effect of time is different for men and women. The linear mixed models used a data file with a long format. In this format, each observation is

represented by a single row, and a separate column represents each variable. This format facilitates modeling random and fixed effects (UCLA, 2021). One crude model was included, one adjusted for covariates, and one analysis with an added interaction effect was also adjusted for covariates.

5.9.2 Cross-Lagged Panel Models

Cross-lagged panel models must include longitudinal data in which each subject or observation is documented over multiple time points (Kearney, 2017). The main objective of this analysis is to examine temporal relationships and influences between two or more variables, as the aim of research questions III and IV are. A temporal association is where the cause precedes the effect (Green et al., 2019, p. 83). This analytical approach assesses the directional influences or reciprocal correlations between the respective variables over time (Kearney, 2017). A 'cross-lagged' model indicates the path between one variable at time point t – 1 and another variable measured at a later time point, t (Usami, 2020).

As the variables were measured at different scales, all cross-lagged panel models were standardized in STATA for the regression coefficients to be comparable. For the sake of simplicity, estimates were estimated to be equal across time. Standardized regression coefficients "indicate the number of standard deviations that scores in the dependent variable would change if there were a one standard deviation unit change in the predictor" (Pallant, 2020, p. 168). Consequently, there were three main predictor variables for each outcome variable. This was the appropriate analysis as research questions III and IV aimed to examine the predictive interrelations between variables using longitudinal data. The cross-lagged analyses included in this study are one crude model, one adjusted for covariates, and one with an added interaction effect, also adjusted for covariates. Each dependent variable has six main predictor variables for this analysis.

5.10 Checking Assumptions in the Analyses

Proper statistical analyses require that one considers the set of assumptions that follow each analysis (Pallant, 2020, pp. 229-239). Checking for these assumptions will help the researcher ensure that the chosen statistical model is reliable and valid. The assumptions represent conditions that must be met for the model to reflect the underlying data and produce meaningful results accurately. If the related assumptions are not sufficiently met, the statistical results may be incorrect or biased, leading to incorrect conclusions and flawed

decision-making. Therefore, checking assumptions is critical in statistical analysis to ensure the results are trustworthy and accurate. Checking for these assumptions allows the researcher to identify and address potential problems (Pallant, 2020, pp. 229-239).

Although not an explicit assumption in either analysis, the sample also must be of sufficient size. The necessary sample size may vary based on various factors. The two most common formulas account for how many independent variables are included in the model. The formulas are 8m + 50 or m + 104 (m = the number of independent variables) (Tabachnick & Fidell, 2013, p. 160). In the current study, the lowest number of respondents was 981. For adjusted models, the most amount of variables was eight. Thus, the sample size is considered sufficient using both formulas.

5.10.1 Assumptions of the Linear Mixed Models

The assumptions related to the linear mixed models are more or less similar to those related to linear regression, including linearity, normality, independence, and homoscedasticity (Field, 2018, pp. 385-388; Pallant, 2020, p. 156-165). Multicollinearity and outliers are critical assumptions for linear regression but are not included in linear mixed models as this model already accounts for random effects (multicollinearity) and is robust to moderate levels of outliers. Tests for these assumptions were conducted in SPSS. Linearity includes that the variables are related linearly to the responses. Normality assumes that the errors are normally distributed. Independence in the data means that the errors are independent of each other. Finally, the errors must have a constant variance, which is the assumption of homoscedasticity. Violating these assumptions may lead to inefficient and biased estimates of the regression coefficients and can thus affect the accuracy and reliability of the statistical inference in the model (Field, 2018, pp. 385-388; Pallant, 2020, p. 156-165). The Normal P-P plot of Regression Standardized Residual in SPSS presented the points in a straight line from the bottom left to the top right corner. The scatterplot of residuals was also roughly rectangular. These findings suggest linearity, homoscedasticity, independence, and no significant deviations from normality in the data (Pallant, 2020, p. 164).

5.10.2 Additional Assumptions of the Cross-Lagged Panel Models

As used in this thesis, the cross-lagged panel model is best suited to study predictive relationships and not causal associations. Still, several vital assumptions are associated with this analysis, such as synchronicity, stationarity, and stability (Kearney, 2017). Synchronicity

assumes that the measurements at t1, t2, and t3 occurred simultaneously. This assumption is upheld in the SPoT study. Stationarity assumes that the variables and relationships stay the same across time. This requires that the time intervals between measurements are approximately constant, which is the case in this study. The assumption of stationarity has not been formally tested as this was considered beyond the scope of this master thesis. Further, stability is an assumption that often does not hold. This assumes no differences between individuals, or inter-individual differences, in stability over time. Ideally, these stable individual differences should be accounted for in the model. Failure to meet this assumption is an important reason why a causal interpretation of the cross-lagged panel model is problematic. Alternative models often require four-time points or more, which was unavailable in the current study (Kearney, 2017).

5.11 Quality Assurance

Within the quantitative method, there are specific steps to ensure quality in research. Essential terms are reliability, validity, and objectivity (Morse, 2015; Punch, 2014, p. 240; Yilmaz, 2013). When analyzing the data and conducting the statistical analyses in SPSS and STATA, these criteria had to be met to secure quality in this research. Given that the data was already collected before the author's involvement, quality in the measurements, analyses, and interpretation could be assured, though not in the data collection and planning stages.

5.11.1 Reliability

Reliability suggests consistency or dependability in research (Neuman, 2014, p. 212). High reliability is achieved when there is compliance between observations or findings among separate researchers. This shows that the measurement tool is independent of the researcher applying it (Johannessen et al., 2010, p. 40). Reliability is a central concept in the quantitative field that encompasses both consistency over time and internal consistency (Punch, 2014, p. 237). The measurements of internal consistency regard to what degree the items that make up the scale consolidate and whether the items are all measuring the same underlying construct (Pallant, 2020, p. 102).

Cronbach's alpha coefficient (α) is one of the most used measures to evaluate internal consistency. Cronbach's alpha was applied in the present thesis to assess this aspect of reliability in the measurements of problematic gaming behavior and subjective QoL. The physical activity score was based on a simple algorithm, not a sum score, and Cronbach's

alpha was not applicable. Values ranging from .7 to .8 are deemed acceptable (Field, 2018, pp. 821-823). When values for Cronbach´s alpha are within the accepted range, it ensures that the measurement reflects the underlying constructs that it is supposed to. To obtain Cronbach's alpha, SPSS was used. The respective Cronbach´s alpha for gaming was .89, and the subjective QoL was .90, meaning they are both well above the generally accepted range of .7 to .8. The GAS-7 scale has previously been tested for its reliability and showed high values of Cronbach's alpha at .81 and .86 across two samples (Lemmens et al., 2009). Therefore, one can assume that the items that make up the respective scales for problematic gaming and subjective QoL consistently reflected the constructs they aimed to measure (Field, 2018, pp. 821-823).

To determine the reliability of the three-item questionnaire for physical activity, a test-retest comparison was conducted in the context of the HUNT 2 study to measure consistency over time (Kurtze et al., 2007). The study participants were asked to complete the questionnaire once more, one week after completion. Kappa coefficients and Spearman's correlation coefficients showed various degrees of reliability, ranging from poor to excellent associations. The Spearman correlation for light physical activity was poor (0.17), while the correlation was moderate for hard physical activity (0.50). However, Spearman´s correlation for occupational activity was 0.85, which showed excellent reliability (Kappa coefficient weighted 0.80). These findings align with previous research indicating that it is most challenging for the subject to recall light physical activity (Kurtze et al., 2007).

5.11.2 Validity

Validity refers to which degree an idea fits with reality and consequently indicates truthfulness (Neuman, 2014, p. 212; Punch, 2014, p. 239). This aspect of quality regards whether the data collecting instrument, in this study a questionnaire, measures what it intends to measure (Pallant, 2020, p. 7). Data collected through research is a representation of reality and not reality itself (Johannessen et al., 2010, pp. 69-71). Many topics studied in social sciences are abstract, and validity includes converting these phenomena into something measurable. Validity is not absolute, but it is a criterion of quality that one should strive to fulfill (Johannessen et al., 2010, pp. 69-71). No specific coefficient proves or disproves validity, as with reliability and Cronbach's alpha (α), and it is more challenging to explicitly evaluate than reliability (Neuman, 2014, p. 215). Several variations of validity exist, such as internal, external, concurrent, and construct validity (Neuman, 2014, p .217).

External validity is the generalizability of the study, meaning if the findings can be generalized from the sample to the population from which it is drawn (Cozby & Bates, 2015, pp. 72-86; Green et al., 2019, p. 556; Johannessen et al., 2010, p. 357). The sample is relatively large, increasing the study´s external validity (Neuman, 2014, p. 221). As this survey solely enquires about students from the University of Bergen, one must consider that the findings might not be transferable to other student groups from different parts of the country. One must also consider that those who agreed to respond to the questionnaire might have certain similar traits, with the possibility of neglecting and missing extreme cases. This also lowers the external validity (Neuman, 2014, p. 221).

Internal validity regards whether a scale is likely to measure what it is supposed to and to what degree the causal or temporal relationships that are established are not due to extraneous factors (Cozby & Bates, 2015, pp. 72-86; Field, 2018, p. 15; Green et al., 2019, p. 556; Johannessen et al., 2010, p. 230). For this to happen, the study must be free from errors and confounds that might lead to incorrect conclusions (Cozby & Bates, 2015, pp. 72-86). The longitudinal design increases the internal validity of this thesis as this is more suitable for studying temporal relationships than cross-sectional studies (Johannessen et al., 2010, p. 310). The three-item questionnaire for physical activity has shown moderate associations between direct measurement of VO_2 max during maximal effort on a treadmill (r = 0.43[frequency], r = 0.40 [intensity], and r = 0.31 [duration]), and the accelerometer ActiReg (Grasdalsmoen et al., 2019). The questionnaire displaying associations with physical tests and objective measurements increases the internal validity of the instrument (Grasdalsmoen et al., 2019; Kurtze et al., 2007).

Concurrent validity involves using an already established and acknowledged measure to validate the indicator of a concept (Neuman, 2014, p. 217; Punch, 2014, p. 240). Lemmens et al. (2009) assessed the concurrent validity of the GAS-7 scale by comparing mean scores of the participants' loneliness, life satisfaction, aggression, social competence, and time spent gaming to their respective GAS-7 scores. The GAS-7 scale exhibited strong correlations with gaming time and, overall, the scale displayed high concurrent validity. Furthermore, the GAS-7 scale showed approximate results to the extended 21-item version, indicating similar validity. However, only moderate associations were found in the psychological aspects (Lemmens et al., 2009). Lemos et al. (2016) and Lemmens et al. (2009) also found high

criterion validity within GAS-7. Criterion validity involves establishing that the instrument measures what it intends to do through comparison to an objective criterion (Field, 2018, p. 15).

Construct validity has been assessed for the included physical activity and subjective QoL measures. Kurtze et al. (2007) examined the construct validity of the three-item questionnaire for physical activity. This aspect of validity involves the degree to which the measurement aligns with the theoretical concepts related to the phenomenon or phenomena being studied (Kurtze et al., 2007, p. 381; Punch, 2014, p. 240). The construct validity for the three-item questionnaire for physical activity was assessed by comparing responses obtained through the HUNT-study to those from the International Physical Activity Questionnaire (IPAQ). The authors found moderately good construct validity for vigorous physical activity and weaker associations for light activity (Kurtze et al., 2007). The minimum list for subjective QoL is applied in the SPoT study as a recommended measurement by the Norwegian Directorate of Health (Nes et al., 2018). The list was developed based on research and literature that empirically supports the list´s ability to measure the concept of QoL (Nes et al., 2018), which increases the construct validity of the SPoT study (Pallant, 2020, p. 7).

5.11.3 Objectivity

The objectivity criterium reflects the postpositivist epistemological stance on reality (Neuman, 2014, p. 121). The research should strive to be objective and value-neutral, led by a researcher who is merely an instrument of empirical data collection in their approach for an approximation of reality. The postpositivist stance recognizes that scientific research and inquiry are shaped by the assumptions and perspectives of the researcher and thus may influence how data is collected, analyzed, and interpreted. It is always important to be transparent when reporting the research process and findings, but it is essentially impossible to be entirely value-neutral when conducting research (Neuman, 2014, p. 121).

5.12 Ethical Considerations

Ethics considers the right, virtuous, or appropriate course of action. Research ethics centers on specific contextual concerns through the stages of a research process (Punch, 2014, p. 36). Several ethical aspects need to be maintained throughout the study, starting already in the planning stage of research (Dalland, 2020, p. 171). Critical ethical considerations include

anonymity, informed consent, voluntary participation, confidentiality, and privacy (Dalland, 2020, pp. 172-175; Punch, 2014, p. 47).

The ethical considerations of this study align with the Declaration of Helsinki (Punch, 2014, p. 41), a set of ethical guidelines actively used around the world when researching humans. The Regional Committee for Medical and Health Research Ethics in South-East Norway (no. 2019/1325) approved the SPoT study. The participants received a complete description of the study where they could read how the information obtained was stored and secured. Consent is only deemed valid if it is voluntary, informed, and unequivocally explicit (Dalland, 2020, p. 173). The subjects electronically consented to participate in the study after reading the description. There was an additional consent where they could specifically decline or accept that other registers could securely obtain their data from the study (see attachment 2, p. 93). The participants were informed about their right to view the data that has been stored about them. The participation was voluntary, and the participants' consent can at any time be withdrawn and further request that all data regarding them be deleted. However, this does not apply to data already incorporated in scientific research and analyses. The last date they can request this is July 31, 2029, when the project officially ends.

Anonymity is an essential ethical consideration within research ethics that protects the integrity and identity of the study´s participants (Dalland, 2020, p. 172). At the baseline questionnaire, the subjects´ social security numbers were collected, but only NSD, now Sikt, has access to these data, and this information is safely stored in a secure databank. The participants were informed that specific personal data that could link them to their responses were removed and replaced with an anonymous code. There are strict regulations as to who may access this code, and researchers and collaborators will only get access to data that has been de-identifiable. In addition, all persons dealing with the research data are under contracts of confidentiality.

6. Results

6.1 Basic Descriptive Statistics of the SPOT-Study

The sample consisted of 4186 participants, of which 67.8% (*n* = 2840) were female. The respondents' ages ranged from 18 to 73. The mean age was 24.14 years (SD 5.17). At baseline, 53.4% reported to not have a partner. Regarding socioeconomic status, 21.1% reported to experience trouble managing running expenses in the past twelve months. The majority reported that one or both parents had a college or university education (74.3%).

6.2 Changes in Physical Activity, Gaming, and Subjective QoL from t1 to t3

Table 2 presents the mean values (SD) in subjective QoL, problematic gaming, and physical activity and the output for the analyses assessing development over time. There was a statistically significant decline from t1 to t3 for subjective QoL and physical activity. Adjusting for the effect of the covariates did not substantially affect the results obtained in the crude analyses. However, Cohen´s *d* for physical activity was 0.12 and 0.35 for subjective QoL, indicating relatively small effects. Figures 3 — 5, following Table 2, display the changes in these variables from t1 to t3.

Table 2.

Mean scores (SD) of physical activity, problematic gaming behavior, and subjective QoL from January 2020 to November 2020. Output for linear mixed model analyses assessing development in variables.

	T1 **Mean (SD)**	**T2** **Mean (SD)**	**T3** **Mean (SD)**	**Crude model** **[95% C.I.]**	**Adjusted model ◊** **[95% C.I.]**
Subj.QoL	65.34 (6.18) *N – 4130*	61.82 (8.46) *N – 1853*	61.74 (8.25) *N – 981*	**-2.15*** **[-2.36 -1.95]**	**-2.17*** **[-2.38 -1.97]**
Gaming	.35 (.59) *N – 4161*	.33 (.54) *N –1881*	.30 (.50) *N – 994*	-.01 [-.02 .00]	-.01 [-.02 .00]
PA	4.76 (3.83) *N – 4160*	4.23 (3.44) *N – 1872*	3.73 (3.27) *N – 986*	**-.45*** **[-.52 -.38]**	**-.45*** **[-.53 -.37]**

* – $p < 0.001$

◊ – model adjusted for SES, age, gender, and having a partner.

Note. Statistically significant regression coefficients are highlighted.

Figure 3.

Graph of the development in physical activity in the sample from t1 to t3, CI95%

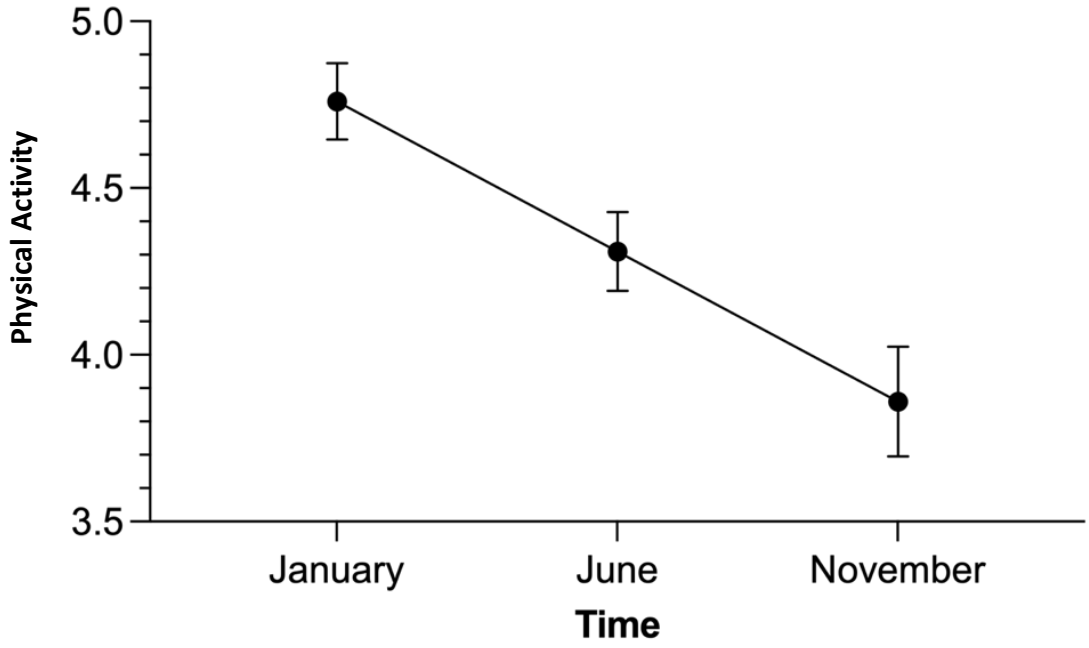


Figure 4.

Graph of the development in subjective QoL in the sample from t1 to t3, CI95%

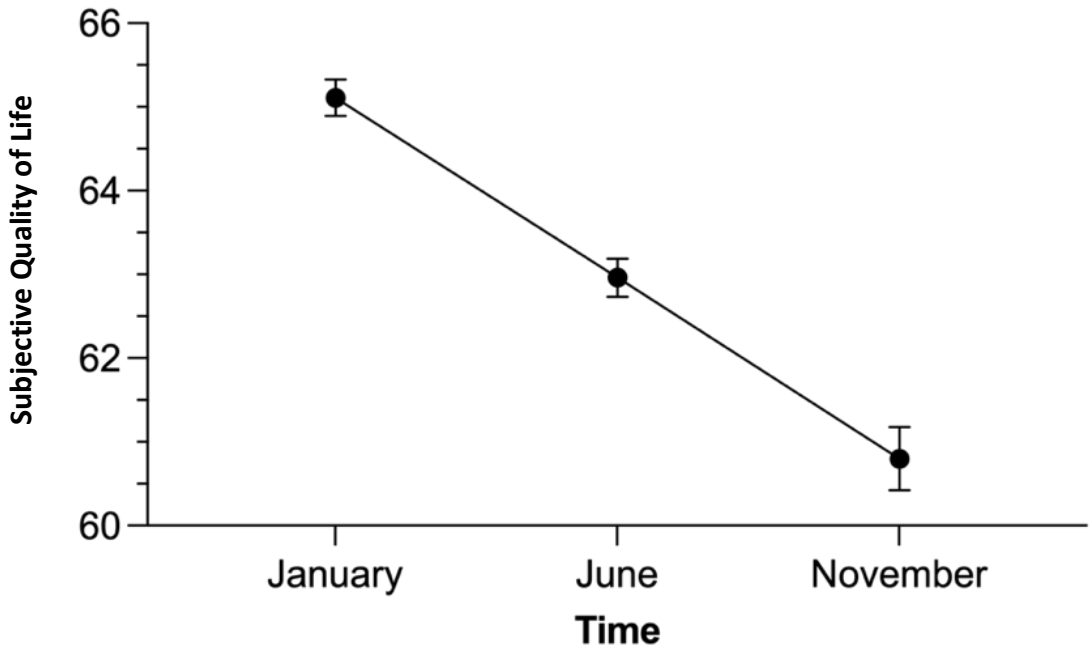
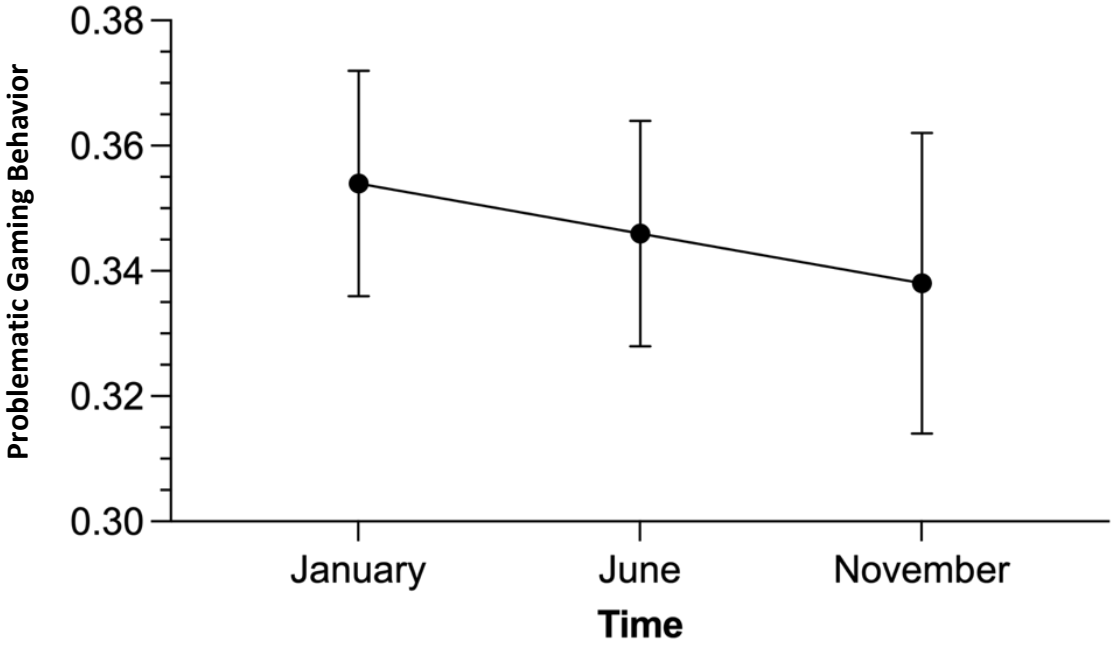


Figure 5.

Graph of the development in problematic gaming behavior in the sample from t1 to t3, CI95%



6.3 An Examination of Gender Differences

After adding an interaction term between time and gender, there were found significant gender differences over time in the development of physical activity and problematic gaming behavior. The interaction effect between time and gender was -.03 (95% CI, -.05, -.00, $p < 0.05$) for problematic gaming, and -.31 (95% CI, -.47, -.14, $p < 0.001$) for physical activity. Further linear mixed analyses regarding physical activity and problematic gaming behavior were performed separately for men and women. Women did not exhibit a significant change in their problematic gaming behavior from t1 to t3, -.00 (95% CI, -.01, .01, $p > 0.05$). However, men did report less problematic gaming behavior over time -.02 (95% CI, -.05, -.00, $p < 0.05$), with a minor Cohen's *d* of 0.03. Both women and men had a statistically significant decline in physical activity from t1 to t3. Albeit men had a more severe decrease with a coefficient of -.67 (95% CI, -.82, -.52, $p < 0.001$) compared to women, -.36 (95% CI, -.45, -.27, $p < 0.001$). Cohen's *d* were 0.17 and 0.09 for men and women, respectively. Both genders displayed similar values for physical activity at baseline, but men decreased more substantially. Male students also exhibited higher levels of problematic gaming behavior throughout the study. Figures 6 – 8 display the gender differences over time in the variables, unadjusted.

Figure 6.

Gender difference in the development of physical activity from t1 to t3, CI95%

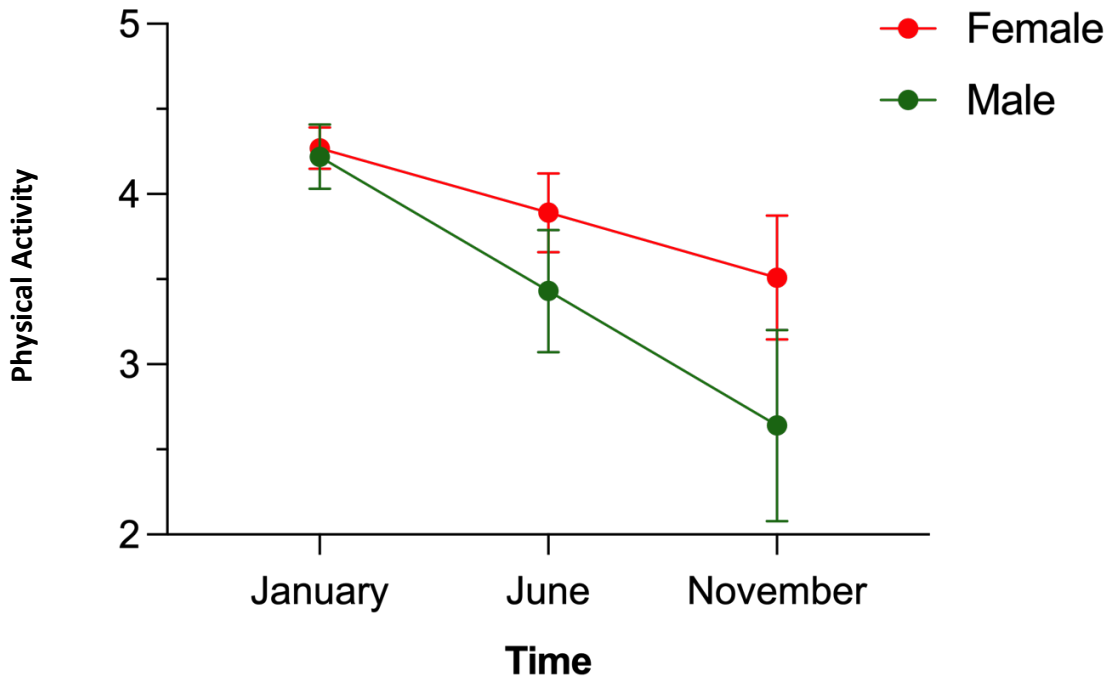


Figure 7.

Gender difference in the development of problematic gaming behavior from t1 to t3, CI95%

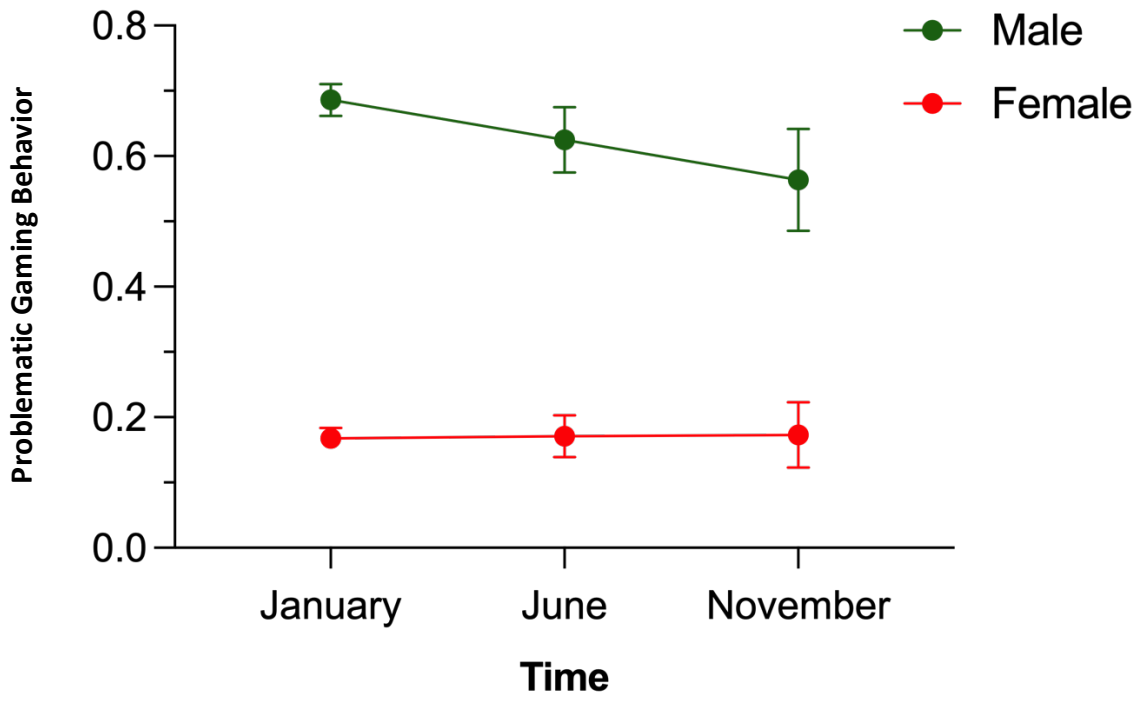
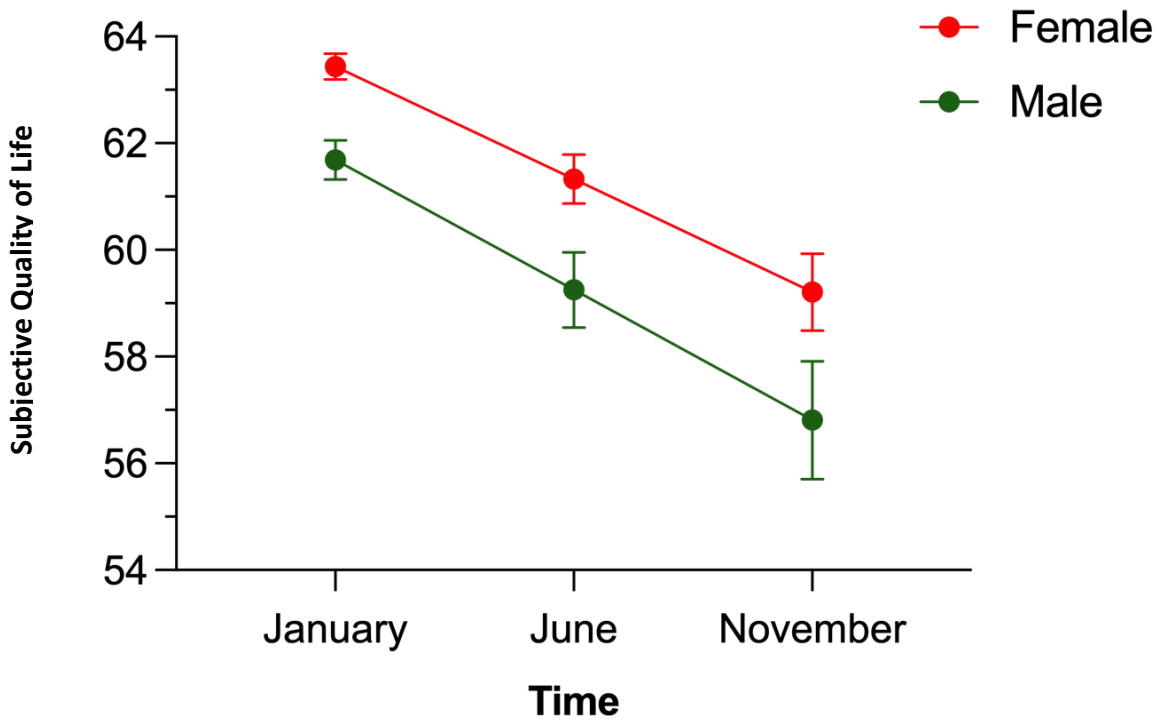


Figure 8.

Gender differences in the development of subjective QoL from t1 to t3, CI95%



6.4 The Cross-Lagged Associations Between Variables from t1 to t3

The results of all cross-lagged panel analyses are presented in Table 3 (p. 56). It includes one model with crude estimates (Figure 10, p. 55), one adjusted for covariates, and one with an added interaction effect that was also adjusted for covariates. All analyses were estimated to be equal across time points by adding labels; thus, each dependent variable has three predictor variables. The standardized models made it easier to compare to regression coefficients as the variables were measured at different scales (Field, 2018, p. 338). The strongest predictions were the autoregressive associations, where problematic gaming, subjective QoL, and physical activity predict the individual variable at later times, which is to be expected. The strongest cross-lagged association was found for problematic gaming behavior at time point t-1 and physical activity at time point t. Moreover, engaging in physical activity at t-1 suggested less problematic gaming at time point t. Thus, problematic gaming and physical activity were associated in a reciprocal negative relationship. Engaging in problematic gaming activity was also found to negatively impact subjective QoL at time t. Adjusting for covariates did not substantially alter the results from the crude model, except for problematic gaming at time t – 1 associated with subjective QoL at time t, which lost statistical significance.

6.5 Were the Cross-Lagged Associations Similar Between Genders?

Column three in Table 3 (p.56) displays output from the model with added interaction effects between time and gender, adjusted for covariates. The association between subjective QoL at t – 1 and problematic gaming at time t was the only cross-lagged relationship with a statistically significant gender difference. Autoregressive associations of problematic gaming behavior were somewhat stronger for men compared to women, whereas autoregressive associations of physical activity were somewhat weaker for men as compared to women, but these are not within the scope of the current study.

Figure 10.

Illustration of the crude model for cross-lagged associations between physical activity (PA), subjective QoL (Sublq), and problematic gaming behavior (Gam) from January 2020 (t1), June 2020 (t2), to November 2020 (t3).

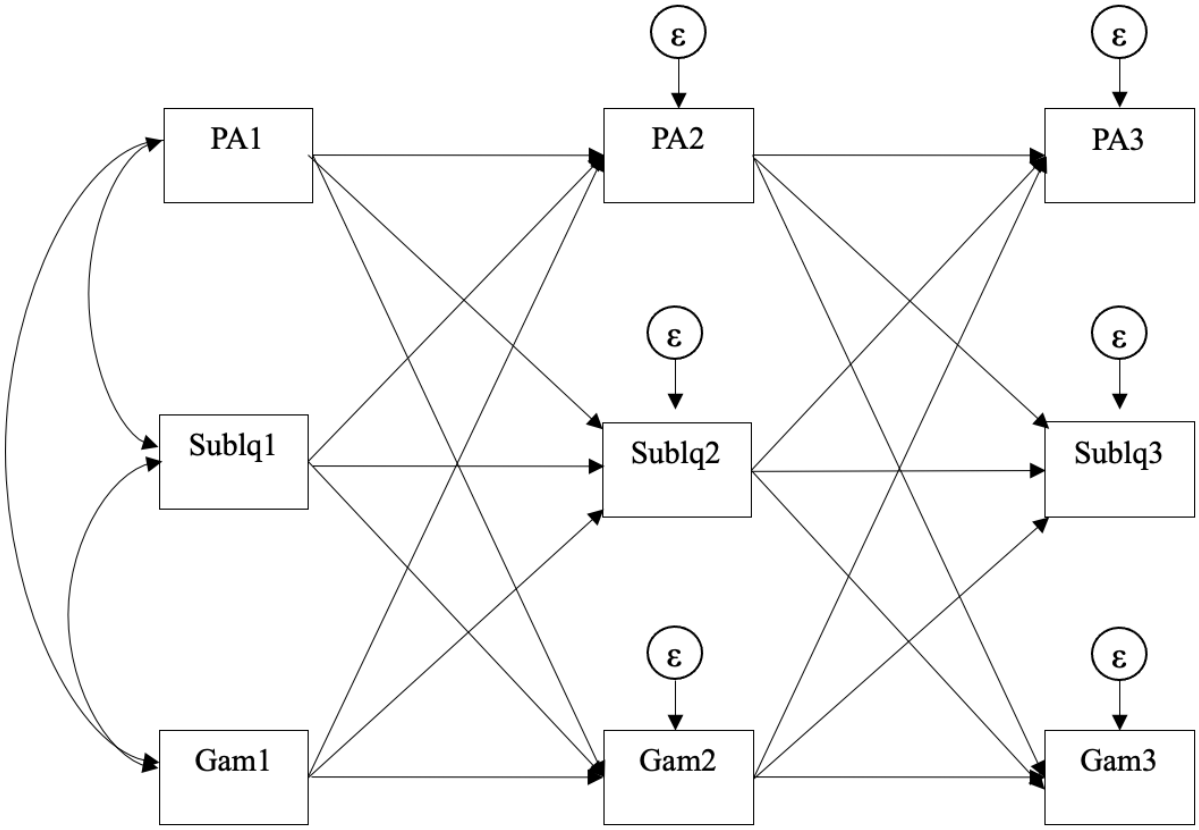


Table 3.

Output for all CLPM analyses assessing the temporal interrelationship between the variables.

Time t	Time t – 1	Crude ‡ [95% C.I.]	Adjusted ‡† [95% C.I.]	Interaction ‡◊ [95% C.I.]
PA (t)	PA (t-1)	**.72*** **	**.72*** **	**.72*** **
		[.70 .74]	**[.70 .74]**	**[.70 .74]**
	Gaming (t-1)	**-.06*** **	**-.05** **	**-.09*** **
		[-.09 -.04]	**[-.08 -.02]**	**[-.13 .04]**
	Sub.QoL (t-1)	.00	.00	.02
		[-.02 .04]	[-.02 .02]	[-.01 .04]
	Gender*PA (t-1)			-.00
				[-.00 -.00]
	Gender*Gaming (t-1)			.05
				[-.00 .11]
	Gender*Sub.QoL (t-1)			-.22
				[-.45 .01]
Sub.QoL (t)	PA (t-1)	-.00	.00	-.02
		[-.04 .04]	[-.03 .04]	[-.07 .02]
	Gaming (t-1)	**-.05** **	-.02	-.04
		[-.08 -.01]	[-.06 .02]	[-13 02]
	Sub.QoL (t-1)	**.55*** **	**.54*** **	**.55*** **
		[.36 .41]	**[.50 .58]**	**[.51 .60]**
	Gender*PA (t-1)			.06
				[-.00 .12]
	Gender*Gaming (t-1)			.04
				[-.04 .11]
	Gender*Sub.QoL (t-1)			-.22
				[-.53 .08]
Gaming (t)	PA (t-1)	**-.03** **	**-.04*** **	**-.05** **
		[-.06 -.01]	**[-.06 -.02]**	**[-.07 -.02]**
	Gaming (t-1)	**.79*** **	**.77*** **	**.74*** **
		[.77 .80]	**[.74 .79]**	**[.70 .77]**
	Sub.QoL (t-1)	.01	.01	-.00
		[-.01 .03]	[-.00 .03]	[-.02 .02]
	Gender*PA (t-1)			.01
				[-.03 .05]
	Gender*Gaming (t-1)			**.06***
				[.01 .10]
	Gender*Sub.QoL (t-1)			**.24***
				[.05 .44]

* – $p < 0.05$ ** – $p < 0.01$ *** – $p < 0.001$

‡ – Estimates equal across time.

† – Adjusted for covariates (age, gender, socioeconomic status, and having a partner).

◊ – Added interaction effect (male values are displayed). Adjusted for covariates (age, gender, socioeconomic status, and having a partner).

Note. Statistically significant coefficients are highlighted. All estimates are standardized.

7 Discussion

This thesis aims to contribute knowledge regarding subjective QoL, problematic gaming behavior, and physical activity behavior among Norwegian university students in the context of the pandemic. This area requires more research, particularly with a longitudinal design. The aims were to examine the change in problematic gaming behavior, physical activity, and subjective QoL from January to November 2020 and the temporal interrelations between variables. Both developments and the interrelations were examined for gender differences. This section will discuss the results against research and relevant theory presented in previous chapters. Methodological considerations will be accounted for, and implications for future research and health promotional practice will be put forth.

7.1 Summary of Main Findings

The sample displayed a substantial decrease in physical activity and subjective QoL from January 2020 to November 2020. No statistically significant change in problematic gaming behavior was found. When exploring gender differences, the effect of time differed between males and females for physical activity and gaming behavior. Males had a statistically significant decrease in problematic gaming behavior, while women did not have a considerable change. Despite the decline in men, they reported more problematic gaming than females throughout the study. Development in physical activity varied between genders, and although both men and women declined throughout the pandemic, men displayed a more significant decrease. The covariates gender, age, having a partner, and socioeconomic status only yielded minor changes in the coefficients when examining the change in variables over time and gender differences. Men exhibited lower levels of subjective QoL throughout the study and a greater deterioration of physical activity. Moreover, although they displayed decreasing problematic gaming behavior, men still reported higher scores on the GAS-7 scale at all three time points.

The strongest predictions were the autoregressive associations over time, which is not the main purpose of this study. Within the scope of the current study, there was a mutual negative temporal association between physical activity and problematic gaming behavior. Problematic gaming at time point t – 1 also suggests negative impacts on subjective QoL at time t. After adjusting for covariates, the interrelations remained more or less identical, except for the association between subjective QoL at time t and problematic gaming at time t – 1 which was

no longer statistically significant. After adding an interaction effect between gender and time, there was only one statistically significant difference within the temporal interrelations. Subjective QoL at time point t – 1 was a stronger association for problematic gaming behavior at time t for men.

7.2 Change in Physical Activity Levels Among University Students

Physical activity levels among students attending UoB decreased from January 2020 to November 2020, according to the SPoT study data. The finding from the current research aligns with other longitudinal studies and systematic reviews from this period that found a decline in physical activity levels in university students (Imaz-Aramburu et al., 2021; Larsson et al., 2022; López-Valenciano et al., 2021). The decline of physical activity in university students found in the current study seems to coincide with longitudinal trends from the adult population during the pandemic (Bu et al., 2021; Cheval et al., 2021; Mitchell et al., 2022). Studies also suggest that the implemented restrictions more severely affected the student population. This finding is supported by cross-sectional findings (FHI, 2021), reporting that 18-24 years old experienced the most significant decline in physical activity levels. Although this aspect is beyond the scope of this thesis, the finding corroborates a decline in subjective QoL in university students.

The studies have assessed different properties of physical activity. Cheval et al. (2021) distinguished between moderate and vigorous engagement. Meanwhile, Larsson et al. (2022) reported minutes of exercise and daily activities, such as walking and cycling. The present study presented the subjects with a definition of exercise, including walking and playing a sport. However, the different forms of physical activity are not distinguished. As some studies found a decline in overall physical activity but an increase in moderate physical activity and walking activities (Cheval et al., 2021; Larsson et al., 2022), this may also be the case for the sample included in this study, although not formally addressed. The present finding does suggest that there were changes in physical activity levels among students during the initial phases of the pandemic.

The social restrictions have likely interfered with individuals' normal physical activity levels for two reasons (Cheval et al., 2021). The practical reason is the government measures, such as gym closures, restrictions on public movement, and loss of daily commutes to campus or work. There is also an affective reason. The heightened anxiety and stress levels for

contracting the pathogen may have reduced individuals' inclination to perform their usual activities and leave their homes (Cheval et al., 2021). The practical and affective reasons can be interpreted in light of the mechanisms described in the YPAP framework. The YPAP framework identifies determinants that can promote physical activity engagement in youth (Welk, 1999) and has, in recent years, been applied to university students (Druica et al., 2021).

The social restrictions impacted the environmental factor in the YPAP model by limiting access to recreational facilities and community programs. The reinforcing aspect (peer and coach influence) and the enabling factors (access and environment) were also limited in the period (Druică et al., 2021). The policies caused many individuals to lose their physical opportunity to be physically active as recreation facilities and gyms were closed (Knight et al., 2022). The social distancing measures during the pandemic decreased the strength of the reinforcing factor caused by peers, which is a part of the social/cultural aspect of YPAP (Druică et al., 2021). The psychological component of YPAP was also affected. Fear of infection (Keller et al., 2023) and a general lack of motivation for physical activity among adolescents (Knight et al., 2022) are among the psychological influences that may have caused a decline in physical activity during the pandemic. Thus, in light of the components in the YPAP framework, the pandemic likely interfered with the student's physical activity levels. This coincides with the decline found in the current study.

Motivation is, as mentioned, identified as an imperative factor of the psychological component that promotes physical activity, according to the YPAP model (Welk, 1999). To further understand the underlying mechanisms for the decline in physical activity in the present study, the self-determination theory is relevant to recognize motivational processes for physical activity. The pandemic may have interfered with the framework's three basic psychological needs: autonomy, relatedness, and competence. These aspects affect an individual's intrinsic motivation (Ryan & Deci, 2000). Conditions that foster autonomy has been recognized to promote intrinsic motivation, which is the core motivation for physical activity (Ryan et al., 2006). As the social guidelines affected the autonomy and relatedness domains particularly (Randall et al., 2022), individuals may have experienced less motivation to engage in physical activity. Relatedness can be associated with the social/cultural aspect of the YPAP model. Unfulfilled factors of the self-determination model are associated with declined physical activity in adolescents over time (Gunnell et al., 2016). Furthermore, as the extrinsic forces of motivation were reduced during the pandemic with closed facilities and

social restrictions, intrinsic motivation was likely increasingly important for maintaining physical activity.

The social determinants of health model puts forth a framework that recognizes factors in the individual and society that influence health. This health model is useful when understanding factors that led to the decline in physical activity levels found in the current study (Dahlgren & Whitehead, 1999). As society faced unprecedented social restrictions and societal changes, the social determinants of health were also widely affected (Muller et al., 2022). Practically all factors could be negatively influenced by the pandemic. The environmental conditions impacted society as a whole, which is also acknowledged in the YPAP model (Druică et al., 2021). The social determinants were also impaired, aligning with the reinforcing component of the YPAP model. Interference of determinants such as education and work likely disrupted many students' daily structure. This is associated with less physical activity as structure promotes physical activity (Brazendale et al., 2017). Public access to physical activity was also restricted due to closed facilities and social limitations. Long et al. (2022) corroborated in their study that some health determinants, such as socioeconomic status, were associated with the change in HR-QoL. Thus, changes in society may contribute to explaining the deterioration of subjective QoL, which can be further examined through the time-filled perspective.

The structured days hypothesis may elucidate the underlying mechanisms for the decline in physical activity levels. Most students were faced with online lessons over extended periods, and many were laid off from their jobs (Kjøs et al., 2021, p. 27), removing important routines from their daily lives. There was also limited access to participate in hobbies and organized physical activities (Nes et al., 2020a, 2020b). These restrictions and consequences may have resulted in many students facing a lack of structure in their day-to-day life during the pandemic. Structured day's hypothesis derives from the premise that a structured day positively impacts physical activity in youth (Brazendale et al., 2017). As the students in the current study reported decreased physical activity, the lack of structure and activities in their daily life may have contributed to this change. There are other aspects of student life that can also have negatively impacted physical activity levels.

Before the pandemic, university students were prone to high levels of sedentary behavior and insufficient physical activity (Larsson et al., 2022). Over the past few decades, a decrease in exercise and physical activity has been found among students, along with the most significant

increase in sedentary behavior (Nelsen et al., 2008). Thus, the pandemic may have intensified the preexisting pattern of increased physical inactivity and sedentary behaviors, particularly among students (Knight et al., 2022), supported by the current study. As physical activity has several health-promoting factors and increased physical inactivity is a concerning trend in university students (Herbert et al., 2020; Devita & Müller, 2016), the overall physical health of university students may have deteriorated during the pandemic. Whether these declined levels have been sustained is considered beyond the scope of this thesis.

7.2.1 Gender Difference in the Development of Physical Activity

There was a significant gender difference in the change in physical activity behavior from t1 to t3. The physical activity levels started approximately identically at baseline, and both genders experienced a significant decline in physical activity from January 2020 to November 2020. Despite more Norwegian men achieving the physical activity recommendations (Hansen et al., 2023), the present thesis found that men declined significantly more than women during the initial stages of the pandemic.

There was a discrepancy in longitudinal research regarding the potential gender differences. Bu et al. (2021) found no gender difference in their longitudinal study regarding adults. Another longitudinal study identified women as more vulnerable to a decline during the pandemic (Mitchell et al., 2022). A possible reason for these inconsistencies is the various ways of assessing physical activity in the included articles. Some longitudinal research suggests that female adults were more likely to have strong negative associations with maintaining muscle-strengthening and vigorous physical activities (Cheval et al., 2021; Mitchell et al., 2022). Cheval et al. (2021) also found that women increased moderate physical activity more than men. A longitudinal study regarding university students found that although there was a decrease in exercise levels, there was an increase in daily activities, such as walking (Larsson et al., 2022). A systematic review of studies concluded that physical activity levels declined among university students during the initial phases of the pandemic, but more studies reported declining vigorous physical activity (López-Valenciano et al., 20201). An important consideration is that men and women generally engage in different forms of physical activity.

Norwegian men generally report more moderate and hard intensity, while women report mild physical activity (Hansen et al., 2023, p. 19). As gym and recreation facilities were closed, it is plausible that men’s engagement was more affected as they lost access to necessary

equipment. Light physical activity, such as walking, was perhaps easier to engage in. The SPoT study assessed physical activity with an overall frequency, intensity, and engagement time score. Hence, the current thesis did not differentiate between physical activity's different forms and intensities. Though it is beyond the scope of the current study and not formally assessed, it is possible that men and women would display different levels within the various forms of physical activity. For example, female students may have displayed lower levels of moderate, vigorous, and muscle-strengthening activities but reported more mild physical activity, which coincides with previous literature from the pandemic.

In light of the highlighted gender difference in behaviors (Hansen et al., 2023, p. 19), one may also assess the gender differences within determinants of engaging in physical activity through the YPAP framework. According to the YPAP model (Welk, 1999), one can argue that the enabling component, including environment and access, was more impaired for men's physical activity behaviors. The reinforcing domain is highly relevant to further assess the discrepancy between genders in light of the YPAP model. External social forces, such as peer influence, are reinforcing factors for engaging in and maintaining physical activity (Welk, 1999). However, with the enforced social restrictions, this factor was limited. Wenthe et al. (2009) found that the reinforcing factor of the YPAP model was a stronger predictor for MVPA among males. Hence, the pandemic may have more severely impaired the factors within the YPAP model for men than women, resulting in a greater decline for male students.

The self-determination model may also be applied as a psychological framework to further address the gender difference. According to Ryan & Deci (2006), intrinsic motivation is essential to maintain physical activity over time. However, male university students have been identified to be more motivated by extrinsic forces (Lauderdale et al., 2015), aligning with the reinforcing aspect of the YPAP model. Randall et al. (2022) found that all aspects of the self-determination model may have been impacted by social restrictions. Individuals likely found fewer extrinsic motivation forces during the pandemic (Randall et al., 2022). Thus, according to the self-determination model and the enabling and reinforcing factors of the YPAP framework, men were more vulnerable to the impacts of social restrictions regarding physical activity. Male students may also be vulnerable to a decline in physical activity, due to engaging more in gaming during the pandemic.

The' time-filled perspective' and the ‘displacement hypothesis´ are contributing explanatory factors for the more severe decrease in men. Problematic gaming behavior was not assessed by time in the present study. However, it is likely that individuals reporting this behavior also spent much time playing video games. Studies suggest increased game time is associated with developing addicted gaming behavior during the pandemic (Han et al., 2022; Wang et al., 2023). Addicted gamers are generally excepted to spend more time playing video games, and the GAS-7 scale displayed strong concurrent validity with game time (Lemmens et al., 2009). Thus, the ‘time-filled perspective’ is included to elucidate this gender difference. According to the displacement hypothesis, time spent engaging in favorable activities creates less available time to spend in unfavorable activities (Haug et al., 2022; Kwok et al., 2021). Gaming reached an all-time high during the pandemic (Lufkin et al., 2020; Nielsen et al., 2020), and the present study found that men engaged in more problematic gaming than women throughout t1 to t3. As a consequence, male students have likely devoted more of their time to gaming. This could create a disparity between genders in this development of physical activity.

7.3 Change in Subjective Quality of Life Among University Students

Students in the sample experienced a substantial decline in subjective QoL from January to November 2020. After controlling for the effect of the covariates, there was no significant change in the regression coefficient. This finding follows a clear tendency found in previous longitudinal research inferring a deterioration in students’ QoL and well-being during the pandemic (Barbieri et al., 2021; Buizza et al., 2022; Pierce et al., 2020; Ravens-Sieberer et al., 2021; Savage et al., 2021; Weber et al., 2022). The same longitudinal trend has been reported in adults (Genta et al., 2021; Pierce et al., 2020). However, studies suggest that students experienced worse mental health than the population means in 2020 (Savage et al., 2021; Weber et al., 2022). This is supported by Pierce et al. (2020), who found that mental well-being in the population declined but was most substantial in individuals aged 16-24.

Norwegian cross-sectional studies also support the finding of a decline in subjective QoL in the population. SSB (Rønning, 2021a, 2021b) reported increased levels of loneliness and a decline in life satisfaction in 2021, and the NIPH (Nes et al., 2020a) found an increase in people reporting poor QoL in 2020. Again, students were reported as particularly negatively affected (Rønning (2021a, 2021b), with less life satisfaction and higher levels of loneliness than the overall average. University students also reported lower scores on nine of the twelve QoL indicators than the population means (Rønning, 2021a). As the present study solely

assessed subjective QoL in UoB students, it neither confirms nor denies that students' QoL declined more than the population means. However, it does corroborate that the pandemic and implemented restrictions negatively affected the levels of QoL among students.

There is a multitude of reasons why the students' QoL may have declined from January to November 2020. Buizza et al. (2022) suggest university students typically experience poorer mental health than the overall population, partly due to their heightened stressors during this period in their lives, both before and, particularly, after the virus outbreak. This is also supported by Savage et al. (2021) and Weber et al. (2022), who highlight that students are in a unique situation and are exposed to financial, social, and academic stressors. After the first lockdown was initiated on March 12, individuals throughout Norway spent more time isolated (Bekkhus et al., 2020). The campuses were closed, many students lost their source of income, and social arenas and recreational facilities were closed (Kjøs et al., 2021, p. 27). The social restrictions led to individuals socially isolating, which likely led to an increase in loneliness (Keller et al., 2023; Rønning, 2021b; Weber et al., 2022) as they were deprived of social connection, which humans inherently crave (Keller et al., 2023). This could further reduce subjective QoL, which coincides with the current finding.

Students were seemingly disproportionately affected by the social restrictions by reporting a more severe decline in QoL and well-being (Buizza et al., 2022; Savage et al., 2021; Weber et al., 2022). However, there may be discrepancies within the student population in Norway. The students attending UoB may have been more affected than other students in the country, as Bergen and Oslo faced the most intrusive measures (Nes et al., 2020b). Though it is beyond the scope of this thesis, it is possible that the decline in subjective QoL in the overall Norwegian population and students attending other universities was less substantial.

The self-determination theory (Ryan & Deci, 2000) may also explain the decline in subjective QoL. Particularly the aspects of autonomy and relatedness were likely impacted by the pandemic and strict social restrictions on university students (Randall et al., 2022). Strict social restrictions impacted individuals' relatedness and autonomy. During normal societal conditions, student life is associated with increased autonomy and self-discovery (Erevik et al., 2017; Røtan et al., 2019). The pandemic consequently limited students' autonomy and independence, which can lead to frustration. The relatedness component was also significantly affected due to strict societal limitations (Randall et al., 2022). Without the components of self-determination being fulfilled, students may also have felt less intrinsic motivation, which

is known to foster well-being in individuals (Ryan & Deci, 2000). Based on the self-determination theory, depression is hypothesized to lower feelings of competence, autonomy, and relatedness (Gunnell et al., 2016). As symptoms of depression were reported to increase during the pandemic in students (Hagen et al., 2023; Ravens-Sieberer et al., 2021; Reme et al., 2022), more individuals may have felt less self-determined and experienced a decline in their QoL. Based on the implemented restrictions, the self-determination theory can be a helpful framework to assess the underlying mechanisms that led to the decline in subjective QoL observed in the present study. Why the restrictions impacted QoL can also be elucidated through the social determinants.

Changes in the social determinants of health during the pandemic (Dahlgren & Whitehead, 2006) likely contributed to the decline in subjective QoL found in the current study. Many students lost their source of income and faced online lessons (Kjøs et al., 2021, p. 27). Changes in these determinants may have caused financial and educational stress, which may have reduced their QoL. The social arenas were heavily restricted, thus potentially increasing loneliness in the students and reducing QoL well-being. General environmental conditions in society were restricted, resulting in less individual autonomy over individual lifestyle factors. According to the self-determination model, this may also cause a decline in well-being in individuals (Ryan & Deci, 2000).

7.4 Change in Problematic Gaming Activity Among University Students

There was no significant change in problematic gaming activity among the sample over time. Problematic gaming behavior and high scores on the GAS-7 scale reflect that the individual reported behavior that interfered with other aspects of their life, including mood, social conflicts, education or work, and sleep. This finding is contrary to the included literature, which mainly reported increased levels of addictive or pathological gaming behavior during the pandemic among university students (Teng et al., 2021; Wang et al., 2023), young adults (Claesdotter-Knutsson et al., 2022), adolescents (Han et al., 2022), and across age groups (Masaeli & Farhadi, 2021).

There are some possible explanations for this contradicting finding. The pandemic led to more free time as students had online classes, and many were laid off from work, in addition to strict social regulations and stay-at-home mandates. Spending more time at home was associated with more gaming activity (Claesdotter-Knutsson et al., 2022), and there has been

reported increased gaming time among university students (Balhara et al., 2020; Barr & Copeland-Stewart, 2021). Increased gaming engagement is a known risk factor for developing problematic gaming behavior or a gaming addiction among university students (Claesdotter-Knutsson et al., 2022; Wang et al., 2023). A potential explanation for the current study finding is that before the initial lockdown, at baseline, the subjects had other activities and obligations that may have been in conflict with their gaming activity. Thus, they may have experienced it as more problematic and reported higher scores. After the lockdown initiation, the participants may have engaged in more gaming activity, as studies suggest. However, gaming may have been associated with less conflict, thus reporting lower scores. Another consideration is that students most affected by problematic gaming behavior may have chosen not to participate in the study or drop out at t2 or t3 if the behavior was too destructive. This will be further elaborated on in the methodological considerations.

7.4.1 Gender Difference in the Development of Problematic Gaming Behavior

There were statistically significant gender differences in the development of problematic gaming activity. Men exhibited a decline in problematic gaming behavior, while women maintained more or less the same levels from January to November 2020. Based on the literature, males were expected to report more addictive gaming (Han et al., 2022; Wang et al., 2023), which aligns with the current finding. The surprising and contradicting finding was that men reported decreased levels of problematic gaming over time.

An applicable theoretical framework to elucidate this finding is the social determinants of health (Dahlgren & Whitehead, 1999). Before the pandemic, at baseline, males reported a higher incidence of addictive gaming behavior, both in this study and other literature (André et al., 2020; Wang et al., 2023). This suggests that males may have experienced more severe conflict related to their gaming activity before the first lockdown. High scores on the GAS-7 scale indicated that the individual had gaming activity that negatively impacted other areas of their lives, such as work, education, hobbies, and physical activity. Social relations could also be affected. The implemented social restrictions impacted the general environmental conditions, living and working conditions, and social life (Muller et al., 2022).
Thus, the individual may have perceived less conflict associated with their gaming behavior. People had fewer options for activities and were encouraged to stay home and socially distance. Thus, this finding does not directly imply that men decreased their game time more than women. Male students may have spent more time playing video games. This was not

formally assessed in this study but is supported in research among university students (Balhara et al., 2020; Claesdotter-Knutsson et al., 2022; Han et al., 2022; Wang et al., 2023). However, the potential problems from the problematic gaming behavior may have been perceived as reduced during the pandemic. Game time was not formally addressed in this thesis.

7.5 Interrelations and Temporal Relationships

The current study assesses temporal interrelations between problematic gaming behavior, physical activity, and subjective QoL. Thus, the autocorrelations found in this study, e.g., physical activity at t – 1 predicting physical activity at time t, will not be elaborated. Only the associations between the included variables will be discussed. This includes the negative reciprocal temporal association between physical activity and problematic gaming. The association between problematic gaming at time point t – 1 and subjective QoL at time t will also be discussed. There were no associations between physical activity and subjective QoL, which will also be elaborated on. Although these interrelations are not exclusive to the pandemic, they will mostly be addressed in light of the social measures to adhere to the scope of this study. Only gender differences within temporal interrelations will be discussed in section 7.6.

7.5.1 Temporal Interrelationship Between Physical Activity and Problematic Gaming

A reciprocal negative association was found between problematic gaming behavior and physical activity in the sample. Although these analyses cannot prove causality, the findings suggest that being more physically active may lead to less problematic gaming and vice versa. The relationship is multifaceted, particularly during the pandemic and periods of confinement. The interrelation has not been greatly explored in a longitudinal context or in university students. Most studies assessed the association between physical activity and gaming time rather than problematic gaming. Research supports the longitudinal relationship between university students' gaming time and physical activity during the pandemic (Kwok et al., 2020). Haug et al. (2022) and Hygen et al. (2022) also support this association in Norwegian adolescents. Cross-sectional studies assessing this relationship found negative associations (Hassan et al., 2020; Lavados-Romo et al., 2021). The present study corroborates trends from previous studies, suggesting a negative relationship between problematic gaming behavior and physical activity during the Covid-19 pandemic.

This finding adds to the literature supporting these behaviors potentially displacing one another (Haug et al., 2022). The displacement hypothesis is based on the principle that when a person is physically active, this time cannot be spent sedentary as they, by definition, are mutually exclusive (Kwok et al., 2021; Nie & Hillygus, 2002). As mentioned, addicted gaming is highly associated with game time (Lemmens et al., 2009). Thus, this perspective is included, although gaming time was not formally addressed in this study. As the sample displayed reciprocal negative associations between problematic gaming and physical activity, the displacement hypothesis is a possible contributing explanation for this finding.

The self-determination model puts forth a theoretical framework that may elucidate the temporal association. Intrinsic motivation is the core motivation facilitator of physical activity engagement and gameplay (Ryan et al., 2006) and is also identified as a predisposing component of the Youth Physical Activity Promotion Model (Welk, 1999). An individual feels encouraged to engage in an activity that fulfills their psychological needs (Ryan & Deci, 2000). If an individual feels competent in either physical activity or gaming, they likely feel encouraged to continue this action. This competence aspect also aligns with the enabling domain of the YPAP model (Welk, 1999). An individual may feel relatedness and autonomy through physical activity or through video games. Thus, either of these activities may fulfill an individual's basic psychological needs but may not be fulfilled or motivated by the other behavior.

An individual engaging in problematic gaming is less likely to exhibit high levels of physical activity due to the nature of this behavior. Gaming is most commonly sedentary, which fundamentally denotes physical activity engagement (WHO, 2020b). Gaming addiction and problematic gaming are often time-consuming and interfere with other aspects of the individual's life (Charlton & Danforth, 2007; 2010; WHO, 2018). As measured by the GAS-7 scale, problematic gaming behavior suggests that the individual avoids other activities, e.g., physical activity, and spends increased amounts of time playing video games.

7.5.2 The Temporal Interrelationship Between Quality of Life and Problematic Gaming

Although causality was not assessed, this study suggests that problematic gaming behavior at time t – 1 could decrease subjective QoL at time t. However, after adjusting for covariates, the association was no longer statistically significant. This relationship has not yet been greatly explored in longitudinal trends, particularly not in university students and in the context of Covid-19. This finding adds to the emerging longitudinal research among adolescents found

that symptoms of depression and anxiety could predict the severity of IGD during the pandemic (Teng et al., 2021). Other cross-sectional findings support the negative association in adolescents. It was reported that excessive gaming could result in loneliness (Masaeli & Farhadi, 2021). Fazeli et al. (2020) found that although gaming could improve QoL, the frequency and duration are highly imperative, as addictive gaming was associated with a decline in QoL (Fazeli et al., 2020). This finding adds to the emerging studies suggesting that this negative interrelation was present during the pandemic.

The self-determination model provides an applicable theoretical framework for this interrelationship. Addictive gaming may influence aspects of the three innate psychological needs: autonomy, competence, and relatedness (Ryan et al., 2006). An addiction is often accompanied by a loss of autonomy, as the individual is not in control of the behavior. The competence domain may have been affected by problematic gaming behavior, as the behavior may negatively influence other areas of the individual's life, such as academic, physical, personal, or social. Although individuals may experience relatedness through gaming, they may simultaneously alienate themselves from real-life social connections (Ryan et al., 2006). These psychological needs must be fulfilled for the individual to thrive and improve their well-being (Ryan & Deci, 2000). Thus, if the behavior led to unfulfilled psychological needs, this may have contributed to the negative interrelation.

After adjusting the model, the prediction lost statistical significance, implying that the included covariates explained the prediction. This temporal relationship may not be truly independent (Field, 2018, p. 17). The control variables applied in the analysis are known to be associated with gaming behavior and QoL. Literature supports that the covariates partner status, age, (Smith et al., 2020), socioeconomic status (Claesdotter-Knutsson et al., 2020; Lavados-Romo et al., 2021), and gender (Lemmens et al., 2009, 2011) are important factors related to gaming behavior. Gender, age (Long et al., 2022), and socioeconomic and partner status (Gram, 2023; Rønning, 2021a) have been suggested to influence QoL. However, the loss of statistical significance does not strictly imply that there is no relationship between the variables or that it lacks practical significance, hence why it is worth discussing.

7.5.3 The Temporal Interrelations Between Physical Activity and Quality of Life

A surprising result from this study was that no temporal association was found between physical activity and subjective QoL in either direction. It has been widely acknowledged that

physical activity can maintain and improve mental health (Herbert et al., 2020; Kekäläinen et al., 2020; Devita & Müller, 2016). This has been observed even in periods of isolation, such as during lockdowns instigated by preventative social measures (Abrantes et al., 2021). However, longitudinal studies exhibit a discrepancy regarding this association. Low levels of sedentary behavior have been shown to have a role in helping cope with stressful events, such as the pandemic (Cheval et al., 2021), but negative relationships were also found. Havnen & Ernstsen (2022) suggest that higher levels of physical activity during the initial phases of the pandemic predicted anxiety and depression symptoms six months later. Despite studies supporting the relationship, both in positive and negative associations, this study found no relationship.

The relationship is complex, and there may be associations despite this study's lack of a statistically significant temporal association. The pandemic likely influenced contextual factors that mediated the relationship. For example, social restrictions limited the possibility of physical activity and likely affected QoL. There may have also been a shift in the QoL domains that individuals emphasize. As there were limited possibilities for social interactions, individuals may have put greater importance on other arenas, such as academic or physical. The disruption of routines and daily activities could also impact the relationship. With limited possibilities for physical activity and remote learning, this might disrupt the association. Thus, the relationship may differ from pre-pandemic times.

7.6 The Gender Differences in the Interrelationships Between Variables

Only one interrelationship between variables statistically varied between genders. Subjective QoL at time point t – 1 associated with problematic gaming at time t was a stronger relationship among men. The gender differences within this interrelation are not extensively explored. However, Lemmens et al. (2011) highlight that there are general gender differences that may moderate the relationship between well-being and pathological gaming, as boys and girls generally differ in their gaming activity. Girls generally spend less time playing video games (André et al., 2020; Wang et al., 2023) and are less likely to exhibit and develop pathological gaming (Claesdotter-Knutsson et al., 2022; Lemmens et al., 2011; Wang et al., 2023).

Teng et al. (2021) also found longitudinal trends of depressive and anxiety symptoms strongly associated with later gaming addiction during the pandemic in adolescents. The association was significant for both genders, but the prediction was more robust among boys, supporting

the finding from the present study. Many individuals used gaming as a means to cope with the pandemic and the social restrictions (Barr & Copeland-Stewart, 2022; Cheval et al., 2021). However, men may be more prone to use this to cope as they generally spend more time gaming. Men exhibited lower levels of QoL in the linear mixed findings from the present study, which could result in a greater need for coping mechanisms. Although the underlying mechanisms for the interrelation were not formally addressed, these may be relevant factors to elucidate why this association was significantly stronger among men.

7.7 Methodological Considerations

In this subchapter the methodological considerations will be accounted for. The researcher has a professional and ethical responsibility to be transparent regarding possible limitations in the data, design, and analyses (Punch, 2014, p. 36). Strengths and limitations for the design and measures will be put forth.

The data this thesis derives from is the SPoT study which raises methodological considerations. A strength of the study is the large sample, which increases external validity. There were more female (67.8%) than male (32.2%) participants. This is typical in survey research, where women generally participate more than men (Knudsen et al., 2010), but it can introduce potential bias and limit generalizability for male trends. However, the large sample size better approximates the overall population from which the sample is drawn (Field, 2018, p. 84) and increases statistical power (Cozby & Bates, 2015, p. 139).

A prominent advantage of the study's design is that longitudinal studies are more robust and powerful than cross-sectional studies, particularly when examining temporal interrelations between variables. In cross-sectional studies, one cannot exclude the possibility that the relationship is in the other direction than what is portrayed (Johannessen et al., 2010, p. 310; Neuman, 2014, p. 44). Another advantage was that the survey was initiated before the virus outbreak. This poses a unique contribution to research as one could compare baseline values collected before the pandemic to later time points, after lockdown initiation. This enables the researcher to capture changes in the variables that were likely due to the pandemic and social restrictions. A disadvantage of the longitudinal design is the risk of interrupted or incomplete follow-ups from participants (Caruana et al., 2015), which is the case in this study as there is a large degree of dropout.

One must also consider who is generally responding to surveys. Those who choose not to respond typically have poorer health and socioeconomic status than those who participate (Knapstad et al., 2019; Knudsen et al., 2010). Furthermore, there was quite a significant drop-out. At t3, 23.8% of the baseline sample responded. There were conducted no drop-out analyses and the dropout could yield various sources of bias. The participants that fell out may share specific characteristics, which can generate a loss of generalizability and systematical differences between remaining participants and those who dropped out. If dropout participants became depressed or addicted to gaming and thus chose not to participate further, the exhibited changes over time may have been reported as less severe than reality.

Hence why temporal associations and development over time must always be interpreted with caution.

An important consideration is that the study includes students from only one university in Norway. As there were periods of national and regional restrictions, some areas were more affected than others. Bergen and Oslo were the cities with the strictest guidelines for the most prolonged periods (Nes et al., 2021b). Thus, the UoB students may not accurately represent other student populations. Moreover, cultural, social, and economic differences exist within populations and countries. Different governments also handled the pandemic with various degrees of lockdowns and restrictions. This may be a contributing reason for the discrepancy in the literature with the findings from this thesis. The findings of this study were generated in a Norwegian context, which is a limit for external validity. Thus, one must be careful generalizing the findings beyond country borders.

The study incorporated already established measurements for all variables, which increased the validity and reliability of the study. High values of Cronbach's alpha were found for the minimum list for subjective QoL and the GAS-7 scales in the current study. However, there are possible weaknesses are associated with the chosen measures. The three-item questionnaire for physical activity did not differentiate between the various intensity levels, such as mild, moderate, or vigorous physical activity. Studies suggest increased light physical activity, such as walking, during the pandemic (Cheval et al., 2021; Larsson et al., 2022) and gender differences within the different forms for physical activity. Research also suggests that it is more challenging to recall light activity (Kurtze et al., 2007), which introduces recall bias. Moreover, the instrument displayed lower levels of validity and reliability for light physical activity (Kurtze et al., 2007). Thus, there may have been gender differences and increased trends of light physical activity which were not uncovered as levels were assessed with an overall score.

There are some weaknesses associated with the GAS-7 measure. As scores were self-reported and individuals may have perceived their gaming activity with less conflict during the social measures, problematic gaming behavior may have been underreported. Moreover, the GAS-7 scale showed only moderate associations with psychological components such as loneliness and life satisfaction (Lemmens et al., 2009). Thus, there may be more appropriate instruments to examine the interrelation between subjective QoL and problematic gaming behavior. Despite several scales being used to examine addicted gaming behavior in previous studies,

most used measures based on the DSM-5 criteria, which examine similar domains as the GAS-7 scale. Although one cannot directly compare the findings between different scales, the studies were more likely to reflect similar domains of this behavior.

Bias implies that the information given by the subject is at odds with objective truth (Field, 2018, p. 227). A disadvantage of this study was that all behaviors were self-reported and based on subjective perceptions. For example, physical activity is often overreported when subjects self-report the behavior (Larsson et al., 2022). Participants tend to report health behavior, such as physical activity, by social desirability (Larsson et al., 2022; Cozby & Bates, 2015, p. 127). This may also affect response for subjective QoL and gaming behavior. Thus, the reported scores may not accurately portray reality. However, it is reasonable to expect honest responses by openly communicating the purpose of the study and assuring the participant's confidentiality, which was the case for the current study (Cozby & Bates, 2015, p. 127) (see attachment 3, p. 94-95).

7.8 Implications

This study aimed to increase the knowledge of the physical activity, gaming behavior, and subjective QoL among university students attending UoB. Changes from January 2020 to November 2020 and the interrelations between the variables were examined. Gender differences were also explored. Based on the findings and discussion of the topics, the following subchapter will discuss the implications this thesis prompts regarding future research and for the health promotional field.

7.8.1 Implications for Future Research

Although this thesis did not find increased problematic gaming behavior, video game activity is reportedly increasing globally (Lufkin, 2020) and will likely become a critical behavior to study for health promoters. The temporal association between gaming at t – 1 and subjective QoL at time t lost statistical significance after adjusting for covariates. There is a need to elucidate this relationship, underlying mechanisms, and various aspects that may influence this association. Although the present thesis puts forth some suggestions, more research is required regarding problematic gaming behavior in longitudinal trends, included within relevant interrelations.

QoL is a multidimensional construct with many interpretations. With a wide range of terms such as QoL, HR QoL, well-being, and life satisfaction being used interchangeably, it is challenging to compare levels. Nes et al. (2018) highlight that subjective QoL has yet to be prioritized in Norwegian research or politics. The knowledge acquired from studies assessing this topic can therefore contradict data on other aspects of QoL (Nes et al., 2018). There is, as previously mentioned, an objective domain of this concept which includes measurable economic, environmental, and social factors (Boelhouwer & Noll, 2014). Incorporating this domain in future research assessing subjective QoL may add valuable knowledge that could generate a better understanding of this important health aspect.

There is generally a need to address whether the changes that occurred during the pandemic have prolonged in the population. Although this thesis does not examine the development after November 2020, the second lockdown in January 2021 (Regjeringen, n.y) may have exacerbated the decline in physical activity and subjective QoL. The SPoT study was further extended to February 2021 and additional trends can therefore be examined within the same sample. Research suggests that the mental health impacts have been both more severe and sustained in students than in the general population (Barbieri et al., 2021; Savage et al., 2021). Norwegian cross-sectional studies also suggest that QoL is still declining in 2022, particularly in students (Gram, 2023). It has been recommended that quantitative data examining QoL should be accompanied by qualitative studies (Espnes & Smedslund, 2017, p. 278), as it produces a more complex and in-depth understanding of the findings. Qualitative follow-up studies could therefore add to this study by uncovering the underlying mechanisms as to why the students reportedly experienced a substantial decline in their QoL and whether these changes have been prolonged.

Regarding physical activity, the majority of the research includes self-reported measurements. Health behaviors like physical activity are often overreported (Larsson et al., 2022; Hansen et al., 2023, p. 34). Self-reported measures of physical activity are not the most nuanced or accurate. Thus, more studies using objective measures, or a combination of both, may yield more accurate displays of physical activity levels. Incorporating objective measures in studies is likely the new standard when researching physical activity (Hansen et al., 2023, p. 34). A study from the NIPH and the Norwegian School of Sports Sciences did find that the pandemic did not likely significantly impact physical activity levels (Hansen et al., 2023). However, this was a cross-sectional study on the adult population that compared levels with previous

studies. Thus, future research could aim to incorporate objective measures to accurately assess whether the decline reported during the pandemic has prolonged after the restrictions have been lifted.

7.8.2 Implications for Health Promotion

As society moves forward from the pandemic, the reported changes in physical activity, gaming behavior, and QoL should be accounted for. University students displayed a significant decline in subjective QoL and physical activity, which are concerning trends. However, men generally displayed less favorable trends in the current study. Thus, male students may need more targeted interventions in the case of another similar event and in general.

Physical activity has several significant benefits for mental and physical health (Abrantes et al., 2021; Gill et al., 2013; Herbert et al., 2020; Knight et al., 2022; Welk, 1999). The trend of decreasing physical activity among students is concerning as they were already identified as a group with insufficient physical activity before the pandemic (Larsson et al., 2022). The Department of Health (Meld. St. 19 (2018-2019), p. 116) aims for a ten percent reduction of physical inactivity by 2025 and fifteen percent by 2030. These goals are in line with the global UN sustainability goals (UN, 2023). Whether the decline has been sustained in university students was beyond the scope of this thesis. However, students may need targeted interventions to address the overall low levels pf physical activity in this population group in order to facilitate healthy development in students and reach the national and global goals.

In line with the social determinants of health, there were many societal factors that may have contributed to the changes found in the present study. The environmental, living, and social conditions were likely particularly affected during the social restrictions. Though uncovering the underlying mechanisms was not the aim of this study, it is likely that these societal changes contributed to the decline in physical activity and subjective QoL. Muller et al. (2022) found that the restrictions practically influenced all levels of determinants, beside the core characteristics. Applying such frameworks known to affect health and behavior in individuals can be useful when to identify appropriate courses of action to facilitate healthy development during adverse conditions.

Druică et al. (2021) found that the predisposing dimensions of the YPAP framework, worth and ability, were mediating factors between the enabling and reinforcing aspects and physical activity among university students during the pandemic. Health promoters should be aware that targeting students' predisposing factors for physical activity may not directly improve physical activity levels but indirectly influence their self-efficacy, competence, and enjoyment during exercise (Druică et al., 2021). Applying this socioecological framework that has been proven robust in students even during the pandemic may be beneficial when developing interventions targeting specific population groups.

QoL is a central concept within public health work focusing on mental health. Improving QoL is a public health goal in Norway identified in white papers (Meld. St. 19 (2014-2015), p. 23; Meld. St. 15 (2022-2023), p.8), and internationally through the UN sustainable development goals (UN, 2023) and the WHO (2013). The government wants to examine the reasons for students' mental health issues and loneliness to find targeted measures (Meld. St. 15 (2022-2023), p. 75). The decrease in subjective QoL for both genders is concerning. Whether this development has sustained in students is beyond the scope of this thesis, but other studies have addressed this concern. Long et al. (2021) found longitudinal trends of the pandemic having sustained a negative impact on QoL. Norwegian cross-sectional studies from 2020-2022 also display a continuing decline in QoL and life satisfaction, despite removing social restrictions (Rønning, 2021b; Gram, 2023). As students were reportedly disproportionately affected by the interim guidelines (Nes et al., 2020b), and report generally low levels of QoL (Sivertsen, 2021), this group should be prioritized for targeted interventions.

As gaming is becoming an increasingly popular leisure activity (Kulturdepartementet, 2019) health promoters should inform of risk factors for developing gaming addiction. One should not discourage playing video games, as there are proven benefits (Granic et al., 2014) when played in moderation (Fazeli et al., 2020). Moreover, problematic gaming behavior was the only variable that exhibited negative associations to both later physical activity and subjective QoL. Thus, if an individual has a gaming addiction, there is a chance for this behavior to negatively impact both physical and mental aspects of their life. By informing individuals of the known risk factors and the possible negative impacts of excessive gaming, one can enable them to make empowered health decisions.

8 Conclusion

The Covid-19 pandemic instigated governments globally to implement strict social regulations. As these measures are lifted, and the WHO no longer considers the virus a global health emergency (Rigby, 2023), the broader health effects of the restrictions must be disclosed. This study was the first to examine trends in development, interrelations, and gender differences within physical activity, problematic gaming behavior, and quality of life in Norwegian university students during the pandemic. Research suggests that the social measures disproportionately affected students, who were already a vulnerable group, in terms of mental well-being, and physical and economic circumstances.

Emerging studies suggest less favorable trends in the development in quality of life, physical activity, and problematic gaming in university students during the pandemic. The present study corroborates a decline in physical and subjective QoL which may have been influenced by the social restrictions. The majority of studies suggesting that gaming addiction increased in students, which contradicts the finding from this study. The social restrictions may have influenced the individuals perception of severity as there were fewer commitments and they were encouraged to stay at home. Knowledge about gender differences was scarce within longitudinal trends and there were several discrepancies. The general trends displayed that more men reported gaming addiction and game time, whereas in this study, men displayed decreased levels of problematic gaming behavior over time and women reported no significant changes. Although some studies reported no gender differences within QoL, women were more commonly identified as vulnerable for lower QoL and mental well-being. The current sample displayed the same deterioration in subjective QoL levels. As for changes in physical activity, there were reported various gender differences which mostly concerned the differences within intensities. Both women and men declined in their overall physical activity levels, but male students exhibited a more substantial decrease.

The negative reciprocal temporal relationship between physical activity and problematic gaming is particularly relevant as gaming is increasingly popular, and physical activity is vital for health and gaming is an increasingly popular leisure activity. The temporal association between problematic gaming behavior at time point t – 1 and later subjective QoL at time t is also relevant, although it lost statistical significance. Literature supports that such behavior may negatively impact QoL, and the association could have been influenced by the

extraordinary circumstances. Therefore, this interrelation should be further elucidated in future research.

The findings from this thesis are relevant for future public health policies and interventions targeting these behaviors for students. The current study has contributed longitudinal trends from a study with unique contextual properties. The study may more accurately portray the impacts of the Covid-19 pandemic as reported levels were compared before and after the initial lockdown. The self-determination theory, the YPAP model, and the social determinants of health put forth frameworks to elucidate the current findings from a health promotional perspective. The time-filled perspective further substantiated the study's findings. Future research should aim to find if these findings have been prolonged in students and examine the underlying mechanism within the changes and interrelations.

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10 Attachments

Attachment 1

Minimum list for measuring subjective QoL from the Norwegian Directorate of Health.

Minimum list subjective quality of life

M1. Overall, how pleased are you with your life recently? State the answer on a scale from 0-10, where 0 means not pleased at all and 10 means very pleased.

M2. Overall, to what degree do you perceive what you do in life to be meaningful? State your answer on a scale from 0-10, where 0 means not meaningful at all and 10 means very meaningful.

Think about how you have felt the past 7 days. To what degree were you....? State the answer on a scale from 0-10, where 0 means that you did not experience the feeling at all and 10 means that you experienced the feeling to a high degree.

M3. Happy
M4. Worried
M5. Down or sad
M6. Annoyed
M7. Lonely
M8. Engaged
M9. Calm and relaxed
M10. Anxious

Do you agree with the statements below? State the answers on a scale from 0-10, where 0 means you completely disagree and 10 means you completely agree.

M11. My social relations are supportive and rewarding.
M12. I actively contribute to others' happiness and quality of life.

From Nes et al., 2018, p. 18

Note. Translated directly from Norwegian to English by the author of the current study.

Attachment 2

Consent form presented to the participants in the SPoT study.

Samtykkeerklæring

Jeg har lest informasjonsskrivet om denne undersøkelsen, og er kjent med hva det generelle samtykket til å delta innebærer. Jeg har hatt anledning til å spørre om mer informasjon.

Generelt samtykke
Samtykker du til å delta i spørreskjemaundersøkelsen?
□ Ja, jeg samtykker til a delta i spørreskjemaundersøkelsen

Du kan delta i undersøkelsen uansett om du svarer Ja eller Nei på valget under.

Spesifikk samtykke for kobling mot andre registre
Nærmere informasjon om dette finner du på side 2 i informasjonsskrivet.

□ Ja, jeg samtykker til at UiB kan sende mitt fødselsnummer ved sikker overføring til Norsk Senter for Forskningsdata og at mine data fra spørreskjemaundersøkelsen kan kobles mot følgende registre: Nasjonal utdanningsdatabase (NUDB), Studieprogresjonsregisteret ved Universitetet i Bergen, trygderegisteret (FD-Trygd), reseptregisteret, og pasientregisteret (NPR, KUHR), samt data fra studentenes helse- og trivselsundersøkelsen (SHoT) i 2018 og 2022.

□ Nei, jeg samtykker ikke til at UiB kan sende mitt fødselsnummer kryptert og at mine data fra spørreskjemaundersøkelsen kan kobles mot andre registre.

Attachment 3

Information about the study's purpose and confidentiality presented to participants.

Forespørsel om deltakelse i forskningsprosjektet

Psykiske plager og livskvalitet hos norske universitetsstudenter: Stabilitet, endring, og sammenheng med helseutfall og fungering

Generell informasjon om prosjektet

Hva er hensikt med prosjektet?

Flere undersøkelser tyder på at norske studenter sliter med psykiske plager i økende grad, men det er uklart hva som er årsaken, hvor vedvarende plagene er, og hvor mye dette påvirker studentene i det daglige og i det lange løp. Formålet med dette prosjektet er å undersøke utviklingen av psykiske plager og livskvalitet blant norske studenter over tid, identifisere faktorer som kan forklare denne utviklingen, og finne ut om ulike forløp knyttet til psykiske plager predikerer helse, fungering og bruk av reseptbelagte medisiner, helsetjenester og trygdeytelser. Prosjektet vil kunne bidra til å øke den nødvendig kunnskapsbasen for å videreutvikle relevante velferds- og helsetjenester knyttet til psykisk helse og livskvalitet, noe som både enkeltindivider, studentene som gruppe, og samfunnet generelt vil kunne dra nytte av.

Hvorfor spør vi deg om å delta?

Dette prosjektet vil bidra til ny kunnskap om psykisk helse og livskvalitet blant studenter. Et stort utvalg av 15000 studenter ved Universitetet i Bergen får muligheten til å delta og bli fulgt opp gjennom et helt akademisk år. Prosjektet blir potensielt en av verdens største longitudinelle studier blant studenter på dette temaet. Jo flere som blir med, desto mer helhetlig og verdifull blir denne undersøkelsen.

Hvordan deltar du?

Du deltar ved å fylle ut et sikkert nettbaserte spørreskjema om helse og livsstil, og samtykker til at dine data kan lagres og brukes til forskning. Det tar 20-30 minutter å fylle ut første skjemaet. Etter det første skjemaet vil du via epost og SMS motta lenker til korte skjemaer ukentlig frem til mai 2020. Det tar ca. 5 minutter å fylle ut disse skjemaene. Til slutt vil du motta de to siste oppfølgingsskjemaene; et i mai 2020 og et i november 2020. Det tar 15-20 minutter å fylle ut de siste skjemaene. For de ukentlige skjemaene vil du maksimalt få en purring, for de øvrige skjemaene maksimalt to purringer.

Hva er fordelene med å delta?

Din deltakelse bidrar til at vi kan finne ut mer om hva som påvirker psykiske plager og livskvalitet for den gruppen du hører til i samfunnet og hva konsekvensene er for helse og fungering.
Du gir dermed et viktig bidrag til helseforskning, og svært nyttig informasjon til universitetene. Dette vil i sin tur bli brukt for å gjøre studentlivet ditt så godt som mulig. Å være med er frivillig og gratis. I tillegg kan du som deltaker vinne 1 av 10 Iphone 11 Pro ved slutten av datainnsamlingen. Sannsynligheten for å vinne vil være en funksjon av antall fullførte spørreskjemaer.

Lagring og sikring av data

Hvordan lagres opplysninger om deg?

All informasjonen du gir lagres i en sikker databank ved Norsk Senter for Forskningsdata (NSD). Dine data lagres i en lukket dataløsning uten koblingsmulighet til internett, og er godkjent for oppbevaring av forskningsdata. Forskere og samarbeidspartnere får kun avidentifiserte data. I tillegg har alle som håndterer forskningsdata taushetsplikt. Utveksling av dine data som inkluderer direkte personidentifiserende opplysninger som for eksempel personnummer eller prosjektspesifikt løpenummer vil bare skje i forbindelse med koblinger mot de ulike registrene og vil kun være tilgjengelig for de som må ha dine opplysninger for å foreta koblingen.

Hva betyr det at dine data er avidentifisert?

At data er avidentifisert betyr at opplysninger som kan knytte dem til deg direkte, for eksempel gjennom personnummeret, er fjernet og dine data blir linket til en anonym kode. Det er svært strenge reguleringer knyttet til hvilke forskere som får tilgang til koblingen.

Hvordan sikres ditt personvern?

Det ivaretas gjennom sikre IT-løsninger og strenge regler for datahåndtering. Vi gir ikke utenforstående, som politiet, arbeidsgivere, reklamebransjen, utdanningsinstitusjoner, Lånekassen, eller forsikringsselskaper tilgang til opplysninger fra spørreskjemaundersøkelsen som kan knyttes til deg som person.

Hva skjer med dine opplysninger ved prosjektslutt?

Dato for prosjektslutt er 31.07.2029. Ved prosjektslutt blir de innhentete dataene anonymisert. Med anonymisering menes det at det ikke lenger er mulig å finne tilbake til personen som opplysningene angår, verken via en kodeliste, eller at de innhentete opplysningene i seg selv avslører hvem personen er.