MASTER-THESIS

Effectiveness of an 8-week Digital Prevention Course with Exergames on Physical Activity and Stress Management in University Students in Germany

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Abstract

Background: Different health parameters within the population of university students in Germany had a negative trend in the recent years. University students tend to have low physical activity (PA) levels and high stress levels (SL), which can lead to poor health and low (subjective) well-being (SWB). The promotion of PA shows promising results in improving those parameters. Exergames have recently gained attention in the use of health contexts, by promoting PA in a motivating and enjoyable way. The ergofox GmbH has developed a digital prevention course with Exergames, with the aim to promote PA, reduce SL and enhance SWB in university students.

Methods: The digital prevention course with Exergames had a duration of eight weeks with one course unit per week. Digital pre- and post-questionnaires were implemented to assess the effectiveness on PA, SL and SWB and the feasibility. Dependent t-tests and Wilcoxon signed-rank tests were used to assess significant differences in the pre- and post-intervention variables among the participants. Bivariate analyses in form of Spearman correlation analyses and point-biserial analyses were used to assess significant correlations of the variables with the course participation. The feasibility and suitability of the measure was assessed with descriptive analyses and thematic analyses for the open-ended questions.

Results: Despite the fact that the participants who participated regularly in the course ($n = 24$) showed significant improvements in PA ($z = 2.31$; $p = 0.021$; $r = 0.33$), SL ($z = -2.99$; $p = 0.003$; $r = 0.43$) and SWB ($t(23) = 5.47$; $p < 0.001$; $r = 0.75$) after the intervention phase, it is not possible to attribute these improvements to the digital prevention course. No significant correlation was found between the changes in the variables and the course participation. The improvements might have been caused by confounding variables. The analysis of the data on feasibility and suitability as health promotion measure showed mostly positive ratings, however, participants indicated technical issues and a lack of intensity.

Conclusion: The digital prevention course with Exergames was found to not be effective in improving PA, reducing SL and enhancing SWB among university students. However, the participants rated it to be a feasible and suitable health promotion measure, which still needs improvements. Further comprehensive research with a larger sample size and an enhanced research design is needed to gain further insights into this topic.

Keywords: University students, Exergames, physical activity, stress level, subjective well-being, health promotion

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Abbreviations

IPAQ	International Physical Activity Questionnaire
M	Mean
Mdn	Median
MET	Metabolic Equivalent of Task
Mo	Mode
PA	Physical Activity
SWB	Subjective Well-Being
SD	Standard Deviation
SE	Standard Error
SL	Stress Level
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

1 Introduction

Student health is an increasingly important topic in health promotion and health prevention. This stage of life plays a crucial role for establishing long-term health behaviors, which will most probably be maintained in adulthood (Bielemann et al., 2013; Zheng et al., 2020). However, recent data on the health of university students in Germany shows a concerning trend. This negative and concerning trend highlights the need for suitable, feasible and targeted health promotion measures for university students (Kötter & Obst, 2017; Meyer et al., 2023; Rolle et al., 2024).

One concerning trend can be seen within the levels of physical activity (PA). Overall, 70% of university students indicate to see the importance of regular PA and therefore try to engage in PA regularly. However, a quarter of those students states to exercise for less than half an hour daily, which does not meet the recommendations on health promoting PA by the World health Organization (WHO) (Meyer et al., 2023; World Health Organisation (WHO), 2020). Adding to this concerning trend, the lifestyle of university students became more sedentary in the last years. Those sedentary lifestyles, combined with low PA, can lead to a range of adverse health outcomes (Moulin et al., 2021). Another concerning trend are the high stress levels (SL) among university students. Overall, 44% of students state to frequently feeling stressed, due to various reasons. The most common stressors are academic pressure, financial concerns and the challenge of balancing work and studies at the same time (Heuse & Risius, 2022; Meyer et al., 2023). The high SL might be a reason for the low subjective well-being (SWB) of university students. Almost 61% of students consider their health either “very good” or “good”. However, there has been a drop in those numbers from 84% in the year 2015 to 61% in the year 2023 (Meyer et al., 2023).

Those alarming trends underscore the importance to implement targeted health promotion measures for university students to address the problems effectively. The study by Meyer et al. (2023) furthermore shows, that there are several health promotion measures already implemented at universities. However, especially students who see their health as rather poor see a need for improvement in those measures (Meyer et al., 2023). Furthermore, university students also indicate, that they would like to have more opportunities and time to participate in programs, especially related to PA promotion and stress management. This underscores the need for accessible and flexible health promotion measures (Kötter & Obst, 2017; Rolle et al., 2024).

The ergofox GmbH developed a digital prevention course with Exergames with the aim to promote PA using gamification. The use of gamification elements also aims for a positive effect on SL and SWB. Exergames have become more popular in the use of health context in the recent years due to their ability to make PA motivating and fun. Exergames are used to address and prevent health issues like obesity, type 2 diabetes, depression, back pain and more (Amorim et al., 2018; Comeras-Chueca et al., 2021b, 2021a; Lim et al., 2023; Seo et al., 2023; Staiano et al., 2017, 2018; Valeriani et al., 2021).

The use of Exergames as a health promotion measure to promote PA, reduce SL and enhance SWB in the population of university students has not been extensively researched yet. However, some studies show that Exergames can enhance physical and mental health among university students. A study with 337 university students as participants found that playing Exergames can significantly increase SWB and also happiness (H.-C. Huang et al., 2017). Adding to that, a randomized controlled trial reported that Exergames can improve the quality of life of young adults, especially in terms of physical function and social activities. It was concluded that Exergames can especially benefit individuals, who are less motivated to exercise and have low PA levels (Yu et al., 2023). Moreover, a review by Marques et al. from the year 2023 found that Exergames can positively impact happiness, anxiety, depression, quality of life, self-esteem and emotional regulation (Marques et al., 2023). Additionally, a review by Pallavicini et al. from the year 2021 found that playing Exergames can help to reduce SL and anxiety (Pallavicini et al., 2021).

Although these few studies show promising results in using Exergames to promote various health parameters among university students, research on the health effects of Exergaming within this population is still limited. No study has been conducted among university students in Germany yet. Therefore, this thesis investigates the effectiveness of a digital prevention course with Exergames, which was created by the ergofox GmbH. The primary objective of the course is to increase PA through Exergames and gamification elements, while also aiming to reduce SL and enhance SWB, as these areas represent critical health concerns in the university student population in Germany. This thesis aims to assess the effectiveness of this approach and to determine whether university students perceive the course as a feasible and appropriate health promotion measure. Therefore, this thesis addresses the following overarching research question:

"*Does participation in an 8-week digital prevention course with Exergames have an effect on the physical activity level, stress level and subjective well-being of university students in Germany? How do the university students rate the effectiveness and feasibility of this measure?"*

To address this research question, the theoretical background will be outlined, including the definitions of PA, SL and SWB, along with their interconnections, as well as a definition of Exergames and a review of the current state of research. This will be followed by a description of the methods employed in this study. The results of the analyses conducted to evaluate the research questions will then be presented, accompanied by a discussion of the findings, their limitations and recommendations for practical applications and further research. The thesis will conclude with a summary of key findings.

2 Theoretical Background

The following chapters provide further insight into the theoretical framework of this master thesis. They show the current health situation of university students in Germany, the definition of PA and its effect on health with a focus on SL and SWB, the definition of Exergames as well as their effect on health and the current state of studies concerning the topic of this thesis.

2.1 Health Situation of University Students in Germany and its Relevance

The period of young adulthood represents a relevant stage of life. This phase of life is of particular significance regarding the acquisition and internalization of a healthy lifestyle. This importance is explained by the fact that behaviors developed during this stage of life are most likely to continue into adulthood (Bielemann et al., 2013; Truesdale et al., 2006; Zheng et al., 2020). The university reaches a wide number of young adults (Albrecht et al., 2019). As of the winter semester 2023 / 2024, almost 2.9 million people were enrolled at a higher education institution in Germany (Statistisches Bundesamt, 2024) and the proportion of those starting a degree course will most likely continue to rise in the coming years (Albrecht et al., 2019). Beyond the role as a venue for acquiring specialized skills and knowledge, universities can also serve as a platform for delivering health-related knowledge and skills that can lead to behavioral change (Kohlmann et al., 2018). Nevertheless, despite the considerable importance of acquiring and / or maintaining a healthy lifestyle during this phase of life, the health of university students in Germany appears to be rather poor. To date, only two representative nationwide surveys have been conducted (Grützmacher et al., 2018; Meyer et al., 2023). Most universities conduct their own research in this area. However, there is no systematic reporting for students in Germany, which could be considered a shortcoming. As a result, there is a significant lack of representative figures. However, those reports that do exist indicate a negative trend:

The current health report from Meyer et al., from the year 2023 dealt with the state of health of students nationwide and provided various results, also in comparison to the data

collected in the year 2017 by Grützmacher et al. (Grützmacher et al., 2018) and in the year 2015 by Grobe and Steinmann (Grobe & Steinmann, 2015). The subjective state of health of university students initially appears to be rather good, with 61% of students describing their health as “very good” or “good” and 10% as “less good” or “poor”. When compared to data from 2015, there is a deterioration. In 2015, 84% of respondents reported their health as “very good” or “good”, while in 2017 this figure had dropped to 82%. Additionally, 3% of respondents reported their health as “less good” or “poor” in 2015, compared to 10% in 2023 (Meyer et al., 2023). A visual representation of this data is shown in Figure 1.

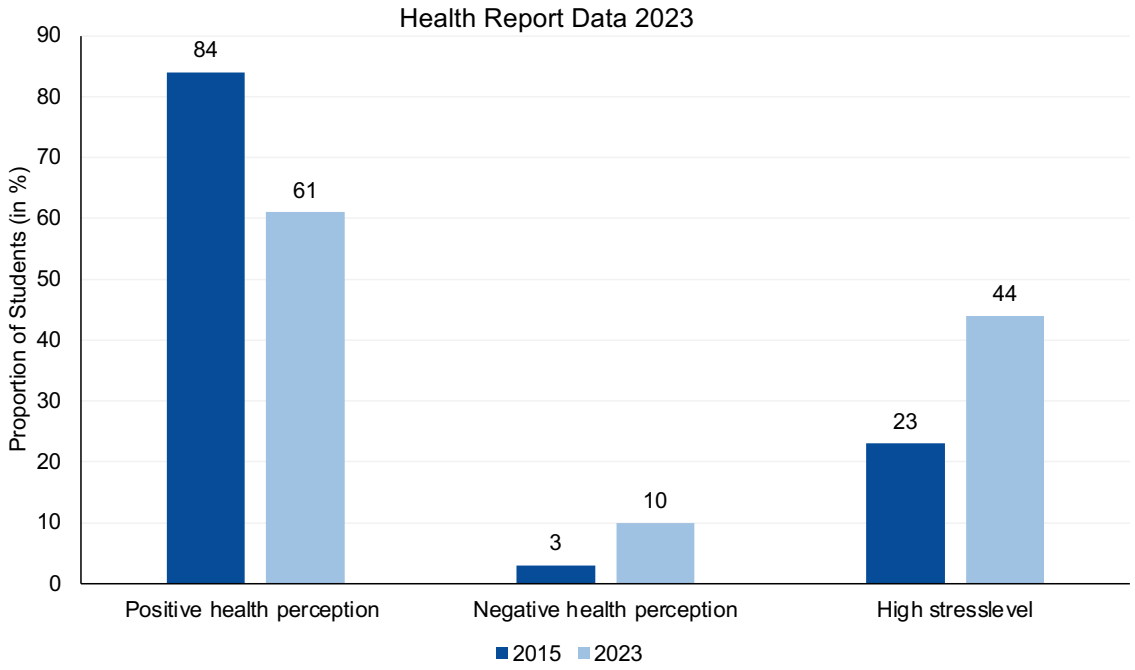

Figure 1: Development of the assessment of the state of health and perception of stress among university students from 2015 to 2023. Adapted from Meyer et al. (2023).

Most university students experience a high SL, which could be the reason for a rather poor subjective health-status and SWB (Chakhssi et al., 2018; Ernst et al., 2022). The proportion of university students who frequently feel stressed has almost doubled (44%) compared to 2015 (23%). Two-thirds of the students surveyed experience this stress as a burden on their health. This data is particularly striking in light of the fact that stress has increased by 3% in the population as a whole between 2013 and 2021. The causes of stress among students are numerous and include examinations, the demands of studying and working simultaneously, concerns about academic performance, financial concerns and numerous other factors. As a result, students not only experience stress but also emotional exhaustion (Heuse & Risius, 2022; Meyer et al., 2023).

Given the high level of stress, respondents were also asked about methods to reduce stress. In 2015, 78% of respondents stated that they engaged in sports. In 2023, this

proportion fell to 70%. However, this contrasts with the data on PA. A quarter of the students surveyed (26%) exercise for less than half an hour per day, a duration that is insufficient when compared to the World Health Organization's (WHO) recommendations (Meyer et al., 2023). Figure 2 shows the proportion of young adults in Germany, who meet the WHO recommended level of health-promoting PA. In terms of endurance activity, 43% of women and 48% of men aged 18 to 29 meet the recommendations for endurance activity according to WHO guidelines. Only 28% of women and 32% of men meet the recommendations for muscle-strengthening activities. One fifth of women (21%) and one quarter of men in Germany (25%) meet both recommendations. These data point to the value of encouraging people to engage in more PA during their leisure time. Adding to that, inactive people who begin to follow the WHO recommendations can significantly reduce their long-term risk of premature mortality (Robert-Koch-Institute (RKI), 2017).

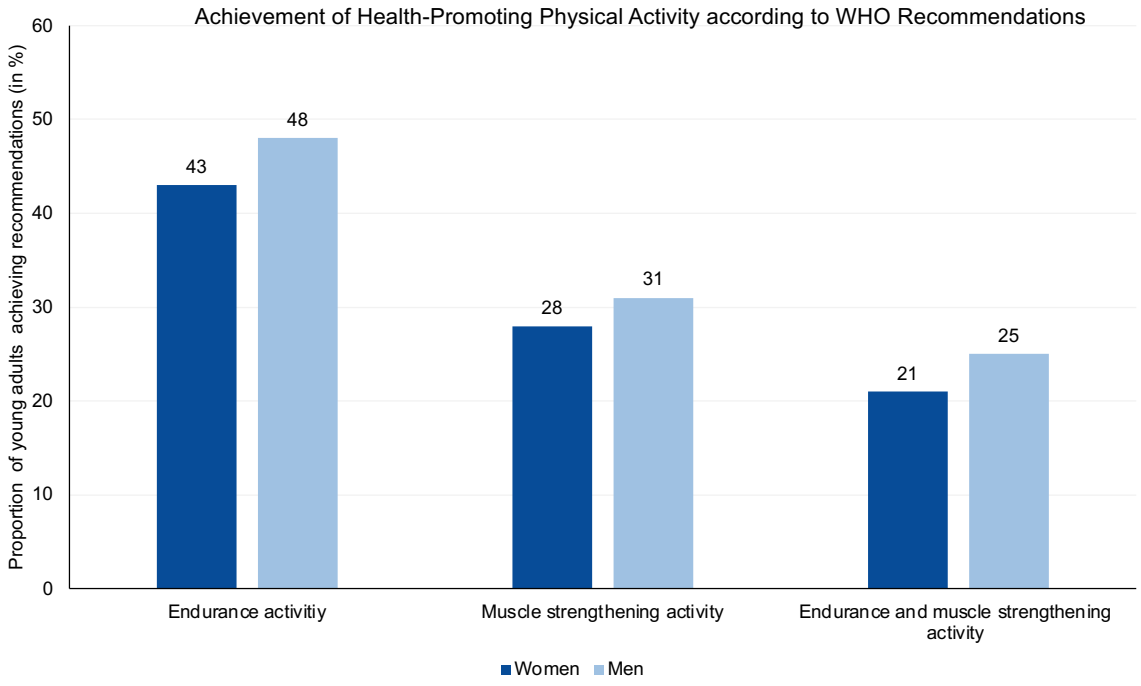

Figure 2: Achievement of health-promoting PA in the leisure time according to WHO recommendations of women and men aged 18-29 in Germany. Adapted from RKI (2017).

It is also important to mention, that university student's lifestyle is characterized by long sitting periods, for instance sitting in lecture halls, libraries and seminar rooms. Also, studying and learning also takes place in the home environment - mostly sitting at a desk. Additionally, many (digital) leisure activities extend the sitting times of a university student. It is therefore unsurprising that university students represent a segment of the population, that sits for an above-average amount of time, for extended periods and without interruption. It is important to consider the potential health risks associated with the combination of

physical inactivity and prolonged periods of sitting, as this could lead to a range of adverse health outcomes (Moulin et al., 2021)

However, in contrast to the rather low PA level in the university student population, the Health Report 2023 also revealed that there is an endeavor and awareness to move more. This is also evident in the form of interest in health promotion measures at university that focus on physical health through sport and exercise (almost 70%). In general, there is great interest in behavioral prevention measures (Meyer et al., 2023).

As already mentioned, a few universities in Germany have implemented their own student health management systems, which, among other things, have also produced their own health reports. The health reports of the *Freie Universität (FU) Berlin* and *Hochschule für Angewandte Wissenschaften (HAW) Hamburg* will be used as supplementary examples. Both reports demonstrate similarly concerning results as the report from Meyer et al. (2023).

The health report from the *FU Berlin* examined a range of health data, including data on health behaviors in the year 2023. The results of the 2023 survey demonstrate notable differences when compared to the findings of the 2021 survey. Overall, the proportion of students reporting high subjective health is significantly lower in 2023 (56% versus 65%), with a similar trend observed among male (60% versus 72%) and female students (56% versus 63%). Nearly half of the respondents (49.7%) indicated that they were experiencing elevated level of stress. In terms of PA, a total of 51% of the students surveyed indicated that they engage in at least 150 minutes of endurance activity per week. It is noteworthy that only 29% of students meet the WHO PA recommendation and that approximately one-third (32%) of students are aware of the importance of PA (Dastan et al., 2023).

The health report conducted at *HAW Hamburg* in December 2022 focused rather on health data than on data on the health behavior. Among other things, respondents were asked about their self-assessment of their physical and mental health. While the results for physical health were still in the average range, the results for mental health were below average. Just under half of the students surveyed reported symptoms of a depressive disorder and just over half reported symptoms of an anxiety disorder. Compared to the nationwide data from 2017 (Grützmacher et al., 2018), these figures have risen sharply (Bart & Schützle, 2024).

The available data clearly demonstrates that university students in Germany are confronted with a multitude of challenges. In particular, data related to subjective health, SWB, SL and PA indicate a negative trend (Bart & Schützle, 2024; Dastan et al., 2023; Finger et al., 2018; Meyer et al., 2023).

It is of great importance to provide students with methods to improve these parameters, as this phase of life is particularly relevant for the development of a healthy lifestyle (Bielemann et al., 2013; Truesdale et al., 2006; Zheng et al., 2020). The relevance of this topic has already been acknowledged. Student health has recently gained attention and relevance, particularly with the enactment of the Act to Strengthen Health Promotion and Prevention ("*Gesetz zur Stärkung der Gesundheitsförderung und Prävention*" / "*Präventionsgesetz*" or "*PrävG*" in short). This act promotes a comprehensive and systematic health promotion at universities, through the improvement of framework conditions, as well as supporting health-conscious behavior, for example through workshops and education about health topics (Gerlinger, 2021). For these reasons, several health promotion measures have already been implemented at universities. However, the Health Report from the year 2023 indicates that students, particularly those who perceive their health to be poor, see a need for further improvement of those measures (Meyer et al., 2023). Other studies have sought to identify the health promotion services that students would find most beneficial. A study conducted by Kötter and Obst (2017) revealed that students represent a particularly vulnerable population with regard to the development of stress-related illnesses. The results of the longitudinal study confirm the deterioration in student health observed in other studies. Regular PA, a healthy ability to distance oneself and a low level of perfectionism were identified as predictors of good health during the time of studying. It was concluded that effective health management for students should focus on both the individual and the framework conditions of their studies. Barriers to a healthy lifestyle should be removed, for example, by providing sufficient time and opportunities for exercise (Kötter & Obst, 2017). A further study, with the same focus on identifying the needs of university students with regard to health promotion, reveals that almost every second student would be in favor of more measures, in particular with the aim of encouraging PA as well as relaxation and stress management (Rolle et al., 2024).The results of these studies indicate a gap in the current health promotion programs available for students. Furthermore, the students expressed a desire for more time to engage with such programs, particularly those focused on PA and stress management (Kötter & Obst, 2017; Rolle et al., 2024).

One promising approach to improving the health parameters, which appear to be rather poor in the university student population, is to enhance PA. A substantial body of research has demonstrated that increased PA can have a beneficial impact on various aspects of health (Chen et al., 2023a; Helmrich et al., 1991; Hsia et al., 2005; Saidj et al., 2016; Wahid et al., 2016). The subsequent chapter will explain these effects in more detail. In particular, during the transition from secondary to tertiary education, first-year university students require targeted support to maintain their PA level. A study from Diehl & Hilger (2016) has

shown, that university students who have relocated for the purpose of their studies may be a particularly vulnerable group. It may be beneficial to provide these students with support to enable them to maintain an active lifestyle during their studies, with a view to facilitating the adoption of an active and healthy lifestyle in their future employment (Diehl & Hilger, 2016).

In light of the numerous benefits of PA for both physical and mental health (Herbert et al., 2020; Penedo & Dahn, 2005), it is of great importance to encourage students to engage in PA and to implement a measure that is accessible and motivating. In the subsequent chapter, the concept of PA will be defined and differentiated for the purpose of this thesis. The following chapters will illustrate the connections between PA and various health parameters, with a focus on SL and SWB. These connections will explain the theoretical framework behind the digital prevention course featuring Exergames, which is the focus of assessment in this thesis.

2.2 Physical Activity and Physical Inactivity

It is well known that incorporating PA into daily life is essential for maintaining mental and physical health (World Health Organisation (WHO), 2024). However, PA is a broad concept that can be interpreted and defined in many ways. In the following paragraphs, the term will be defined more precisely, and the risks of inactivity and main health benefits of PA will be summarized to underline the importance of this topic and to further dive into the topic of this thesis.

PA is generally defined as *any bodily movement produced by skeletal muscles that requires energy expenditure and increases energy consumption above the base metabolic rate* (Caspersen et al., 1985). Engaging in all forms of PA (low, moderate and high) is beneficial for health (World Health Organisation (WHO), 2024). *Low-intensity PA* is defined as minimal exertion that does not result in a significant increase in heart rate or breathing. Examples of low-intensity PA include casual walking, light household chores and gentle stretching. These activities can be performed for extended periods without causing fatigue (World Health Organisation (WHO), 2020). *Moderate-intensity PA* requires more effort than low-intensity activities and leads to noticeable increases in heart rate and breathing. Examples include fast walking, dancing, gardening and relaxed cycling. During *high intensity activities*, the heart rate and breathing is significantly increased. Examples for high intensity activities are jogging, running, carrying heavy groceries or other loads upstairs, participating in an intense fitness class and fast swimming (MacIntosh et al., 2021). PA can also be distinguished into *aerobic* PA, which for instance includes cycling, jogging, playing soccer and

swimming and *muscle-strengthening* exercises, for instance strength training, Pilates and yoga (Robert-Koch-Institute (RKI), 2017).

PA occurs in a variety of settings, including the workplace and during leisure time. It encompasses activities that are undertaken for their physical benefits, for the purpose of exercise or training, for the transportation of objects and for the completion of tasks (Dastan et al., 2023). However, the term “PA” is mostly closely linked to the term “exercise”. *Exercise* or training refers to PA that is intentionally planned, organized and performed consistently with the goal of enhancing or maintaining physical fitness. This type of activity includes specific routines or exercises, such as aerobic workouts, strength training and flexibility exercises, that are systematically repeated to improve cardiovascular health, muscular strength, endurance and overall physical well-being (Caspersen et al., 1985).

Nevertheless, *any* form of PA, as previously outlined in the paragraphs, plays a crucial role in disease prevention and has a beneficial impact on overall health (World Health Organisation (WHO), 2024). However, to provide recommendation on health-promoting PA, the WHO focusses on aerobic and muscle-strengthening exercise, as explained above. There are different national and international guidelines. The following section will focus on the guidelines in Germany (Pfeifer & Rütten, 2017).

Adults between the ages of 18 and 65, who are healthy or adults with chronic conditions that do not significantly impair mobility, such as hypertension or type 2 diabetes mellitus, should engage in regular PA. The minimal exercise recommendation is as follows: The recommended minimum level of PA is *150 minutes per week of moderate-intensity aerobic exercise*, which can be achieved by engaging in five times 30 minutes per week of such activity. Alternatively, *75 minutes per week of high-intensity endurance exercise* can be undertaken, or a combination of both intensities. It is recommended that *muscle-strengthening activities* be performed *at least two days per week*. Additionally, it is advised to avoid long periods of sitting, as these should be limited and regularly interrupted by PA (Pfeifer & Rütten, 2017; World Health Organization (WHO), 2020). Furthermore, increasing the intensity and / or duration of exercise beyond the minimum recommendations can yield additional health benefits. It is also important to note that the greatest health benefits are achieved when people who were completely physically inactive become active, even to a small extent. This means that any additional exercise is associated with health benefits. Every step, however small, away from a lack of exercise is important and promotes health (Arem et al., 2015; Wen et al., 2011).

Physical inactivity is a risk factor for several diseases. A high number of studies have identified correlations between physical inactivity and an increased risk of non-communicable diseases. Those include diabetes mellitus, cardiovascular diseases and strokes, as well as various types of cancer (Lee et al., 2012). Additionally, physical inactivity is associated with a reduction in life expectancy (Ammar et al., 2023). In addition to the effects on non-communicable diseases and reduced life expectancy, physical inactivity can also have a negative impact on mental health, since it can contribute to depression and anxiety (Cunningham et al., 2020; Ferreira et al., 2020; Zager Kocjan et al., 2024). Furthermore, physical inactivity is closely linked to sedentary behavior, which has increased in the recent years due to motorized transport and working with screens. Studies indicate that higher amounts of sedentary behavior are associated with poor health outcomes, including increased all-cause mortality, cardiovascular diseases, cancer and type 2 diabetes (World Health Organisation (WHO), 2024).

In contrast to this concerning yet crucial data, there are a multitude of beneficial effects on various health parameters through the promotion of regular PA and overall health. Regular PA can promote general well-being, as well as physical, mental and social health (Robert-Koch-Institut, 2023). Sufficient PA can also have a preventive effect against the non-communicable diseases mentioned above (Saidj et al., 2016). Furthermore, PA can have a positive effect on the risk factors associated with cardiovascular disease, such as cardiorespiratory fitness and obesity (Wahid et al., 2016). Moreover, PA has been proven to reduce the risk of developing various types of cancer, such as breast cancer (Chen et al., 2023b) and also to lower the risk of developing diabetes (Helmrich et al., 1991; Hsia et al., 2005; Manson et al., 1991). Additionally, PA can possibly enhance mental health outcomes. Regular PA has been associated with increased SWB, greater life satisfaction and also a reduction in depressive symptoms (Penedo & Dahn, 2005). Furthermore, PA has been demonstrated to effectively reduce SL (Herbert et al., 2020).

The necessity for suitable and needs-based measures to encourage PA across all age groups is greater than ever. Given the decline in PA level with age (Langhammer et al., 2018) it is crucial to implement health-promoting measures in younger age groups, such as young adults and university students, to enhance and sustain PA level and promote health (Belsky et al., 2015; Fontana et al., 2014).

As outlined in the previous chapter of this thesis, university students in Germany encounter a multitude of challenges, including insufficient level of PA, high SL and poor SWB. To explain the interconnections between these factors and to further explore the core subject

of this thesis, the following chapters will define stress and SWB and describe their relationship to PA.

2.2.1 Relationship between Physical Activity and Stress

Stress is a prevalent issue. According to a study conducted by the Techniker Krankenkasse in the year 2021, approximately a quarter of adults in Germany deal with stress on a regular basis (Techniker Krankenkasse, 2021). Especially university students in Germany suffer from permanently high SL (Meyer et al., 2023).

The concept of stress can be defined and explained based on different stress models. It is first necessary to distinguish between *distress* and *eustress*. *Distress* is defined as an unpleasant state that an individual is unable to cope with. Such experiences are typically perceived as a burden, leading to feelings of anxiety and helplessness. *Eustress* can be defined as positive stress, which is experienced as a positive challenge that can motivate individuals. It is important to note that stress, is not always perceived as negative. The way in which an individual experiences stress and a particular situation is influenced by their past experiences and their evaluation of the specific circumstances they are in. The approach taken towards a challenge can affect the stress response, which can range from distress to eustress (Ernst et al., 2022). To provide further insight into the definition of stress, the biological stress model, the psychological stress model, stressors and coping strategies will be briefly explained.

The biological stress model describes stress as a physiological process in the body that triggers the “fight or flight” response. In a stressful situation, stress hormones such as adrenaline are released and the heart rate, blood pressure and breathing become higher and faster. The body mainly supplies the muscles in the body by using energy reserves and other processes in the body, such as digestion, are reduced (Klingenberg, 2022).The psychological stress model focuses on a person's cognitive evaluation of a situation or challenge. The cognitive evaluation determines which stimuli are perceived as stressors and how they should be processed. According to the model, stress does not exist per se, but how a person perceives it and deals with it (coping) is decisive (Lazarus & Folkmann, 1984). The sociological stress model - the demand-control model - is also important to mention here and in the context of university students, as it describes a lack of balance between the demands of an activity and the opportunities for control. The greater the demands and the fewer the opportunities for control, the greater the stress (Karasek & Theorell, 1990).

Stressors are stress-inducing stimuli (usually distress) and occur in various forms. They can be divided into physical-sensory stressors (for example noise and heat), physical stressors

(for example hunger and pain), performance and social stressors (for example time pressure, excessive and insufficient demands and competition), life-changing critical events (for example loss of family members and sudden health impairments), critical transitions in the life course (for example puberty and career entry) and chronic tensions and strains (for example permanent everyday problems and chronic illnesses) (Ernst et al., 2022). Depending on how these stressors are assessed, coping strategies can be used to overcome the challenge posed by the stressor. A distinction is made between *instrumental coping*, which is primarily aimed at changing the situation, for example through improved time management and problem-solving behavior, *emotion-oriented* coping aims to change stressful feelings and thoughts, for example by distancing oneself internally and distracting oneself and *regenerative coping* aims to relax the body and turn inner restlessness into energy, for example through exercise and active relaxation. Additionally, there is a destructive form of coping. People in stress situations may tend to a behavior, that is harmful to health (Krafft, 2022).This form of coping, which is also referred to as "dysfunctional coping", includes for instance the consumption of alcohol, unhealthy diet and physical inactivity (Sperlich & Franzkowiak, 2022).

Although stress in the form of eustress can also have a positive effect on a person in the form of motivation, stress can also have physical and psychological consequences for health. Permanent or frequently occurring stress reactions (chronic stress) can damage the organism and thus also health and promote illness. The consequences range from physical impairments, such as cardiovascular diseases, metabolic disorders and headaches and back pain, to mental diseases, such as anxiety disorders, depression and substance abuse (Ernst et al., 2022).

In order to prevent the negative health consequences of stress, it is crucial to implement preventative measures. Among other strategies, this includes engaging in PA, particularly given that regular and sufficient PA is a health-promoting factor for a multitude of parameters. A substantial body of evidence underscores the beneficial effects of PA on SL and stress management in general. Various empirical studies show that there is a connection between PA and stress (Klaperski, 2018; Stults-Kolehmainen & Sinha, 2014). Cross-sectional studies also indicate that regular PA is associated with a lower perception of stress (Aldana et al., 1996; Lovell et al., 2015). However, no causal conclusions can be drawn from these results. The question arises as to whether PA has a stress-reducing effect or whether stressed people tend to be less physically active. Longitudinal studies suggest a *reciprocal* relationship: PA reduces stress and vice versa. Prospective studies show that PA leads to a lower perception of stress, as has already been found in empirical cross-

sectional studies (Jonsdottir et al., 2010; Schnohr et al., 2005). In addition, a literature review by Klaperski (2018) confirms that PA significantly reduced the perception of stress in six out of eleven randomized control trials (Klaperski, 2018). Lutz et al. (2010) also found that during periods of stress, it is easier for people for whom PA is an established lifestyle habit to remain physically active, than people who have only recently started exercising (Lutz et al., 2010).

Furthermore, science is also concerned with the question of whether sufficient PA is able to protect people from stress-related health impairments. A study conducted by Gerber et al. (2016) has shown that moderate PA has a positive effect on perceived SL and cardiovascular risk factors in people exposed to stress. It was found that individuals with increased initial SL showed a reduction in SL and cardiovascular risk factors (Gerber et al., 2016). The effects of PA on the stress response are multifaceted. It has been shown to reduce the intensity and duration of stress reactions, which can be described as alleviating and at the same time facilitates a rapid return to baseline, which can be described as regenerative. These mechanisms explain the “stress buffer effects” of sport, according to which physically active people experience fewer health impairments in times of high stress. However, Gerber and Pühse (2009) conclude that the majority of the studies reviewed support the validity of the “stress buffer effect”, regardless of the age and gender of the participants and also regardless of the study designs (Gerber & Pühse, 2009). Further studies show that people who are resilient to stress (people who have no health symptoms even in times of high stress) are on average more physically active than people who are exposed to high level of stress but who also have a high symptom burden (Gerber et al., 2014). However, it is certain that regular PA generally promotes health, regardless of the individual SL (Klaperski, 2018).

As discussed in chapter 2.1 “Health Situation of University Students in Germany and its Relevance”, university students in Germany represent a crucial and vulnerable group regarding stress and its associated health consequences. Considering the preventive effects of PA on various stress dimensions and its health-promoting benefits in general, the implementation of PA promoting measures for university students could be a suitable approach. PA not only promotes general health but also enhances SWB, which will be explained in the next chapter of this thesis.

2.2.2 Relationship between Physical Activity and (Subjective) Well-Being

The term "well-being" is a broad concept that can be defined in a variety of ways. The WHO defines well-being as follows: “*Well-being is a positive state experienced by individuals and societies. Similar to health, it is a resource for daily life and is determined by social, economic and environmental conditions.*” (World Health Organization, 2021). Adding to this

definition, well-being is “good” and “desirable” and the opposite (ill-being) is “bad” and “undesirable” (Lucas, 2016). *SWB*, as defined by Diener et al., encompasses how people feel and think of their own lives (Diener et al., 1999). Figure 3 visually depicts the different components of well-being and SWB. The term SWB is used to describe an individual’s cognitive and affective (emotional) response to their own lives. The affective components of SWB can also be summarized as “hedonic well-being” and the cognitive components as “eudemonic well-being”. These responses, affective and cognitive, can encompass a range of feelings and attitudes, including emotional reactions to specific events (positive affect and negative affect) and overall life satisfaction and a sense of fulfillment. The spectrum of SWB encompasses both moment-to-moment experiences, such as feelings of happiness or sadness, as well as more long-term and global assessments of life satisfaction (Diener et al., 2009; Kahneman et al., 1999; Lischetzke & Eid, 2006; Steptoe et al., 2015).

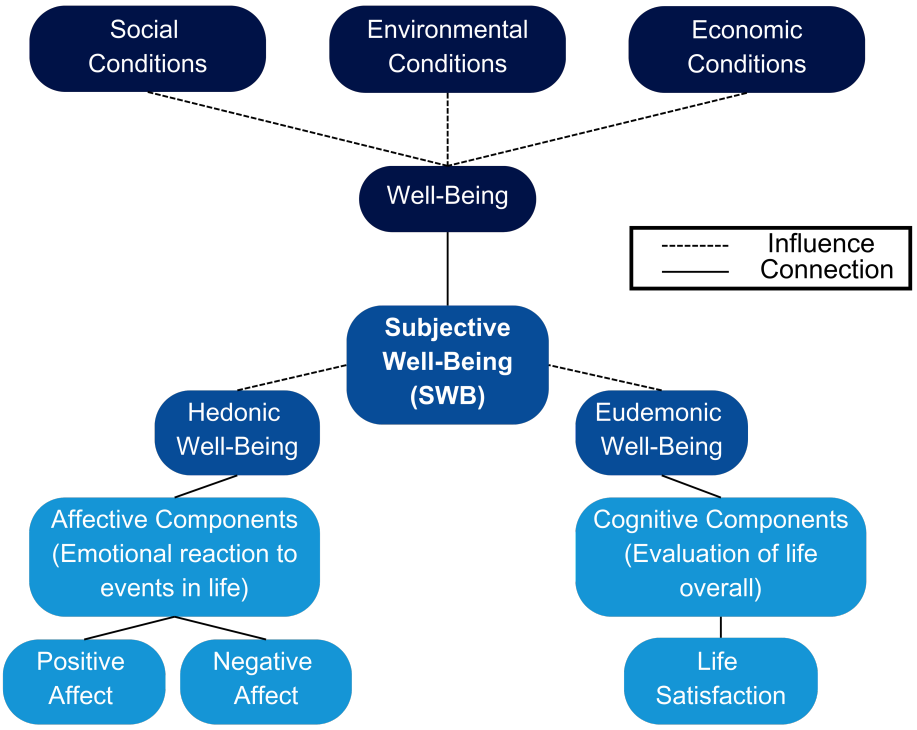

Figure 3: Components and influencing factors of SWB. Own representation. Based on the definitions of Diener et al. (1999), Lischetzke and Eid (2006) and Steptoe et al. (2015).

These definitions indicate that SWB is closely related to health parameters. Various studies show that there is a complex relationship between SWB and health parameters. A longitudinal study conducted by Reinilä et al. examined the bi-directional relationship between SWB and subjective health over an 11-year period. The researchers found that higher life satisfaction and positive mood at certain ages predicted fewer health symptoms years later. Conversely, fewer health symptoms at earlier ages were associated with higher life

satisfaction later in life. Unexpectedly, higher negative mood was associated with better self-rated health. The study highlights the complex relationship between SWB and perceived health throughout adulthood (Reinilä et al., 2023). Other studies have also found this bi-directional relationship, suggesting that poor health impairs SWB and that high SWB could extend life span (Steptoe et al., 2015). In addition, with regard to mental health, specifically (dis)stress, anxiety and depression symptoms, there are positive correlations between SWB and these parameters in clinical and non-clinical populations. This suggests that higher level of SWB are associated with lower SL and fewer symptoms of mental disorders (Chakhssi et al., 2018; Koydemir et al., 2021). Mental problems are, seen the other way around, the leading cause of unhappiness (hedonic well-being) (Helliwell et al., 2013).

There is a strong interrelationship between SWB and PA. PA can influence the SWB in different ways. Wicker and Frick conducted two studies, analyzing the relationship between PA intensity and duration (also considering the WHO recommendations) and the SWB. The results show that moderate PA had a significant positive impact on the SWB, while intense or vigorous PA had a significant negative impact on the SWB. In terms of duration, more minutes spent on moderate PA contributed positively to the SWB, while intense or vigorous PA significantly reduced the SWB level. Furthermore, they emphasize the importance of incorporating light PA into the promotion of enhanced SWB and mental health outcomes. This perspective extends the conventional focus on moderate and vigorous PA, as recommended by the WHO, to consider the potential benefits of light PA (Wicker & Frick, 2015, 2016). Conversely, studies such as one by Zhang et al. (2020) have shown that high levels of PA are a significant predictor of life satisfaction and positive and high SWB. Both moderate and intense PA have been associated with positive affect and happiness. No effects were found on negative affect (Zhang et al., 2020). These effects were also identified in a meta-analysis conducted by Wiese et al. (2017), which focused on leisure time PA and the effect on SWB (positive affect, negative affect, life-satisfaction) (Wiese et al., 2017). A further meta-analysis by Buecker et al. (2021) found that PA has a beneficial impact on SWB, independent of the fitness level of the participants and the type of PA (Buecker et al., 2021). Regarding mental disorders, studies such as that by Panza et al. (2019) show that light PA is positively associated with SWB and negatively associated with depression, which indicates fewer depression symptoms. Moderate PA reduces pain and promotes SWB. Sedentary behavior is negatively associated with SWB and positively associated with depression, meaning that sedentary behavior increases depressive symptoms (Panza et al., 2019). There is a lot of potential of exercise as a therapeutic intervention for clinical depression, to mitigate anxiety, to enhance physical self-perception and foster positive mood (Fox, 1999).

With respect to the student population, a number of studies have also identified positive effects of PA on increased SWB, higher life satisfaction and a reduction in depressive symptoms (Penedo & Dahn, 2005). In this population, a correlation between PA and lower burnout rates and higher quality of life has been established (Dyrbye et al., 2017). Regular PA and cardiovascular fitness are positively related to mental health and SWB in students. Furthermore, aerobic exercise interventions have been demonstrated to act as a buffer against depression and perceived stress (Herbert et al., 2020).

It can be concluded, that SWB has a positive relationship with PA, in the healthy student population but also in clinical populations. The relationship differs in the intensity of PA and the components of SWB. It is also important to note that most studies have focused on examining the effect of only moderate and intense PA on SWB, since it is recommended by the WHO.

2.3 Exergames

The previous chapters have shown the importance of PA and the interconnection with SL and SWB. One potential strategy for promoting PA and with that potentially reduce SL and enhance SWB among university students is the use of Exergames. This thesis assesses the effectiveness and feasibility of Exergames in the health promotion of university students. To further examine this topic, this chapter will define Exergames and their associated health outcomes, as well as provide an overview of the current state of research investigating the use of Exergames for health promotion. Prior to diving into the definition of Exergames and their impact on health, it is first necessary to define gamification.

2.3.1 Gamification

Games encourage motivation and engagement and are an essential part of human culture (Bozkurt & Durak, 2018). Gaming is usually seen as something positive in the daily life. According to Röthig et al. (2003), gaming is a basic human activity that has beneficial impacts from a developmental and educational standpoint. (Röthig et al., 2003). Playing or gaming is seen as a casual, natural activity. It has been shown that games can serve as activating and motivating tools. Games can be played as frequently as desired. According to this viewpoint, gaming supports the advancement of healthy growth (Hauser, 2021). Therefore, the mechanics of gaming are increasingly being applied to generally non-gaming contexts, for example in children education (Ioannou, 2019; Rachels & Rockinson-Szapkiw, 2018), adult and higher education (Barata et al., 2017; B. Huang et al., 2019a), healthcare and fitness (Sardi et al., 2017) and also at work (Passalacqua et al., 2020), to promote motivational, behavioral and learning outcomes (Zainuddin et al., 2020). Gamification - the use of game elements in non-game contexts (Deterding et al., 2011) - is associated with

effects on affect and motivation on behavior, such as academic performance and engagement and also on (cognitive) learning (Albertazzi et al., 2019; Barata et al., 2017; B. Huang et al., 2019b; Zainuddin et al., 2020). The use of gamification for health topics, such as the promotion of PA, can lead to more interest in a health-related topic and thus (intrinsically) motivate and reach individuals who cannot otherwise be reached with conventional health offers (Lampert, 2017; Schwier & Seyda, 2022). Examples for the use of gamification are the app “Duolingo”, which uses level, streaks and awards for learning languages (Duolingo, 2024) and a project management tool called “Trello”, which uses checklists, progress bars and success reports (Trello, 2024). Examples for gamification for health topics are the app “Zombies, Run!”, which is a fitness app that combines running with a story in which users have to run away from zombies (Gandon, 2017) and “SuperBetter”, which is an app designed to help people overcome personal challenges and improve their mental health by using game mechanics such as quests, power-ups and social support (SuperBetter, 2024).

2.3.2 Definition of Exergames

Digital games are often negatively associated and connotated. Digital gaming is often classified as harmful to health due to the risk of addiction and aggression. Furthermore, digital gaming is also seen as restrictive for other activities, especially in terms of exercise and sport, which can also lead to overweight and obesity. However, these dangers do not apply to all game genres (Rehbein et al., 2009).

The positive effects of gaming, in terms of gamification, are also seen and used for health-promoting or “serious” purposes - so-called “serious games” or “Exergames”. The term “Exergame" is a combination of the English words "exercise" and "games". It refers to video games that can be played through physical movements. These movements are typically captured using 3D sensors or conventional web or mobile cameras (Oh & Yang, 2010). Originating in the 1980s and early 1990s, Exergames have undergone diverse development. One of the first developed Exergames is "Dance Dance Revolution" by Konami from the year 1998. In this game, the players have to step on arrows on a dance pad to dance and achieve points. The game gained popularity and led people to move more, even though the aim was not even to encourage movement. Over time Exergames evolved, particularly with the introduction of motion sensors and wireless controls, with consoles such as the Nintendo Wii, Xbox Kinect and PlayStation Move. Those consoles contributed to a wider recognition and popularity of Exergames (Carson, 2016).

2.3.3 Health Outcomes

In the past years, Exergames have gained more attention in research and in the use of healthcare context. The relevance of Exergames lies in their ability to make PA enjoyable

and motivating, addressing diverse needs and age groups. Many studies have focused on investigating whether exergaming leads to more PA, also in comparison to other sports. exergaming can be just as physically challenging as conventional sports, according to the results of recent randomized controlled studies. For certain sports, the PA level of exergaming with a games console is even slightly higher than that of the “original sport” (Douris et al., 2012; Perusek et al., 2014; Rhodes et al., 2018).

Nevertheless, it can be said, that exergaming can be seen as a form of PA. A systematic review and meta-analysis by Mohd Jai et al. from 2021 examined the physiological responses of exergaming in adults. They concluded that exergaming (especially boxing) shows a range of PA intensity from very light to vigorous. It was also concluded, that exergaming can provide adequate PA for young adults and is useful for improving cardiometabolic health (Mohd Jai et al., 2021). Another systematic review by França et al. from the year 2024 focused on the energy expenditure while playing Exergames. The conclusion was, that short-term active video games can match moderate-intensity PA level and those can complement traditional physical activities, especially appealing to youth (França et al., 2024). A cross-sectional study by Ketelhut et al. from the year 2022 showed that exergaming can also induce a high intensity exercise stimulus (Ketelhut, Röglin, et al., 2022). It should be noted that there is a variety in energy expenditure and level of PA depending on different factors. Those factors are for example the specific Exergame used, the characteristics and demographics of the target group and especially the fitness level (França et al., 2024; Ketelhut, Ketelhut, et al., 2022; Mohd Jai et al., 2021). Moreover, some studies have shown that Exergames can enhance fitness level, muscle strength and endurance (Berg et al., 2022; Comeras-Chueca et al., 2021b; Feodoroff et al., 2019; Pacheco et al., 2020).

The promotion of PA has been demonstrated to positively impact a range of health parameters, as discussed in chapter 2.2 "Physical Activity," of this thesis. A significant body of research has yielded comparable findings and outcomes using Exergames. Through the use of Exergames, cardiovascular health can be promoted. The impact of Exergames on cardiovascular health has been investigated by several studies, including those conducted by Kircher et al. (2022), Amorim et al. (2018), Lim et al. (2023), and Staiano et al. (2018). The studies concluded that exergaming can lead to lower blood pressure, as well as lower cholesterol, triglycerides and low density lipoprotein (LDL), when compared to other training methods (Kircher et al., 2022). Additionally, there was a reduction in inflammatory markers and body fat (Amorim et al., 2018), a decrease in blood pressure and an improvement in quality of life in patients with type 2 diabetes (Lim et al., 2023) and a significant enhancement in body-mass-index (BMI), blood pressure and cholesterol in children with obesity

(Staiano et al., 2018). Besides the positive effects of Exergames on the cardiovascular health, some effects were also found in terms of weight management. This can also have an impact on other health outcomes such as diabetes type 2 and obesity (Seo et al., 2023; Staiano et al., 2018; Yu et al., 2023).

Exergames are also becoming increasingly important in rehabilitation, as they have been shown to have positive effects in various population groups. Studies conclude that Exergames can significantly improve motor function, trunk stability, balance and functional mobility for people in stroke rehabilitation (Aslam et al., 2021; Henrique et al., 2019; Malik & Masood, 2021; Peláez-Vélez et al., 2023). For patients with Parkinson's disease, Exergames have also shown positive effects, especially in terms of motor and cognitive skills. Exergames seem equally effective and equally safe as traditional therapies (Chuang et al., 2022; Garcia-Agundez et al., 2019). For patients in cardiac rehabilitation Exergames can improve the heart rate, walking ability, PA and motivation (García-Bravo et al., 2021). Studies have also indicated that Exergames can reduce the pain intensity in patients with chronic back pain (MacIntyre et al., 2023). Overall, Exergames can be effective and motivating supplements or alternatives to traditional methods in various areas of rehabilitation.

Besides the effects on physical health, Exergames have been shown to have positive effects on cognitive health and mental health. In this terms Exergames combine PA with cognitive challenges and promote learning and memory processes, problem solving, attention and motivation. A meta-analysis from 2017 showed significant improvements in various cognitive areas, in healthy individuals and also in people with cognitive impairments (Stanmore et al., 2017). Also, different age groups, especially children and older adults, profit from the positive effects of Exergames on the cognition (Gao et al., 2019; Litz et al., 2021; Liu et al., 2022; Phirom et al., 2020; Yen & Chiu, 2021). Adding to that, Exergames can also improve executive functions and visuospatial perception in people with neurological impairments and are particularly effective for verbal memory in older adults with cognitive impairments (Abd-Alrazaq et al., 2022; Mura et al., 2018).

All these positive health outcomes, on physical and mental health, as well as the positive outcomes in rehabilitation, are mostly reasoned by the promotion of PA through Exergames, as it was already explained in this chapter. However, the mechanism on how Exergames work in terms of health promotion can also be described through the theories of behavior change: Exergames do not influence physiological effects directly, but primarily rather indirectly through psychological and social variables like knowledge, attitude, self-efficacy, communication and support. Exergames have the potential to influence knowledge through the introduction of educational content related to exercise, to positively influence attitudes

by encouraging a positive association with exercise and thereby to enhance motivation, self-efficacy through the completion of different level and the perception of capability. Furthermore, they can facilitate communication and social support through the formation of exercise groups or challenges (Krath et al., 2021). Changes in those variables tend to change / influence the (health) behavior of people and with that physiological and clinical parameter can be improved – it can also be seen as secondary effect (Lieberman, 2001; Liebermann, 1997). Various theories and models, like the Social Cognitive Theory (SCT) by Bandura or Theory of Planned Behavior by Ajzen, are used to explain the psychological and social effects. Those models consider components, such as intention, subjective norms, attitudes, perceived control and self-efficacy, which influence motivation and behavior (Bandura, 1997; Godin & Kok, 1996; Hagger et al., 2002). In terms of the topic of Exergames, self-assessment, gaming experience, social support and knowledge are included as well (Brown et al., 1997; Lieberman, 2001). It can be said that these theories and models play a vital role in the efficacy of Exergames on (health) behavior change and furthermore effects on physiological and clinical parameters of health.

2.4 Current State of Studies

The previous chapters have shown the health situation of university students in Germany, the definition of PA, SL and SWB and their interconnection, as well as their impact on health. Furthermore, the previous chapter defined Exergames and outlined the ways in which they have been shown to affect health outcomes. This chapter will examine the effectiveness of Exergames on PA, SL and SWB. The studies included in this chapter focus on university students; however, as the studies on the effectiveness of Exergames in this population are limited, studies with a focus on young adults, aged 18 to 30 years, will be included to provide a better understanding of the subject matter. First, studies concerning the effectiveness of Exergames in the improvement of PA level among university students and young adults will be presented.

A systematic review by Davis et al. (2022) evaluated studies on exergaming, which focused on exercise intensity, perceptual responses, activity enjoyment and also the adherence rates among young adults. The method was a literature search. The results from the study indicated that exergaming can lead to moderate to vigorous exercise intensity, which leads them to be a potential alternative for traditional exercise. It was also found that exergaming can promote exercise adherence by reducing the perceived exertion while increasing enjoyment through the engaging gameplay. The review suggests that exergaming offers a new, enjoyable form of exercise, which is particularly beneficial for sedentary individuals. In conclusion, exergaming could effectively replace traditional exercise, offering a different and

enjoyable alternative (Davis et al., 2022). A study by Zhano et al. (2024) critically reviewed the effects of Exergames on PA in overweight and obese college students to determine their effectiveness in promoting recommended level of PA. The results indicated that Exergames can reduce sedentary behavior and positively impact PA, including time spent on moderate-to-vigorous PA, as well as improve positive psychological factors and game attendance rates. In conclusion, the study found that Exergames can effectively increase PA in overweight or obese college students, helping them reach recommended PA level (C. Zhao et al., 2022). A study by Gu et al. (2023) investigated the effects of dance-based exergaming versus traditional aerobic dance exercise on energy expenditure, self-efficacy and enjoyment among college students. Overall, 40 participants completed two separate 20-minute exercise sessions with a 10-minute interval on the same day. Results showed no significant difference in energy expenditure or self-efficacy between the two sessions. However, participants reported significantly higher enjoyment in the dance-based exergaming session compared to the aerobic dance session. These findings suggest that, while both exercise modes provide similar energy expenditure and self-efficacy, exergaming offers greater enjoyment, making it a fun alternative for promoting PA among young adults (Gu et al., 2023). Further findings from Feodoroff et al. (2019) and Wu et al. (2015) support the previous study results. Feodoroff et al. (2019) indicated that a virtual reality-based exergame produced moderate aerobic intensity and notable muscle activity, especially in the back muscles of young adults. Most participants enjoyed the exercise, though some experienced cybersickness or muscle pain (Feodoroff et al., 2019). Wu et al. (2015) demonstrated that Xbox 360 Kinect Exergames, such as boxing and soccer, lead to vigorous PA, making them an effective alternative to traditional exercise for healthy young adults (P.-T. Wu et al., 2015). However, these studies focused on young adults, not university students. As already mentioned, studies that focus on the effect of Exergames in the student population are rather scarce and, in terms of PA, do not primarily focus on the promotion of PA but rather on explicit outcomes, like the study conducted by Wu et al. (2022), which was a randomized controlled trial on the effect of an Exergame on running completion time and psychological factors among university students over 4-weeks. Key findings include improved running performance, with the Exergame group significantly reducing their run times, while the control group showed no improvement. Participants in the Exergame group exercised for 30 minutes, three times a week. It was concluded that, overall, the Exergame was effective in improving physical fitness, making it a valuable tool for those with limited access to outdoor exercise (Y.-S. Wu et al., 2022).

Furthermore, studies were also conducted on the effect of Exergames on the different components of SWB, as defined in chapter 2.2.2 “Subjective Well-Being”. A systematic review

by Marques et al. (2023) analyzed the impact of Exergames on emotional experiences. Out of 38 articles found, 16 were included in the review. The results indicate that Exergames significantly affect various emotional aspects, including happiness, anxiety, depressive symptoms, mental health-related quality of life, self-worth, self-esteem, self-efficacy, perceived behavioral control, vigor, vitality, intrinsic motivation, perceived energy and relaxation. These results show that Exergames can have a variety of effects on psychological aspects. The review concluded that Exergames generally lead to an increase in positive emotions. This supports the use of Exergames as a leisure activity to enhance SWB and emotional regulation and highlights their potential for health promotion, public health and clinical practice (Marques et al., 2023). Another important component of SWB is the rating of quality of life. A randomized controlled trial by Yu et al. (2023) investigated whether playing Exergames can enhance the quality of life among young adults and examined potential moderators. A 12-week randomized controlled trial was conducted with participants aged 20 to 24 in Taiwan. The intervention group (55 participants) played Exergames three times a week for 30 minutes per session, while the control group (62 participants) did not play Exergames. Results showed that the intervention group experienced improvements in physical functioning, general health and social functioning. Additionally, participants who were not enthusiastic about exercising saw improvements in those parameters as well. The study concluded that playing Exergames could improve both physical and mental aspects of quality of life (Yu et al., 2023). In addition, hedonic well-being (affect / emotional reactions) also plays a crucial role in overall SWB: A randomized controlled trial by Huang et al. (2017) focused on the impact of Exergames on mood states in university students and university staff. The study included 337 participants, where the intervention group played Exergames for 30 minutes per week for two weeks. This led to a significant increase in SWB and happiness compared to the control group, regardless of gender, age or occupation. Playing Exergames could therefore improve the mood (affect) of university students and employees (H.-C. Huang et al., 2017). Another randomized controlled trial by Hastürk and Munusturlar (2022) analyzed the effects of Exergames on physical and psychological health in young adults. 22 men, who played sedentary video games at least once a week, were randomly assigned to either an experimental group (11 participants) or a control group (11 participants). The experimental group participated in a 5-week Exergame program, playing three times a week for 45 minutes per session. The control group continued their usual sedentary gaming routine. The experimental group showed significant improvements in reaction time, subjective happiness and mental well-being. Additionally, when comparing the two groups, the experimental group demonstrated statistically significant better results in reaction time, right leg static balance, mental well-being and subjective happiness level. The study

concluded that exergaming positively supports young adults' reaction time, mental well-being and subjective happiness (Hastürk & Munusturlar, 2022).

As already explained in the previous chapter 2.2.1 “Stress”, SL could be reduced through PA. A few studies have investigated in the effect of Exergames on the SL reduction of young adults and university students. These include a pilot study by Xu et al. (2021), which focused on the usability and feasibility of a six-week immersive virtual reality Exergame intervention for reducing anxiety, depression and perceived stress among university students, as well as its usability and acceptability. Overall, 31 university students were recruited to play the Exergames twice a week for 30 minutes per session. Anxiety, depression and perceived SL were measured before and after the intervention. Fifteen participants completed the study. Results showed a significant reduction in mean depression scores after the intervention. However, the study did not report significant findings related to changes in perceived SL. Most participants (93%) found the Exergame to have good usability, were satisfied with the gameplay experience and would play it again in the future. Additionally, 73% of participants would recommend the Exergame to friends. The study concluded that exergaming is usable, highly acceptable and has potential to reduce depression level among university students (Xu et al., 2021). Adding to that, a systematic review by Pallavivini et al. (2021) analyzed the effect of video games on reducing stress and anxiety. The review included 28 studies, primarily involving young adults, though some studies focused on children, middle-aged and older adults. The results demonstrated that video games were effective in reducing stress and anxiety across all age groups. Notably, not only Exergames and casual games but also action, action-adventure and augmented reality games showed positive effects. Importantly, even single and short gaming sessions provided benefits. In conclusion, video games across multiple platforms can effectively reduce stress and anxiety (Pallavicini et al., 2021). Other studies have also focused on the effect of Exergames on anxiety and depression. A systematic review and meta-analysis by Viana et al. (2019) focused on the effects of Exergames on anxiety level by analyzing data from seventeen studies. Within-group analysis showed that Exergames and usual care significantly improved anxiety level. However, between-group meta-analysis found no significant difference between Exergames and control interventions, nor between usual care and Exergames plus usual care. In conclusion, while Exergames showed within-group improvements in anxiety, these were not superior to non-exercise interventions. The researchers concluded that this evidence is currently insufficient to support the added benefit of Exergames over usual care in reducing anxiety level (Viana et al., 2021).

In conclusion, the reviewed studies collectively indicated that Exergames can enhance PA, improve various aspects of SWB and are likely to help in the reduction of SL. It is important to mention that some studies indicated contrasting results. However, several critical issues and research gaps are apparent. Firstly, most of the studies are short-term and investigated the immediate effects, which limits insights in the long-term effects of Exergames on PA, SL and SWB. Additionally, the different studies used different Exergames. This leads to variability in outcomes and makes it difficult to generalize the findings (Wiemeyer, 2010). There were also inconsistencies in how SL and SWB were measured. Various measurement methods can cause discrepancies in the results. Moreover, the studies focused on different components of SWB, such as happiness, self-esteem, and quality of life, which complicates comparisons and comprehensive conclusions. SL was often evaluated indirectly through the outcomes of anxiety and depression rather than direct measures of SL. Overall, while Exergames show potential for increasing PA and improving SWB as well as possibly reducing SL in young adults, no clear conclusions for the university student population can be made. This highlights a research gap, which is the focus of this thesis.

Therefore, this thesis addresses the existing research gap by evaluating the effectiveness of an Exergame-based prevention course on PA, SL and SWB being among university students in Germany. The aim is also to assess whether the participants rate the prevention course as a feasible and suitable health promotion measure for university students. The results of this thesis will show whether such an intervention is an effective, feasible, suitable and realistic method to promote university students' health.

3 Objectives and Research Questions

Based on the presented literature and theoretical background, this thesis deals with the main research question:

> *RQ: Does participation in an 8-week digital prevention course with Exergames have an effect on the physical activity level, stress level and subjective well-being of university students in Germany? How do the university students rate the effectiveness and feasibility of this measure?*

To address the overarching research question, several sub-research questions and specific objectives are defined.

The **first objective** of this thesis is to assess whether the 8-week digital prevention course with Exergames had an effect on the PA, SL and SWB of the university students who

participated in this study. To meet this objective, the following research question will be investigated:

> *RQ 1: Is there a significant difference in physical activity level, stress level and subjective well-being following the 8-week digital prevention course among the university students who participated?*

The **second objective** is to assess whether the changes in PA, SL and SWB can be attributed to the 8-week digital prevention course and whether the variables influenced each other. For that, the aim is to assess whether there is an association between the number of completed units in the 8-week digital prevention course and changes in PA, SL and SWB. To meet this objective, the following research question will be investigated:

> *RQ 2: Is there a significant correlation between the number of completed course units in the 8-week digital prevention course and the changes in physical activity level, stress level and subjective well-being among the participants?*

The **third objective** of this thesis is to evaluate which factors are associated with the number of completed course units in the 8-week digital prevention course. To meet this objective, the following research question will be investigated:

> *RQ 3: Which factors are significantly associated with the number of completed course units within the 8-week digital prevention course?*

The **fourth objective** of this thesis is to assess how the participants rated the perceived effectiveness of the 8-week digital prevention course. Additionally, the objective is to assess how students rate the perceived effectiveness of the digital prevention course compared to other university health promotion measures, if they have participated in such measures during their time at university. To meet this objective, the following research question will be investigated:

> *RQ 4: How do the participants perceive the effectiveness of the 8-week digital prevention course on improving the physical activity level, stress level and subjective well-being? How do they rate the effectiveness on physical activity level and stress level in comparison to other health promotion measures at university?*

The **fifth objective** of this thesis is to assess whether the perceived effectiveness of the digital prevention course is associated with the number of completed course units within the digital prevention course. To meet this objective, the following research question will be investigated:

RQ 5: Is there a significant correlation between the number of completed course units within the 8-week digital prevention course and the perceived effectiveness of the digital prevention course on physical activity level, stress level and subjective well-being, as well as fun and motivation?

The **sixth objective** of this thesis is to assess participants' ratings of the feasibility and suitability of the 8-week digital prevention course. To meet this objective, the following research question will be investigated:

RQ 6: Do participants perceive the 8-week digital prevention course as a feasible and suitable measure for university students?

4 Methodology

In this chapter, a detailed description of the methods applied in this thesis is provided. For this, first the digital prevention course, its concept and its structure will be explained, including the description of the study design and data collection, with a detailed description of the questionnaires created and used for this thesis. Lastly, the planned statistical analyses to answer the research questions are explained.

4.1 The Digital Prevention Course

The digital prevention course with Exergames was conceptualized and developed by the ergofox GmbH - a start-up focused on digital health promotion applications. The primary objectives are to assess the effectiveness of the course on PA level, SL and SWB and to assess the feasibility and suitability of Exergames as a health promotion tool specifically for university students.

4.1.1 Objectives and Methods

The digital prevention course is guided by the principles of the “Leitfaden Prävention” (Prevention Guide). The course was developed by experts within the research fields of sports and health sciences. The concept of the prevention course aligns with the objectives outlined in the German “Präventionsgesetz” (Prevention Act), particularly in the prevention principle of PA habits through the reduction of physical inactivity (GKV Spitzenverband, 2023). One of the primary goals is to strengthen physical health resources by enhancing health-related fitness. In addition, the course focuses on enhancing psychosocial health resources, such as improving knowledge about actions and their effects, the change of health behavior, stress management techniques and also body awareness. The course also aims to address and raise awareness for risk factors associated with physical inactivity. The

course also encourages participants to integrate PA more into their daily routines and offers practical tips for everyday activities, training methods, goal setting and establishing routines.

The digital prevention course follows a structured methodological and didactic approach, using diverse methods to meet the objectives. It consists of eight practice-oriented units, which have a consist format with varying content. The course emphasizes applied knowledge and skill development by incorporating quizzes for self-assessment, for example after the theory components. Learning methods therefore include theoretical content but also interactive modules, which are the Ergogym (biofeedback training) and the Exergames (movement-based games). Tutorials and learning games are included for the proper execution of movements in the Exergames. The performance feedback after the Exergames and within the Ergogym can help the participants to track progress and to refine their techniques. The gamification approach aims to boost motivation and promote PA, with engaging content.

The course incorporates key principles from sports science through the progression of load. As the participants progress through the course, the difficulty of the games and workouts increase. It starts with easier challenges and moves towards more complex tasks. The game mechanics also increase from simple to more challenging. Additionally, the course first teaches individual exercises and then combines them into more complex routines. This aims to ensure a comprehensive development of skills and fitness.

4.1.2 Concept and Structure

The concept of the digital prevention course was a journey of movement through well-known European cities. The program covered a period of eight weeks with one session per week. The target was approximately 45 minutes per unit. The units were activated once per week. The primary focus of the course was strength training. The eight units were organized into different muscle groups: upper body (week 1 and 2), lower body (week 3 and 4), core (week 5 and 6) and full body (week 7 and 8). Each muscle group was the focus for two weeks, with the focus shifting every two weeks to ensure comprehensive strength development. However, each unit had the same main components. The components were as follows:

Theory

The theory component of the prevention course was designed to be a 20-minute knowledge unit. The theory comprised an average of seven pages, with the content supported by graphics and illustrations. The theory was research-based and offered a concise summary of the latest and most relevant studies on these topics. The theory always ended with a short quiz that allowed participants to test the knowledge they have acquired. The theory

components covered the following topics: *(1) Health effects and basics of exercise, (2) Lack of exercise - a problem in today's society, (3) Habits and behavioral changes, (4) Body awareness, (5) Coordination, (6) Strength (endurance), (7) Correct training, (8) Relaxation for body and mind.*

Figure 4: Screenshot of the Theory.

Ergogym

The Ergogym was five to ten minutes of exercises with body tracking, which also served as a warm-up. The participant performed eight exercises for the respective focus areas. The Ergogym was a virtual training area in which the participant was instructed on the correct execution of the movement via an audio track and a video, showing the correct execution of the movement. These instructions were displayed as the participant progressed between exercises during the breaks. For each exercise, the participants saw themselves (including movement recognition stick figures) in a natural environment on one side and a demonstration video with correct execution on the other. This allowed the participants to imitate the exercise using the video and learn how body tracking works. In the middle there was a progress bar for the repetition progress of the respective exercise as well as a visualization of the next body position to be taken in the form of icons. The body parts that were not yet in the correct position were marked orange and those that were in the correct position were green. In this way, the participant received biofeedback and could correct their execution based on this.

Figure 5: Screenshot of the Ergogym.

Figure 6: Ergogym Overview.

Exergames

One unit included 15 minutes of Exergames divided into three games. The Exergames required continuous PA to control the game. The game principles of the Exergames were based on the current muscle group focus. The Exergames therefore required movements, which targeted the focused muscle group, for example squats for lower body focused weeks and hammer curls for the upper body focused weeks. A total of eight games were developed and adapted to the respective focus of the weeks. Each game also progressed in difficulty within the five minutes and if a game was scheduled a second time during the course, it began with a higher level of difficulty to provide an appropriate training stimulus. Following the three active Exergames, a three-minute Exergame focused on stretching and cool-down was included to help gradually bring the heart rate back to normal. Table 1 provides a summary of the typical flow of one unit, through which the participants were guided on the platform, including the previously described components.

Table 1: Typical flow of one unit within the prevention course.

	Start	
Login		The participant must sign in with his or her own login data.
Selection of unit		The participant can complete the current unit or repeat a prior unit, if wanted.
1.	Theory	The theory encompasses 20 minutes of reading material on a specific health topic.
2.	Ergogym (Warm-Up)	The Ergogym encompasses five to ten minutes of exercises with body tracking and biofeedback, focusing on the respective muscle group focus of the week.
3.	Exergames	The Exergames encompass 15 minutes of exergaming with three different Exergames (each five minutes), focusing on movements targeting the respective muscle group focus of the week.
4.	Cool-down Exergame	The cool-down Exergame encompasses 3 minutes of one Exergame, which included stretching exercises and slow body movements.
5.	Quiz and Statistics	The participant can complete a quiz on the topic of the theory and look into his or her Exergame statistics to check his or her progress and score.
	Completion	

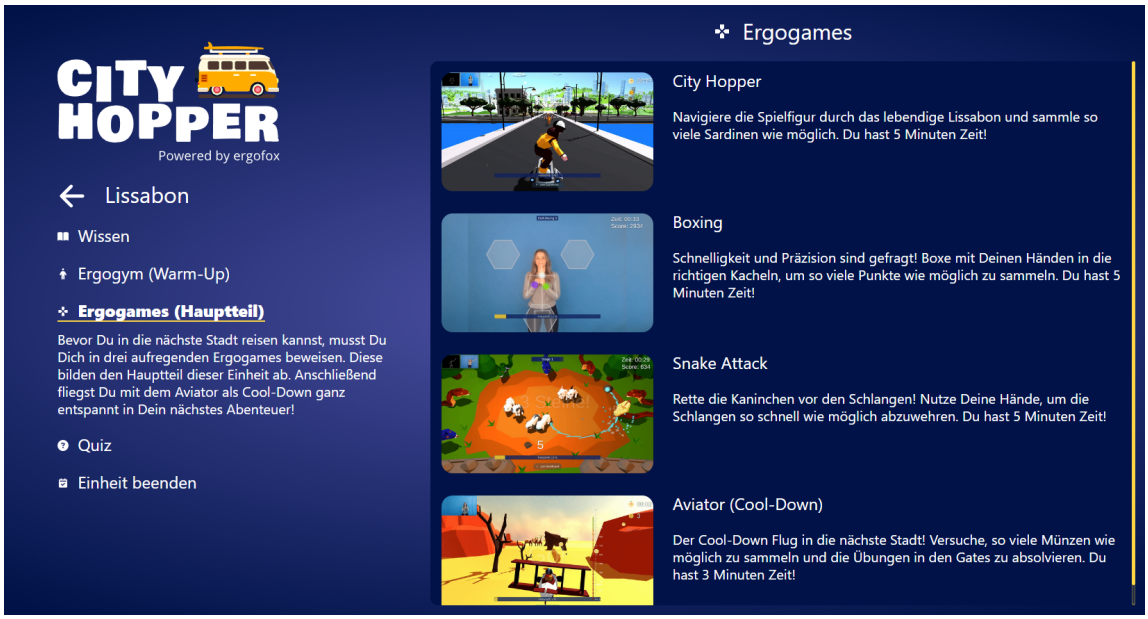

Figure 7: Screenshot of the unit overview and Exergames.

The sequence of activities remained consistent for each of the eight units, as seen in Table 1 and Figure 7. However, the content of the units varied on a weekly basis, depending on the muscle group that was the focus of the week and the theoretical topic, as previously outlined in this chapter. Table 2 provides a summary of the Exergames utilized in the prevention course, including a description of their game principles and the main body movements involved, with the aim of offering a more comprehensive understanding.

Table 2: Description of the Exergames and the game principles.

Exergame	Game principles
City Hopper	The player navigates their character through various virtual European cities (for instance Lisbon, Munich) using side lunges to move left and right. They must avoid obstacles by raising their hands or jumping and collect objects along the way. Additionally, players pass through gates that trigger mini workouts featuring exercises introduced in the Ergogym.
Boxing	The player sees themselves on the screen and must quickly punch colored targets via active arm movements or move their upper body into designated zones (body movements left, right, up, down). The targets are positioned near the upper body.
Reaction Game	*Upper body focus:* The player sees themselves on the screen and must quickly hit randomly appearing points in the space with strong arm / hand movements before they disappear. In some cases, the sequence and color of the points must be followed. *Full body focus:* Similar to the Reaction Game – Arms, but here both arms and legs can be used to reach the points. Strong arm/hand movements and leg movements (for example kicking) are required.
Tower Defence	Set at a volcano, the player controls a water hose, using arm movements (hammer curls) to extinguish incoming lava balls before they reach the tower that needs protection. Squats are used to recharge the water.
Cube Ninja	*Upper body focus:* The player must destroy flying cubes with powerful, precise arm movements. *Lower body focus:* The player destroys flying cubes in the room with controlled knee movements.
Skippings	The player destroys a descending wall of cubes by raising their knees and shooting the cubes.
Snake Attack	The player protects rabbits surrounded by snakes by performing squats to pick up stones and using controlled, powerful hand and arm movements to defend the rabbits with the the stones from the snakes.
Aviator (Cool-Down)	Similar in gameplay to City Hopper, the player controls an on-screen airplane through body movements (side lunges left and right) in a virtual world. By making controlled, slow arm movements, the plane can ascend and descend to avoid obstacles. Passing through gates initiates mini workouts focused on stretching exercises.

4.2 Study Design

The study was designed as a one group experimental pre-post design with an intervention taking place for eight weeks. The sample size was calculated using G*Power of Version 3.1. A a-priori test for dependent t-tests was chosen with a medium effect size and a significance criterion of $\alpha = 0.05$. The required sample size was N = 54, with an estimated Power of 0.95.

As participants, university students in Germany were recruited. The participation in this study was voluntary. The way of recruitment is further elaborated on in chapter 4.2.1 “Target Group and Recruitment” of this thesis.

In this study, a control group was not included due to ethical considerations and the voluntary nature of participation. Offering the intervention to all participants ensured equitable access to potential benefits, preventing the ethical dilemma of withholding a potentially beneficial treatment (Salazar et al., 2015). Therefore, all university students who wished to participate were eligible to do so. However, some students may have chosen not to engage in the intervention but still completed the pre- and post-questionnaires. These students were included as part of the “control” group.

The study had a single-factor-design, implementing that one factor (in this case the prevention course) is “manipulated” (Salazar et al., 2015). The factor “prevention course” was therefore the independent variable (IV) and the PA, SL and SWB were the dependent variables (DV). However, the IV had different level – completing I. at least half of the course, II. less than half of the course III. no unit of the course. These levels were considered in the analysis of the collected data of this study.

The duration of time of this study were eight weeks, since the prevention course was conceptualized for this duration of time with eight units in total. The participants had access to the prevention course for an additional four weeks after the eight-week period if they were unable to complete one or more units due to illness, exams or other reasons. The personal data (name, surname, e-mail address) and statistics (scores achieved in the Exergames) stored in the participant's profile will be anonymized 12 weeks after the profile is created, so that individual details about personal or factual circumstances can no longer be assigned to a specific or identifiable natural person. The participants have the option of having their profile deleted at any time.

Furthermore, the study had a prospective design with two time points of measurement: t1 (pre-intervention, baseline) and t2 (post-intervention, end of intervention). The methods of measurement were digital questionnaires, with closed, semi-open and open questions, which will be further described in the chapter 4.3 “Data Collection”.

4.2.1 Target Group and Recruitment

The target group of this study was the population of university students in Germany. The target group was chosen based on a literature review made beforehand, which results can be found in the first chapters of this thesis. The potential participants were approached

through a variety of recruitment channels. The foundation for recruitment was a landing page offered by ergofox GmbH and created by the researcher with the website-building program “Mobirise”. The website offered comprehensive details regarding the prevention course and the study project. Those who wished to obtain further information could view the study information and data protection declaration directly on the website. The website contained a link to a further website of the ergofox GmbH, which provided a system check to check the performance of the interested participants end device. The system check served only to determine whether the end device in question had the necessary performance to support the prevention course and the included Exergames. Subsequently, interested participants were able to consent to participate in the study and authorize data processing by checking a checkbox (voluntary informed consent). The participants could then enter their e-mail address in a field and submit the form. The emails were securely stored in the ergofox GmbH backend and utilized to disseminate the course link and the pre-questionnaire at the start of the intervention phase, which was on the 5th of July 2024.

To reach a wide range of university students in Germany, a variety of recruitment strategies were employed, with the objective of reaching the target group in the most effective manner. The link to the landing page and registration page with system check was communicated in the following ways:

- E-mail Distribution Lists: Over 20 universities in Germany were contacted, asking if they could distribute study information via student e-mail lists. Only two universities, HAW Hamburg and Charité University in Berlin, agreed to assist.
- Flyers: Flyers containing a QR code to the study landing page were distributed at exhibitions, to universities for display and by lecturers to their students.
- Social Media: Recruitment posts, including a digital version of the flyer and a link to the landing page, were shared on LinkedIn and Instagram by both the researcher and ergofox GmbH.
- Friends and Family: Snowball-sampling was empleyed by asking friends and family (who are students) to participate and share the study with other university students.

The study information, including information on the background, aim, methods and risks of the study and the privacy policy, which were included on the landing page, as well as the flyers used for recruitment are attached in appendix I and II. The link of the landing page used for recruitment was the following: https://ergofox.me/de/ExerVenture.html. Informed consent was a crucial element of the study, and thus, prior to enrolling in the waiting list via e-mail through the landing page and prior to completing both questionnaires, participants were actively required to review the study information and data protection policies. Only

after actively agreeing to these conditions by clicking on a checkbox, the participants were permitted to register and complete the questionnaires.

Furthermore, inclusion and exclusion criteria for participation were defined before the recruitment. The following criteria resulted in exclusion from the study:

Table 3: Inclusion and exclusion criteria for participation.

Exclusion Criteria	Inclusion Criteria
- Not being a enrolled student in Germany - Being over 30 years old - Lacking a functioning end device with a web camera - Insufficient device performance, failing the system check - Physical limitations (for instance cardiovascular, lung, or joint problems) that could hinder participation - Lack of German language knowledge (the course was in German) - Lack of consent to participate in the prevention course and the evaluation	- A minimum age of 18 years - Enrollment as a student in Germany - Access to a functional end device with an integrated or external webcam - Sufficient performance of the device, having a sufficient result in the system check - Proficient knowledge of German - Consent to participate in the prevention course and evaluation.

To determine eligibility for the prevention course, participants were first asked a number of questions regarding exclusion criteria. These questions were presented at the beginning of the pre-questionnaire, which was to be completed prior to registration. More information on the questionnaires can be found in chapter 4.3 “Data Collection”. If a participant indicated that they met one of the exclusion criteria, the questionnaire was unable to be completed and the process was terminated.

4.2.2 Study Timeline

The conceptualization and development of the prevention course started in September 2023. In the beginning of 2024, a literature review on the topic of Exergames in health promotion and student health in Germany was made by the researcher and it was determined to use the prevention course developed by ergofox GmbH to conduct further research in this research field. Afterwards the professors and supervisors of this thesis were contacted to finalize the framework of the study. In March 2024 the study design and the study process, also including the creation of the questionnaires and recruitment strategy was made, due to the reason that an ethical proposal was submitted to the Ethics Committee from the HAW Hamburg. The ethical proposal was handed in the beginning of April 2024 and a positive votum was given on 4th June 2024. With that the recruitment phase started.

During that time, the potential participants could enroll in the waiting list. On the 5th of July an e-mail was automatically sent to the participants with information on the further procedure, the link to the pre-questionnaire (t1 baseline measurement) and the link to the registration for the prevention course. With the link the participants were able to create a private profile for the prevention course. With that, the eight-week intervention phase started. A week after, an automatic reminder-mail was sent to participants, in case the prior mail was not acknowledged. Exactly eight weeks after the first e-mail with the pre-questionnaire was sent, the post-questionnaire (t2 post intervention measurement) was sent out to the participants automatically via e-mail on the 30th of August 2024. Additionally, a week after, the same e-mail was sent out again, as a reminder. However, since the course was accessible for a total of 12 weeks, the e-mails got sent out once again in the end of September, to reach the participants who needed to take more time for the prevention course and the participants who did not start directly in the beginning of the intervention phase. Afterwards, the evaluation of the data has started. The study timeline is visualized in Figure 8.

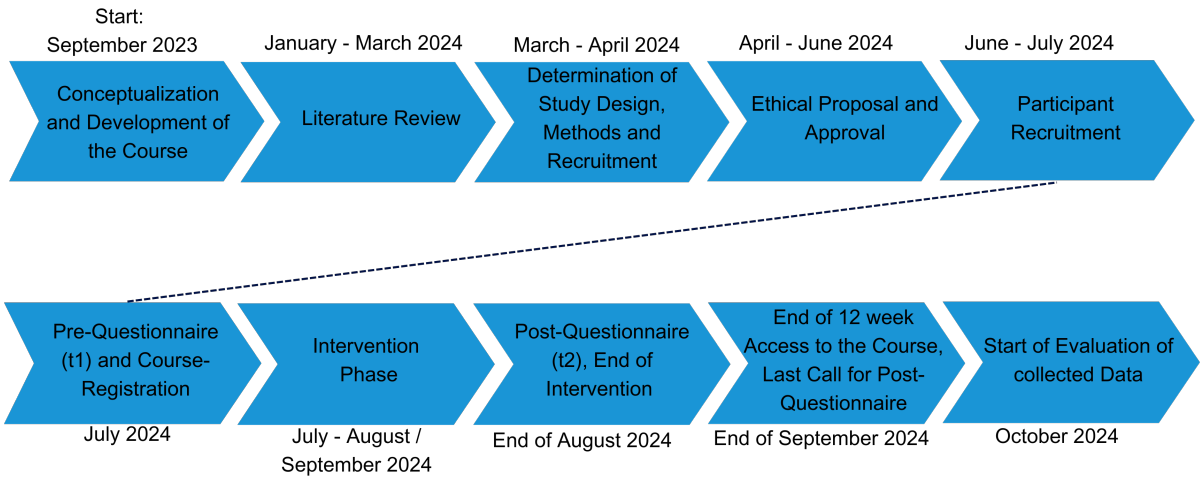

Figure 8: Study Timeline.

4.3 Data Collection

For the data collection of this thesis two digital questionnaires were created to implement pre (t1) and post (t2) intervention. The digital questionnaires were administered through the SoSci Survey platform. SoSci was chosen for its user-friendly interface, flexibility in questionnaire design and robust data security features (SoSci Survey, 2024). The questionnaires were developed in German, as the target population is university students in Germany, and the digital prevention course is also only available in German. A *digital* questionnaire was utilized as the method of data collection, as the prevention course is also digital and thus more convenient for participants to complete the questionnaires digitally as well. However, this is why objective data, such as physical measurements, could not be collected. Only subjective data were gathered through the digital questionnaires. The objective here was to

make the intervention as accessible as possible for the participants. Due to concerns about the potential for data to be traced back to individual participants, no objective data was collected regarding progress in the prevention course itself. Both questionnaires consist of different validated questionnaires and other further questions for the overall evaluation of the course. The participants were also asked to create a unique code, which they had to enter again in the post-questionnaire. This way dropouts could be identified, which is important for the data analysis afterwards. The code consists of the first letter of the place of birth, the first two letters of the mother's first name and the two numbers of the month of birth, for example Munich, Maria, May (05) = MMA05. Table 4 depicts the variables of the pre- and post-questionnaires in a comprehensive manner.

Table 4: Variables included in the pre- and post-questionnaire.

Pre-Questionnaire	Post-Questionnaire
- Demographic Data - Subjective Health Status - Subjective Well-Being - Physical Activity, Causes of Physical Inactivity - Stress Level, Causes of Stress, Methods of Stress Reduction - Prior Exergaming Experience and Motivation	- Subjective Health Status - Subjective Well-Being - Physical Activity, Causes of Physical Inactivity - Stress Level, Causes of Stress, Methods of Stress Reduction - Rating of Perceived Effectiveness of the Prevention Course - Rating of Feasibility in the Everyday Life - General Course Evaluation - Other (technical issues, suggestions for improvement etc.)

In the following sections the pre- and post-questionnaire will be described. It has to be noted that a pre-test was done with both questionnaires, with N = 8 university students, independent from the study, to assess the comprehensibility of the questionnaires and to identify potential areas for improvement. For that, the pre-test comment function on the SoSci-Survey platform was utilized. Based on these insights, the questionnaires underwent adaptations and enhancements before being implemented in the study.

4.3.1 Pre-Questionnaire

As visualized in Table 4, the pre-questionnaire consisted of different dimensions. First, the participants were asked whether they consented to participate in the digital evaluation by ticking an appropriate checkbox. If they did not consent, a screen-out was shown and the participants could no further fill out the digital questionnaire. Afterwards, the participants were asked to create the unique code, as already described in the previous chapter.

Sociodemographic Data

After creating the code, the participants were asked for sociodemographic data and specific questions on the inclusion criteria, so that if they did not meet the criteria, a screen-out was shown and the questionnaire and the data collection is stopped. Questions on the socio-demographic data included age, gender, the pursued graduation, federal state of study, study course and the way of recruitment. In terms of inclusion criteria, they were asked if they had any diseases, such as cardiovascular diseases, which could have prevented them from taking part in the course, if they had an integrated or external webcam, which was needed to take part in the digital prevention course, which end device they were about to use for the course and whether they have made the system check on this device already and if so, which result they had in the system check. In the event that a participant had a diagnosed illness, lacked the necessary webcam or had a device that didn't meet the specified criteria, a screen-out notification was displayed, accompanied by an explanation of the reason for ineligibility.

Subjective Health Status

To assess the subjective health status, the participants were asked to estimate their current subjective health status on a Likert scale from 1 = "bad" to 10 = "good".

Subjective Well-being

To assess the SWB the WHO-5 were used. The WHO 5, consisting of 5 questions, is an internationally recognized, time-efficient and valid questionnaire for measuring SWB. The questions consist of five statements, which relate to the well-being in the past two weeks. Those statements had to be rated by the participants on a 5-point Likert scale, with 1 = "at no time", 2 = "slightly less than half of the time", 3 = "slightly more than half of the time", 4 = "most of the time" and 5 = "all the time". The statements were the following:

1. "In the last two weeks I was happy and in a good mood."
2. "In the last two weeks I felt calm and relaxed."
3. "In the last two weeks I felt energetic and active."
4. "In the last two weeks I woke up feeling fresh and rested."
5. "In the last two weeks my everyday life was full of things that interest me."

Using the quantitative data from the one to five scale, a score can be calculated. The score is calculated by simply adding up the answers. The raw score ranges from 0 to 25, with 0 indicating the lowest level of well-being / lowest quality of life and 25 indicating the greatest well-being / highest quality of life (de Bruin & Others, 1996).

Physical Activity

To assess the subjective PA level, items from the *International Physical Activity Questionnaire (IPAQ) - Short Form* were used. With this questionnaires' items the types of intensity of PA and time spent on those activities and sedentary time that people engaged in as part of their daily life were assessed. With this assessment, the total PA in MET-minutes per week and time spent sitting could be estimated and used for the analysis of the change of PA level pre- and post-intervention. The IPAQ includes seven items with questions surrounding individuals' last seven-day recall of PA (Craig et al., 2003). The IPAQ initially includes open-ended questions. However, to simplify the process for participants and reduce the complexity of subsequent analysis and calculation of PA level, categories were provided. The first two questions of the IPAQ focused on vigorous PA, asking on how many days vigorous physical activities were done (ranging from 0 to 7 days) and how much time was usually spent on those activities (1 = "less than 30 minutes a day", 2 = "30-60 minutes a day", 3 = "more than 60 minutes to 2 hours a day", 4 = "more than 2 hours a day") on one of those days. The third and fourth questions addressed moderate physical activities, however, also asking on the number of days and hours spent engaging in these activities on one of those days. If the participants did not engage in vigorous and / or moderate physical activities, the following question on how much time was spent on these activities were automatically skipped. The fifth and sixth question focused on walking, asking on how many days the participants walked for at least ten minutes at a time (ranging from 0 to 7 days) and if they did, how much time was usually spend walking on one of those days. The seventh and last question of the IPAQ focused on the usual time spent sitting on a weekday (1 = "less than 2 hours a day", 2 = "2 to 4 hours a day", 3 = "more than 4 to 6 hours a day", 4 = "more than 6 to 8 hours a day", 4 = "more than 8 hours a day"). From these variables the MET-minutes per week were calculated. MET stands for Metabolic Equivalent of Task and is a unit used to estimate the energy expenditure of PA. PA are often expressed in multiples of METs, with higher MET values indicating more intense activities. For example, walking at a moderate pace may be around 3-4 METs, while running could range from 8-12 METs or higher (Ainsworth et al., 2011). For the calculation of the PA level with the items for the IPAQ, the following formulas were used, as instructed by Craig et al. (2003):

*Walking MET-minutes/week = 3.3 * walking minutes * walking days*
*Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days*
*Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days*

The combined total PA MET-min per week were computed as the sum of walking + moderate + vigorous MET-min per week scores. The IPAQ was accompanied by questions about the reasons for inactivity, where it was possible to select multiple options (1 = “I am physically active and do sports”, 2 = “Lack of time”, 3 = “Lack of motivation”, 4 = “Health-related restrictions”, 5 = “Lack of access to sports facilities”, 6 = “Discomfort during sport”, 7 = “Lack of social support”, 8 = “Other”, with option to specify other reasons), if the participants were rather inactive and if they have fun doing PA, with a scale from 1 = “not pleasant” to 5 = “very pleasant”.

Stress Level

To assess the subjective SL of the participants, items from a previous study from Meyer et al. (2023), which also assessed the SL of university students in Germany, were used. The first item was a rating of the SL experienced over the past four weeks in both one's personal life and academic studies. Therefore, a 5-point Likert scale was used with from 1 = “never” to 5 = “often”. Afterwards, it was asked for the causes of stress, if the participant experienced stress over the past four weeks. Categories are provided from which the participant was able to select multiple options, with 1 = “I have no stress”, 2 = “Examinations”, 3 = “Fear of bad grades”, 4 = “Learning material that is too difficult or too extensive”, 5 = “Lack of retreat options at the university”, 6 = “Digital teaching”, 7 = “Financial worries”, 8 = “The multiple burdens of studying and working part-time”, 9 = “The multiple burdens of studying and family”, 10 = “Poor time distribution of courses”, 11 = “Private conflicts” and 12 = “Other”, with option to specify other reasons. Furthermore, it was asked for the methods used to reduce stress. From the categories given, multiple methods can be selected: 1 = “I have no stress”, 2 = “Meet up with friends or family”, 3 = “Go for a walk / go outside”, 4 = “Doing sport”, 5 = “Surfing the Internet or playing video games”, 6 = “Watching TV”, 7 = “Relaxation techniques (yoga, autogenic training, etc.)”, 8 = “Drink a glass of wine or beer”, 9 = “Smoking (any form - cigarette, e-cigarette, vapes, etc.)”, 10 = “Consuming cannabis”, 11 = “Take a sedative” and 11 = “Other”, with option to specify other methods. The assessment of the SL was used to assess potential changes pre- and post-intervention. The assessment of the causes of stress and the techniques for stress reduction is utilized to gain deeper insight into the participants' health behaviors.

Prior Exergame Experiences and Motivation

The last set of questions in the pre-questionnaire focused on prior Exergame use and motivation for the digital prevention course. First, the participants were asked whether they ever played an Exergame or any fitness related video game. The answer categories are either “yes”, “no”, or “I don’t know”. If they indicated that they played such a game before,

they were asked to specify which game they played via an open-ended question. Moreover, to assess the motivation for the prevention course, the participants were asked to rate the level of motivation for the course with a scale from 1 = “very unmotivated” to 5 = “very motivated”. The last question asked whether the participants had any concerns or reservations about participating in the prevention course. The options are “yes, the following:” (open-ended) and “no, none.”.

4.3.2 Post-Questionnaire

The post-questionnaire consisted of mostly the same questions as in the pre-questionnaire, as visualized in Table 4. First, the participants were asked whether they consented to participate in the digital evaluation by ticking an appropriate checkbox. If they did not consent, a screen-out was shown and the participants could no further fill out the digital questionnaire, just like in the pre-questionnaire. Afterwards, the participants were asked to enter the unique code, which they created in the pre-questionnaire. After doing so, the first parts of the post-questionnaire were equal to the pre-questionnaire, asking for the subjective state of health, SWB, PA, reasons for inactivity, SL, reasons for stress and coping strategies. The following sections focus on the use of the course, the rating of perceived effectiveness of the course, the feasibility and suitability of the course and the overall rating of the course.

Use of the course

First, the participants were asked for the total number of units completed within the prevention course. The options go from “0” to “8”. If the participants indicate that they did not complete all units of the course, the following question was asked “Why didn't you use the digital prevention course (regularly)?”. The following answer categories are given: 1 = “I did not have time”, 2 = “I wasn’t interested”, 3 = “I had technical problems”, 4 = “I had health restrictions”, 5 = “I did other sports”, 6 = “I had too much stress” and 7 = “Other”, with the with option to specify other reasons. For this, multiple selection of answers was possible. The following question asked about the continuous use of the course, with the answer categories “yes, one unit every week”, “no, with breaks in between” and “I did not use the course”. If the participants indicated that they did not use the course at all, a screen-out was displayed, informing them that the questionnaire will conclude at that point, given that the subsequent questions can only be answered if the course was engaged with at least once.

Rating of Perceived Effectiveness

First, the participants were asked to rate the overall perceived effectiveness of the course, with a scale going from 1 = “does not apply at all” to 5 = “fully applies”. Afterwards, they were given the statements “I find the digital prevention course mentally challenging.”, “I had

the feeling that the digital prevention course was good for my physical well-being.", "I had the feeling that the digital prevention course was good for my mental well-being." and "I had the feeling that the digital prevention course motivated me.", which they are asked to rate on a scale from 1 = "does not apply at all" to 5 = "fully applies". Furthermore, the participants were asked to rate the perceived effectiveness of the prevention course on their PA level with a scale from 1 = "no effect" to 5 = "significant impact". This question was accompanied by an additional question regarding the impact of the effect on PA, in the event that the respondents indicated that they had experienced it. The answer categories were 1 = "Raising awareness of the importance of PA", 2 = "Increased PA through the course", 3 = "More enjoyment of movement" and 4 = "Other", with the option to further specify the impact. Multiple selection was possible. Moreover, the participants were asked about the perceived effectiveness of the digital prevention course on their SL. First, they were asked to rate the impact the digital prevention course had on their SL, with a scale from 1 = "negative impact" to 5 = "positive impact". Furthermore, they were asked, if they were less stressed, since they used the prevention course, with the answer categories 1 = "yes", 2 = "no" and 3 = "I wasn't stressed". If the participants indicated that they felt an impact on their SL, they were asked to specify on the impact with the answer categories of 1 = "Stress management through more PA", 2 = "Variety in everyday life", 3 = "More fun", 4 = "More motivation" and 5 = "Other", with the option to further specify the impact. Multiple selection was possible.

Feasibility

To assess the feasibility and suitability of the digital prevention course for university students, it was first asked if it was possible to integrate the digital prevention course into everyday university life. For answering this question, a scale was given with 1 = "no, not at all" to 5 = "yes, definitely". This was followed by an open-ended question: "Do you think the prevention course is a suitable measure to promote students' health? If yes, why? If not, why not?". Moreover, they were asked if they would further use the digital prevention course on the regular, if there were more workouts in the Ergogym and more Exergames available. For answering this question, a scale was given with 1 = "no, never" to 5 = "yes, all the time". Lastly the participants were asked whether they would recommend the digital prevention course to their fellow students, with a scale from 1 = "does not apply at all" to 5 = "fully applies".

Other

Furthermore, the participants were asked the following: "If you have already used other health promotion measures at your college/university, did you find the digital prevention course...", with the option to finish the statement with the categories "less motivating",

“equally motivating”, “more motivating” and “I have never used other health promotion measures”. This was accompanied by the question “If you have already used other health promotion measures at your college/university, did you find the digital prevention course...” with the option to finish the statement with the categories “less effective”, “equally effective”, “more effective” and “I have never used other health promotion measures”. Furthermore, the participants were asked to rate the frequency of technical issues on a scale from 1 = “never” to 5 “very often”. If they indicated to have had technical issues, they could also further specify on the technical issues through an open-ended question. The questionnaire also included the general rating of the different components of the digital prevention course, whether the participants liked the prevention course, if they experienced issues and also the opportunity for giving improvement suggestions was given.

4.4 Statistical Analyses

To answer the research questions of this thesis, different statistical analyses were used which are described in the following chapter. All statistical analyses were conducted using the statistical software IBM Statistical Package for the Social Sciences (SPSS) version 29 and Microsoft Excel, which was used for calculation of effect sizes and creation of graphs. A significance level of $p < 0.05$ was used for all analyses to detect statistically significant results. It is important to note that all responses (also the quotes within semi-open and open-ended questions) and variables were translated from German to English for this thesis, as both the questionnaires and the digital prevention course were originally provided in German. Furthermore, the data from pre- and post-questionnaires were organized based on the ID the participants had to create. An overview of all variables collected in this study and their data level is attached in appendix III.

4.4.1 Descriptive Analyses

At first, the sample of university students, who completed the pre-questionnaire was described by sociodemographic variables, which include age, gender, currently pursued degree, study course, federal state of studies and additional variables, including the way of recruitment, the used end device, the result in the system check and prior Exergame experience. Following that, groups were classified based on the number of completed course units, which was relevant for the subsequent statistical analyses. Those groups were described by aforementioned variables as well.

The variables of interest, namely the PA, SL and the SWB, were described for each group, presenting both pre- and post-intervention values. Additionally, the reasons for inactivity and stress and the coping measures used for stress were described pre- and post-

intervention and with focus on each group. In these variables, multiple responses were possible. Another variable with a multiple response set were the reasons for no regular participation. For each category, the number of participants who selected the category (n) and the percentage of total responses (%) were reported. When presenting results for a specific group, the percentage of cases (%) were used to provide a clearer representation of the distribution of responses within that group.

Overall, descriptive analyses were used for each research question, but particularly for the variables in the research questions four (rating of perceived effectiveness) and six (rating of feasibility and suitability).

Generally, for categorical variables, absolute frequencies and frequencies in percentages were reported. For ordinal variables, absolute frequencies and frequencies in percentages, as well as the median (Mdn), the mean (M) and the standard deviation (SD) were reported. The M and SD are reported for the ordinal variables as well to provide a more in-depth examination of the data's distribution. Mostly the ordinal data include ratings on a 5-point Likert scale, where equal distances for the categories are assumed. For metric variables, the means, standard deviations and minimum and maximum values were described.

The open-ended qualitative questions related to the specification of potential technical issues and whether the participants view the digital prevention course as a suitable health promotion measure for university students were analyzed using thematic analysis. This analysis employed an inductive, semantic approach, focusing on identifying patterns and themes directly from the data without preconceived categories. The process includes data familiarization, coding of responses, grouping of codes and identification of overarching themes. Afterwards these themes, number of mentions and example quotes were described. This method provides a structured and rigorous approach to analyze qualitative data (Braun & Clarke, 2006).

4.4.2 Inferential Statistical Analyses

Inferential statistical analyses were conducted to address the first research question. Initially, descriptive analyses were performed for the variables of PA, SL and SWB for both the participant and control group. Subsequently, differences in these variables were calculated using the "Compute" command in SPSS, as the differences between pre- and post-intervention values were essential for subsequent statistical analyses. Following this, the newly created variables representing the differences in the metric variables PA and SWB

were assessed for normal distribution using the Shapiro-Wilk test, which is recommended for smaller sample sizes due to its greater accuracy (Field, 2009). Based on the results of the Shapiro-Wilk test, which indicated a normal distribution for the variables with a significance level of $p > 0.05$ (Field, 2009), tests were chosen to assess statistically significant differences between the pre- and post-intervention values. Since the data comes from the same groups but at different time points, dependent tests were used. Either the dependent t-test or the Wilcoxon signed-rank test was employed, as both tests are designed to compare two related conditions, which was necessary due to the repeated measures (Field, 2009).

The dependent t-test is a parametric test, and it was used for the variables, which differences of pre- and post-intervention values showed statistical significance. The test was used to assess whether two means collected from one group at two time points differ significantly. Additionally, the effect size was calculated with Microsoft Excel, using the t-statistics and the following formula (Rosenthal, 1991):

$$r = \sqrt{\frac{t^2}{t^2 + df}}$$

To interpret effect sizes, the classification by Cohen (1988) is used as an orientation. According to Cohen, effect sizes and correlation coefficients between $r = 0.1$ and $r = 0.3$ can be interpreted as a weak correlation, correlations between $r = 0.3$ and $r = 0.5$ are moderate and correlations above $r = 0.5$ can be interpreted as strong correlations (Cohen, 1988).

The Wilcoxon signed-rank test was used for the variables, which showed statistical significance in the Shapiro-Wilk test and for the ordinal variables (SL). The Wilcoxon signed-rank test is the non-parametric equivalent for the dependent t-test and the equivalent for the Mann-Whitney test for repeated measures data. The Wilcoxon signed-rank test is based on the differences between scores from two conditions (time points) and the results indicate whether this difference is statistically significant (Field, 2009). Furthermore, the effect size for this test was calculated as well using the following formula (Rosenthal, 1991):

$$r = \frac{Z}{\sqrt{N}}$$

In this equation, the z-score is the test-statistic for the Wilcoxon signed-rank test and the N is the number of total observations. For repeated measures this means the number of observations at each time point (Field, 2009). The effect size was calculated using Microsoft Excel and for the interpretation the previously described classification by Cohen was used (Cohen, 1988).

These tests, either parametric or non-parametric, were used to assess whether there is a statistically significant difference between pre- and post-intervention values for the variables PA, SL and SWB. With that, the first research question was examined.

4.4.3 Bivariate Analyses

Bivariate analyses were conducted for the research questions two (correlation between number of completed course units and changes in PA, SL and SWB), three (factors associated with a higher / lower number of completed course units) and five (correlation between number of completed course units and perceived effectiveness). Based on the data level of the variables of interest and whether the metric variables show a normal distribution, which is calculated with the Shapiro-Wilk test, the appropriate bivariate analyses were chosen. For normally distributed and metric variables, the Pearson correlation test is the recommended choice (parametric). For not normally distributed metric variables and ordinal variables, the Spearman signed-rank test is recommended. For both tests the result is a correlation coefficient (r) which can have values from -1 to 1. For the interpretation of the correlation coefficient the classification by Cohen was used (Cohen, 1988). Point-biserial correlation analyses were utilized for the correlation between dichotomous and metric variables, which are computed using Pearson's correlation coefficient (r) (Field, 2009) and interpreted according to Cohen's classification (Cohen, 1988). Additionally, nominal variables were dummy coded with values of 0 and 1, allowing for the calculation of point-biserial correlations.

4.5 Ethical Considerations

The participation in the study and the pre- and post-questionnaires was voluntary. The participants could stop their participation at any time without stating any reasons. The participants were informed about the structure of the study, the purpose, the benefits, the risks of the study and about the data protection. Participants were informed about the research project and data protection via the landing page. The study information and privacy policy were integrated on the landing page. Both are attached in appendix I. The students could only register for the course and take part in the questionnaires after they gave their informed consent. The participants could voluntarily register for the course using their e-mail address.

This was a necessary measure to ensure that each individual was able to access the prevention course privately, without any external entities being able to gain access. The registration required consent to participate and confirmation that the study information and the privacy policy have been read. This confirmation is given by clicking on a checkbox, and the field for entering the e-mail address only appears once consent has been given. Clicking on the checkbox and thus agreeing to participate is mandatory in order to be able to register for the prevention course. The participation in the study remained anonymous. Data was collected via questionnaires, in which study information and privacy policy was stated in again. The digital questionnaire could only be filled out when confirmation was given by clicking on a checkbox. The participants had to create an individual identification number before filling out the questionnaire. The identification number was solely utilized for scientific purposes and was not associated with any personal data collected during the prevention course. The identification number was solely used to identify dropouts. It was not possible to utilize the evaluation results to draw inferences about the personal data or course data of any individual. The sociodemographic data (gender, age, etc.) were employed solely for the purpose of describing the sample. Group statistics were used to evaluate the effects of the prevention course, whereby no individual before and after comparisons were carried out. All data collected were stored anonymously and were not traceable to individual persons. The data collected by the researcher were confidential and not given further to any instance irrelevant to this study. Lastly, any type of harm (if any available through the participation in this study) was minimized to the greatest extent possible.

The Ethics Committee of HAW Hamburg has conducted a comprehensive review of the methodology and approach presented in this master's thesis and has granted it a positive evaluation.

5 Results

This chapter presents the results of the analyses conducted in this thesis. First, the results from the descriptive analysis are outlined, including the sample characteristics of the whole sample (N = 45), the group classification based on the participation in the intervention and the description of the characteristics in these groups. Additionally, descriptive statistics for the main variables – PA, SL and SWB - are presented for each group. Furthermore, a summary of the reported reasons for inactivity and stress, as well as the coping strategies employed to manage stress are described. Afterwards each chapter focusses on the research questions described in chapter 3 “Objectives and Research Questions” of this thesis in a chronological order (RQ 1 – RQ 6). This includes description of the results from descriptive analyses, inferential statistical analyses and bivariate analyses. The supplementary outputs

from SPSS for the analyses are provided in addition to the tables and graphs that are presented in the text are attached in appendix V.

5.1 Descriptive Results

In the following, the sample of N = 45 participants, who participated in the pre-questionnaire, is described by different sociodemographic variables and additionally the way of recruitment, the end device used and the system check result. Afterwards, the sample of participants who participated in the post-questionnaire (n = 34) are split into groups, based on the finished course units within the prevention course and shortly described as well. Following that, the main variables, being PA, SL and SWB are described for the group of participants (students, who participated in at least one unit of the prevention course) (n = 27), the group of controls (students, who participated in the pre- and post-questionnaire, but did not participate in at least one unit) (n = 7) and also for the group of dropouts (n = 11). Additionally, reasons for inactivity, stress and coping measures used against stress are described.

The data and figures for the general course evaluation are attached in appendix IV, as they do not contribute directly to answering the research question of this thesis and are therefore not included in the results chapter. However, they still offer valuable supplementary insights.

5.1.1 Sample Description

The sample includes a total of N = 45 university students. Before exclusion of certain participants, the sample included N = 53 participants. However, participants, who did not meet all inclusion criteria were excluded from the analysis, which were university students who were over 30 years old (n = 3), who did not pass the system check (n = 3) and who did not fully complete the pre-questionnaire (n = 2). The participants were mostly between the age of 27 to 30 years (n = 17; 37.8%) and between the age 24 to 26 years (n = 13; 28.9%). Majority of the participants identified as female (n = 24; 53.3%). The participants were mostly currently pursuing a bachelor-degree (n = 24; 53.3%) and the majority was currently studying in Hamburg (n = 31; 68.9%). The participants most frequently indicated to be enrolled in programs related to human medicine, health sciences and psychology (n = 18; 39.9%). The way of recruitment was mostly through family and friends (n = 26; 57.8%). Most of participants use the laptop as their end device (n = 27; 60.0%). When checking their end devices with the system check provided for the prevention course, the largest proportion of the participants had a result of “okay” (n = 19; 42.2%) and “playable” (n = 18; 40.0 %). Overall, 46.7% of participants already had prior experience with Exergames. The detailed information about the sample characteristics is presented in Table 5.

Table 5: Sample description of participants in the pre-questionnaire (N = 45).

Variable		n	n (%)
Age		45	
	18-20		6 (13.3)
	21-23		9 (20.0)
	24-26		13 (28.9)
	27-30		17 (37.8)
Gender		45	
	Female		24 (53.3)
	Male		21 (46.7)
Degree currently pursued		45	
	Bachelor		24 (53.3)
	Master		19 (42.2)
	State exam		2 (4.4)
Federal state of study		45	
	Bavaria		1 (2.2)
	Berlin		6 (13.3)
	Bremen		2 (4.4)
	Hamburg		31 (68.9)
	Lower-Saxony		1 (2.2)
	Schleswig-Holstein		3 (6.7)
	Currently abroad		1 (2.2)
Study course		45	
	Linguistics and cultural studies		1 (2.2)
	Law		2 (4.4)
	Humanities and social sciences, pedagogy		5 (11.1)
	Human medicine, health science**s**, psychology		18 (39.9)
	Mathematics, computer science and natural sciences		7 (15.5)
	Economics		6 (13.3)
	Engineering, mechanical engineering		5 (11.1)
	Art, art sciences		1 (2.2)
Way of recruitment		45	
	Flyer		1 (2.2)
	LinkedIn		4 (8.9)
	Instagram		5 (11.1)
	Friends and family		26 (57.8)
	Ergofox website		1 (2.2)
	Other (open)		
	E-Mail distribution list		7 (15.4)
	Exhibition		1 (2.2)
End device		45	
	Computer		11 (24.4)
	Laptop		27 (60.0)
	Tablet		7 (15.6)
System check result		45	
	Very good		8 (17.8)
	Okay		19 (42.2)
	Playable		18 (40.0)
Prior Exergame Experience			
	Yes		21 (46.7)
	No		19 (42.2)
	I don’t know		5 (11.1)

Note: *n* = number of participants.

5.1.2 Use of Course and Group Classification

For the further analysis of the effectiveness of the digital prevention course, the sample was split into groups based on the course participation. Overall, the digital prevention course implemented in this study had eight units with one unit per week. In the post-questionnaire n = 34 participants were asked how many units they completed within the prevention course. The following graph depicts the number of units completed by the participants.

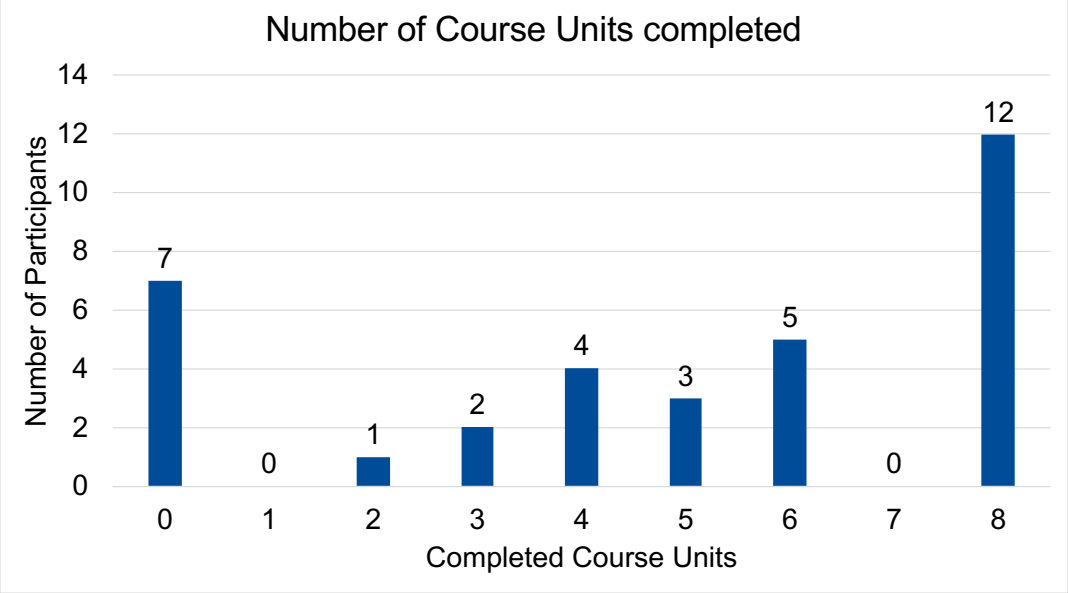

Figure 9: Distribution of completed course units among participants (N = 34)

Figure 9 shows that 12 participants (35.3%) completed all eight units of the prevention course while 15 participants (44.1%) engaged in at least two units but did not fully complete the course. Furthermore, 7 (20.6%) participants reported not completing any unit. In total, 22 participants did not regularly engage with the course (64.7%).

These participants were given the opportunity to provide reasons for their lack of regular participation, with multiple responses allowed. The most cited reason was a lack of time (n = 18), followed by engaging in other sports (n = 11). Additionally, n = 5 participants reported experiencing excessive stress, n = 4 mentioned health restrictions and n = 3 cited technical issues as barriers to participation.

Group Classification

For the analysis of effectiveness in the following chapters, the sample of n = 34 participants was divided into three groups: participants who completed at least half of the course units (n = 24), participants who completed less than half of the course units (n = 3), and participants who completed both questionnaires but did not participate in the prevention course

(n = 7). The analyses primarily focused on the group that completed at least half of the course units (n = 24), as it was assumed that an effect could only be observed with substantial course participation. Therefore, the group of participants who completed fewer than half of the units (n = 3) was not included in the effectiveness analysis. The participants who completed both questionnaires but did not participate in the course (n = 7) served as control group. However, when discussing the overall assessment of the prevention course, *all participants* (n = 27) who completed at least one unit were included, as their opinions were considered valid and potentially informative. Figure 10 presents the course completion data in a pie chart, displaying both the number of participants (n) and the corresponding percentages (%).

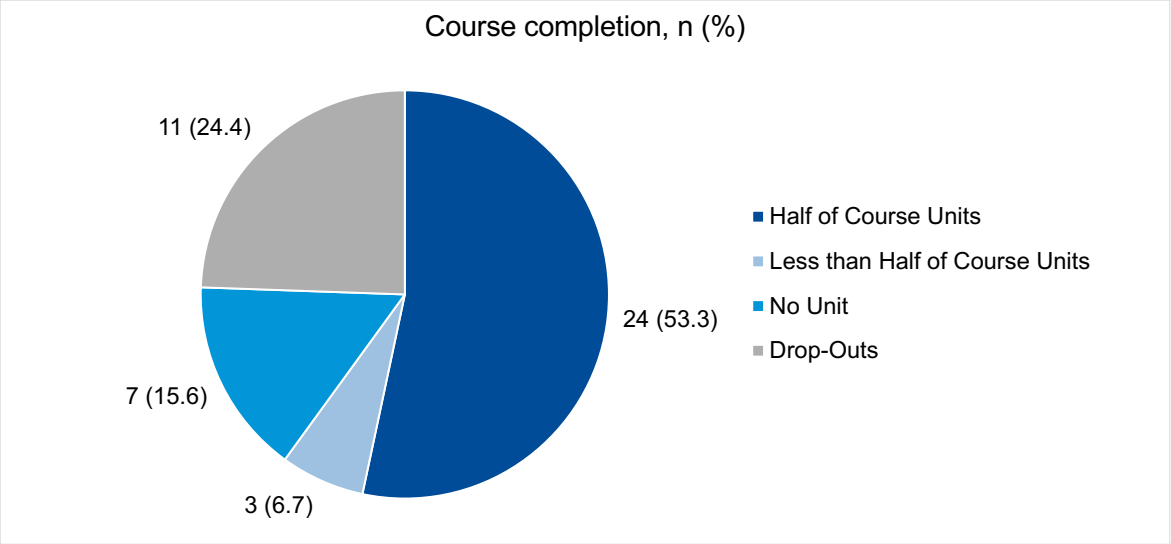

Figure 10: Group classification based on course completion (N = 45).
Note: *n* = number of participants.

5.1.3 Group Characteristics Description

This section provides the group characteristics description of participants, who completed at least one unit within the prevention course (n = 27), the control group (n = 7) and the group of dropouts (n = 11).

Participants

The largest proportion of the participants (n = 27) were between the age of 24 to 26 years (n = 11; 40.7%) and between the age 27 to 30 years (n = 7; 25.9%). Majority of the participants identified as female (n = 17; 63.0%). The participants were mostly currently pursuing a bachelor-degree (n = 15; 55.6%) and the majority was currently studying in Hamburg (n = 17; 63.0%). The largest proportion of the participants were enrolled in programs related to human medicine, health sciences and psychology (n = 10; 37.0%). The way of recruitment, which was most frequently indicated, was the recruitment through family and friends

(n = 12; 44.4%). The most frequently indicated end device of participants was the laptop (n = 12; 44.4%). When checking their end devices with the system check provided for the prevention course, mostly the participants had a result of “playable” (n = 15; 55.6%). Out of the participant group, n = 13 (48.2%) already used Exergames before and n = 11 (40.7%) did not use Exergames before. The detailed information about the sample characteristics is presented in Table 6.

Controls

Most of the participants in the control group (n = 7) were between the age of 27 to 30 years (n = 5; 71.4%). Majority of the participants in the control group identified as male (n = 5; 71.4%). The participants in the control group were mostly currently pursuing a masters-degree (n = 5; 71.4%). and the majority was currently studying in Hamburg (n = 6; 58.7%). Most of the participants in the control group were enrolled in programs related to human medicine, health sciences and psychology (n = 4; 57.2%). The way of recruitment was through family and friends (n = 7; 100.0%). Most of participants in the control group use the laptop as their end device (n = 6; 85.7%). When checking their end devices with the system check provided for the prevention course, the most frequent result was “playable” (n = 3; 42.9%). Out of the control group, n = 2 (28.6%) already used Exergames before and n = 4 (57.1%) did not use Exergames before. The detailed information about the sample characteristics is presented in Table 6.

Dropouts

The largest proportion of the participants in the group of dropouts (n = 11) were between the age of 27 to 30 (n = 5; 45.4%). Majority of the participants in the group of dropouts identified as male (n = 6; 54.4%). The majority is currently pursuing a bachelors-degree (n = 7; 63.6%). and the majority is currently studying in Hamburg (n = 6; 58.7%). The participants within the group of dropouts most frequently indicated to be enrolled in programs related to human medicine, health sciences and psychology (n = 4; 36.4%) and mathematics, computer science and natural science (n= 4; 36,4%). The way of recruitment was mostly through family and friends (n = 7; 63.6%). Most of participants in the group of dropouts use the laptop as their end device (n = 9; 81.8%). When checking their end devices with the system check provided for the prevention course, mostly the participants in the group of dropouts had a result of “okay” (n = 9; 81.8%). The majority has already used Exergames before (n = 6; 54.5%). The detailed information about the sample characteristics is presented in Table 6.

Table 6: Descriptive statistics for the group characteristics.

Groups	**Participants**	**Controls**	**Dropouts**
n	27	7	11
Age, n (%)			
18-20	4 (14.8)	-	2 (18.2)
21-23	5 (18.5)	-	4 (36.4)
24-26	11 (40.7)	2 (28.6)	-
27-30	7 (25.9)	5 (71.4)	5 (45.5)
Gender, n (%)			
Female	17 (63.0)	2 (28.6)	5 (45.5)
Male	10 (37.0)	5 (71.4)	6 (54.5)
Degree currently pursued, n (%)			
Bachelor	15 (55.6)	2 (28.6)	7 (63.6)
Master	11 (40.7)	5 (71.4)	3 (27.3)
State exam	1 (3.7)	-	1 (9.1)
Federal state of study, n (%)			
Bavaria	-	1 (14.3)	-
Berlin	5 (18.5)	-	1 (9.1)
Bremen	2 (7.4)	-	-
Hamburg	17 (63.0)	6 (85.7)	8 (72.7)
Lower-Saxony	-	-	1 (9.1)
Schleswig-Holstein	2 (7.4)	-	1 (9.1)
Currently abroad	1 (3.7)	-	-
Study course			
Linguistic and cultural studies	1 (3.7)	-	-
Law	1 (3.7)	-	1 (9.1)
Humanities and social sciences, pedagogy	5 (18.5)	-	-
Human medicine, health sciences, psychology	10 (37.0)	4 (57.2)	4 (36.4)
Mathematics, computer science and natural sciences	2 (7.4)	1 (14.3)	4 (36.4)
Economics	3 (11.1)	1 (14.3)	2 (18.2)
Engineering, mechanical engineering	4 (14.8)	1 (14.3)	-
Art, art sciences	1 (3.7)	-	-
Way of recruitment			
Flyer	1 (3.7)	-	-
LinkedIn	4 (14.8)	-	-
Instagram	5 (18.5)	-	-
Friends and family	12 (44.4)	7 (100.0)	7 (63.6)
Ergofox website	1 (3.7)	-	-
Other (open)			
E-Mail distribution list	4 (14.8)	-	3 (27.3)
Exhibition	-	-	1 (9.1)
End device			
Computer	8 (29.6)	1 (14.3)	2 (18.2)
Laptop	12 (44.4)	6 (85.7)	9 (81.8)
Tablet	7 (25.9)	-	-
System check result			
Very good	4 (14.8)	2 (28.6)	2 (18.2)
Okay	8 (29.6)	2 (28.6)	9 (81.8)
Playable	15 (55.6)	3 (42.9)	-
Prior Exergame Experience			
Yes	13 (48.2)	2 (28.6)	6 (54.5)
No	11 (40.7)	4 (57.1)	4 (36.4)
I don’t know	3 (11.1)	1 (14.3)	1 (9.1)

Note: *n* = Number of participants.

5.1.4 Description of Main Variables

This section provides descriptive statistics for the main variables pre- and post-intervention: PA, measured in MET-minutes per week; SL, assessed on an ordinal scale from 1 (“never”) to 5 (“often”) and SWB, scored from 0 to 25. These variables are described across three groups: participants (n = 27), controls (n = 7), and dropouts (n = 11).

Physical Activity

The mean PA level of participants (n = 27) prior to the intervention was M = 1920.33 MET-minutes per week, with a SD of 1505.94. The PA level ranged from 198 to 6060 MET-minutes per week. Following the intervention, the mean PA level increased to M = 2650.33 MET-minutes per week, with a SD of 1854.81. The post-intervention values ranged from 240 to 9732 MET-minutes per week. The mean PA level of the controls (n = 7) prior to the intervention was M = 3567.43 MET-Minutes per week, with a SD of 2970.00. The PA level ranged from 198 to 8292 MET-Min per week. At the second measurement time point, the mean PA level was M = 4692.86 MET-minutes per week with a SD of 2471.22. The values ranged from 2514 to 9612 MET-Minutes per week. The group of dropouts (n = 11) had a mean PA level of M = 2705.45 MET-minutes per week with a SD of 1816.66. The PA level ranged from 318 to 6228 MET-minutes per week.

Stress Level

In the group of participants (n = 27), the mean SL was M = 3.7 with a SD of 0.87. The most frequently selected score for the rating of the SL prior to the intervention was '4' (n = 11; 40.7%), with a Mdn of 4.00. Following the intervention, the mean SL was M = 2.85 with a SD of 1.17. The most commonly chosen score was '3' (n = 9; 33.3%), with a Mdn of 3.00. In the group of controls (n = 7), the mean SL was M = 4.57 with a SD of 0.79. The most frequently selected score for the rating of the SL prior to the intervention was '5' (n = 5; 71.4%), with a Mdn of 5.00. At the second measurement time point, the mean SL was M = 3.00 with a SD of 1.53. The most commonly chosen scores were ‘1', ‘3’ and ‘4’ with a Mdn of 3.00. In the group of dropouts (n = 11), the mean SL was M = 3.73 with a SD of 1.35. The most frequently selected score for the rating of the SL prior to the intervention was '5' (n = 4; 36.4 %), with a Mdn of 4.00.

Subjective Well-Being

The mean SWB-score of participants (n = 27) prior to the intervention was M = 13.48, with a SD of 3.37. The SWB scores ranged from 9 to 20. Following the intervention, the mean SWB scores increased to M = 17.67, with a SD of 3.19. The post-intervention scores ranged from 13 to 23. The mean SWB score of the control group (n = 7) prior to the intervention

was M = 15.14, with a SD of 3.13. The SWB scores ranged from 12 to 20. At the second measurement time point, the mean SWB scores increased to M = 17.71, with a SD of 3.64. The post-intervention scores ranged from 11 to 22. The mean SWB score of the group of dropouts (n = 11) was M = 13.45, with a SD of 2.98. The SWB scores ranged from 9 to 18.

The detailed information on the descriptives of the main variables are presented in Table 7.

Table 7: Descriptive statistics for the main variables.

Groups	**Participants**	**Controls**	**Dropouts**
n	**27**	**7**	**11**
Physical Activity			
M (SD), Min-Max			
Pre	1920.33 (1505.94)	3567.43 (2970.00)	2705.45 (1816.66)
	198-6060	198-8292	318-6228
Post	2650.33 (1854.81)	4692.86 (2471.22)	-
	240-9732	2514-9612	
Stress Level			
M (SD), Min-Max, Mdn			
Pre	3.70 (0.87)	4.57 (0.79)	3.73 (1.35)
	2-5	3-5	1-5
	4.00	5.00	4.00
Post	2.85 (1.17)	1.00 (1.53)	-
	1-5	1-3	
	3.00	3.00	
Subjective Well-Being			
M (SD), Min-Max			
Pre	13.48 (3.37)	15.14 (3.13)	13.45 (2.98)
	9-20	12-20	9-18
Post	17.67 (3.19)	17.71 (3.64)	-
	13-23	11-22	

Note: *n* = number of participants, *M* = mean, *SD* = Standard Deviation, *Mdn* = Median, *Min* = Minimum, *Max* = Maximum.

5.1.5 Description of Reasons for Inactivity, Stress and Coping Measures

This section provides a descriptive overview of the participants' reasons for inactivity and stress, along with the coping strategies employed to manage stress. The findings from the entire sample and the contrast between the pre- and post-intervention data are presented. Table 8 depicts the response behavior in relation to the reasons of being physically inactive, the reasons for having stress and the measures used to cope with stress. Participants were allowed to select multiple responses for these questions. Table 8 presents the *percentages of responses*, which do not reflect the percentage of cases. In the subsequent text, however, the reasons for inactivity and stress, as well as the coping strategies, are described for each group using the *percentage of cases.* Further information on the descriptive values for the groups are attached in appendix V.

Table 8: Descriptive statistics for reasons for physical inactivity, reasons for stress and coping measures.

Time-Point	**Pre-Intervention**	**Post-Intervention**
n	**45**	**34**
Reasons for physical inactivity, n (%)		
I am physically active	19 (25.7)	23 (51.1)
Lack of time	17 (23.0)	6 (13.3)
Lack of motivation	21 (28.4)	10 (22.2)
Health restrictions	5 (6.8)	1 (2.2)
Lack of access to sporting facilities	2 (2.7)	1 (2.2)
Discomfort during physical activity	4 (5.4)	-
Lack of social support	4 (5.4)	1 (2.2)
Other	2 (2.7)	3 (6.7)
Reasons for stress, n (%)		
I don't have stress	1 (0.8)	11 (17.5)
Exams	30 (24.2)	9 (14.3)
Fear of bad grades	15 (12.1)	2 (3.2)
Learning material too difficult or too extensive	12 (9.7)	1 (1.6)
Lack of retreat options at university	1 (0.8)	-
Financial concerns	9 (7.3)	10 (15.9)
Multiple burdens from study and work	31 (25.0)	18 (28.6)
Multiple burdens from study and family	8 (6.5)	3 (4.8)
Time distribution of the courses	2 (1.6)	-
Private Conflicts	11 (8.9)	7 (11.1)
Other	4 (3.2)	2 (3.2)
Coping measures, n (%)		
I don't have stress	1 (0.7)	8 (8.1)
Meet friends and family	22 (15.5)	21 (21.2)
Go for a walk / outside	25 (17.6)	17 (17.2)
Do sport	23 (16.2)	17 (17.2)
Surfing the internet / playing video games	18 (12.7)	8 (8.1)
Watching TV	23 (16.2)	12 (12.1)
Relaxation techniques	16 (11.3)	10 (10.1)
Drink wine or beer	6 (4.2)	3 (3.0)
Smoking	4 (2.8)	-
Consume cannabis	3 (2.1)	3 (3.0)
Other	1 (0.7)	3 (3.0)

Note: *n* = number of participants. Each category was answered as a single variable. Multiple responses were possible. Percentages of Responses are presented.

Reasons for Physical Inactivity

Prior to the intervention (n = 45), 19 participants reported being physically active. The primary reason for physical inactivity among participants was a lack of motivation (n = 21), followed by a lack of time (n = 17). Other reasons for being inactive could be stated via an open-ended question. 2 participants indicated other reasons, being "Overcoming the challenge of doing sport" and "Examination phase". The group of participants, who participated regularly in the prevention course (n = 24), most frequently stated a lack of motivation (n = 11; 45.8%) as a reason for inactivity prior to the intervention. The participants, who did not participate regularly (n = 3) stated, that they are physically active (n = 3; 100%). The control group (n = 7) also mostly indicated to be physically active (n = 4; 57.1%). The group of dropouts (n = 11) indicated to have had a lack of motivation (n = 7; 63.6%).

Following the intervention (n = 34), the number of physically active participants increased from n = 19 to n = 23. A lack of motivation remained the most frequently reported reason for physical inactivity (n = 10), though the number of participants citing this reason had decreased. The lack of time was reported as a barrier by n = 6 participants. Additionally, n = 3 participants indicated other reasons for being inactive, being “Injury two weeks ago”, “No fun during sports” and “Vacation”. The group of participants, who participated regularly in the prevention course (n = 24), mostly stated to be physically active (n = 14; 58.3%) after the intervention. The participants, who did not participate regularly (n = 3) stated, that they are physically active (n = 3; 100 %). The control group (n = 7) also mostly indicated to be physically active (n = 6; 75.0%).

Reasons for Stress

Prior to the intervention (n = 45), the primary reasons for having stress were the multiple burden of study and work (n = 31) and exams (n = 30), followed by the fear of bad grades (n = 15), a too difficult and extensive learning material (n = 12) and private conflicts (n = 11). Additionally, n = 4 participants indicated other reasons for having stress, being “Final thesis”, “Everyday tasks and little social contact, also slight fear of public transport”, “Work” and “Job search”. The group of participants, who participated regularly in the prevention course (n = 24), mostly stated exams (n = 17; 70.8%) and the multiple burden of study and work (n = 17; 70.8%) as the reason for having stress prior to the intervention. The participants, who did not participate regularly (n = 3), mostly stated the reason to be the multiple burden of study and work (n = 3; 100%). The control group (n = 7) also mostly indicated the reason for stress to be the multiple burden of study and work (n = 4; 57.1%). The group of dropouts (n = 11) indicated the reason being exams (n = 9; 81.8%).

After the intervention (n = 34), the number of participants indicating not having stress increased to n = 1 from n = 11. The primary reason for having stress remained the multiple burden of study and work (n = 18), followed by financial concerns (n = 10), exams (n = 9) and private conflicts (n = 7). Additionally, n = 2 participants indicated other reasons for stress, being “Final thesis” and “Writer’s block”. The group of participants, who participated regularly in the prevention course (n = 24), most frequently cited the multiple burden of study and work as a source of stress after the intervention (n = 12; 50.0%). In contrast, the reason most commonly cited prior to the intervention, which was exams, was reported by n = 7 participants after the intervention (n = 7; 17.1%), indicating a decrease in this concern. Furthermore, n = 7 participants (n = 7; 17.1%) indicated they experienced no stress after the intervention, a response that had not been mentioned prior to the intervention. The

participants, who did not participate regularly (n = 3), mostly stated the reason of multiple burden of study and work (n = 2; 66.7%) and exams (n = 2; 66.7%) as reasons for stress. The control group (n = 7) mostly indicated the reason of multiple burden of study and work (n = 4; 57.1%). Also, n = 3 participants (n = 3; 42.9%) stated to not be stressed.

Coping measures

When asked about coping measures for stress, prior to the intervention (n = 45), the most frequently reported coping strategy was going for a walk or spending time outdoors (n = 25), followed by engaging in sports (n = 23) and watching television (n = 23). Meeting with friends and family was a common coping mechanism for n = 22 participants. Additionally, a substantial number of participants coped by surfing the internet or playing video games (n = 18), while n = 16 participants used relaxation techniques such as yoga. However, less healthy coping strategies were also reported, with n = 6 participants indicating that they consume alcohol (for example wine or beer), n = 4 reporting smoking, and n = 3 indicating cannabis use. One participant mentioned using another coping measure, being „Playing an instrument“. The group of participants, who participated regularly in the prevention course (n = 24), mostly stated watching TV and going for a walk or spending time outdoors (n = 15; 62.5%) as coping measures prior to the intervention. The participants, who did not participate regularly (n = 3), mostly indicated doing sports, watching TV and surfing the internet or playing video games as coping measures (n = 2; 66.7%). The control group (n = 7) also mostly indicated the coping measure to be doing sports (n = 4; 57.1%). The group of drop-outs (n = 11) mostly indicated the coping measure going for a walk or spending time outdoors (n = 7; 63.6%).

After the intervention (n = 34) the most common coping strategy shifted to meeting with friends and family (n = 21), followed by going for a walk or spending time outdoors (n = 17) and engaging in sports (n = 17). Watching television as a coping mechanism was reported by n = 12 participants and the use of relaxation techniques was reported by n = 10 participants. The number of participants who coped by surfing the internet or playing video games decreased to n = 8. Additionally, n = 3 participants each reported consuming alcohol or cannabis as a stress-coping strategy. Moreover, n = 3 participants indicated other coping measures, one being „Playing an instrument“ and n = 2 did not further elaborate. After the intervention the group of participants, who participated regularly in the prevention course (n = 24), mostly stated to meet friends and family (n = 15; 62.5%) as coping measures. The participants, who did not participate regularly (n = 3), mostly indicated to meet friends and family, going for a walk or spending time outdoors and doing sports as coping measures (n

= 2; 66.7%). The control group (n = 7) also mostly indicated to meet friends and family (n = 4; 57.1%).

5.2 Analysis of the Effectiveness of the Digital Prevention Course

This chapter presents the analysis of the effectiveness of the digital prevention course on physical activity (PA), stress level (SL), and subjective well-being (SWB). Dependent t-tests, Wilcoxon signed-rank tests and bivariate analyses using Spearman's correlation and point-biserial correlations were conducted. The results are described in line with the research questions of this thesis.

5.2.1 Physical Activity

To answer the first research question "*Is there a significant difference in physical activity level, stress level and subjective well-being following the 8-week digital prevention course among the university students who participated?"* with the help of statistical analysis, the variable of PA is observed in this section. To determine whether an observed effect (if detected) could be attributable to the intervention, a control group (n = 7) was incorporated into the statistical analysis.

Descriptive Statistics

Table 9 and Figure 11 summarize the most important descriptive values of the PA level within the group of participants (n = 24) and the control group (n = 7). The mean values with standard deviation of each group at both time points (t1 = pre intervention; t2 = post intervention) are listed in Table 9 and visualized in the Figure 11.

Table 9: Descriptive statistics for physical activity level among the participant and control group, pre- and post-intervention.

	Group	M	SD	n
Time point 1	Participants	1806.13	1473.77	24
	Control	3567.43	2979.00	7
Time point 2	Participants	2555.50	1924.20	24
	Control	4692.86	2471.22	7

Note: *M* = Mean, *SD* = Standard deviation, *n* = Number of participants.

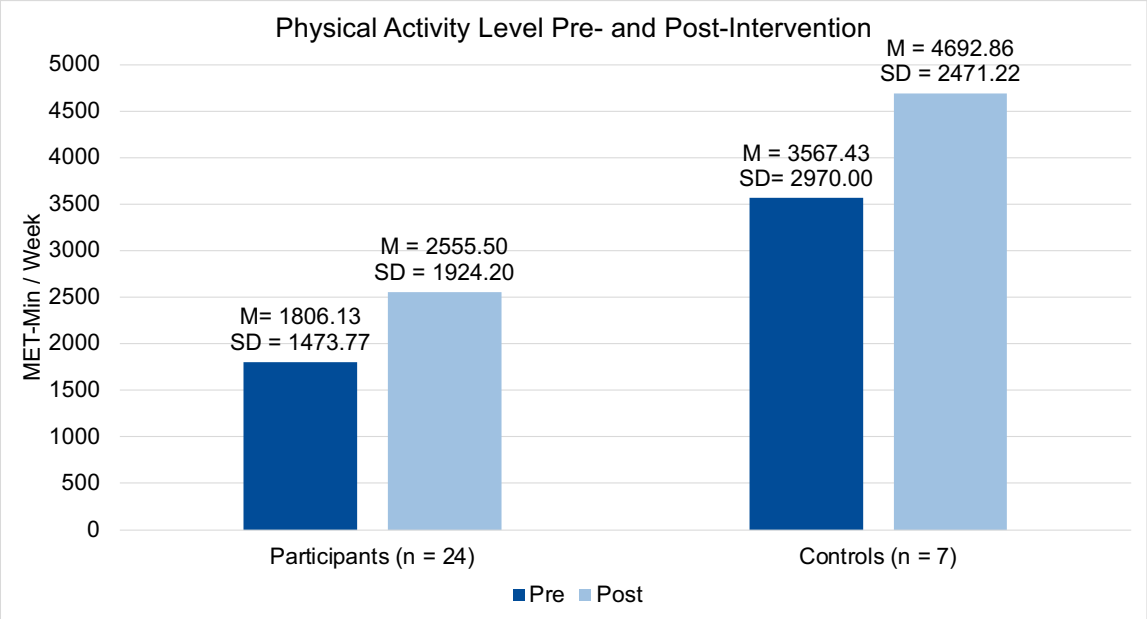

Figure 11: Visualization of physical activity level among the participant and control group, pre- and post-intervention.

From Table 9 and Figure 11 it can be observed that there was an increase in the mean PA level in both groups. At time point 1 as well as time point 2, the participants had a lower mean PA level than the control group. The control group had a higher increase in mean PA level, however, at both time points the control group had a higher SD than the participants. In the following section, the results of the tests for normal distribution for the differences between pre- and post-intervention values for PA level for both groups are described. With this assessment the appropriateness of using parametric or non-parametric statistical tests was determined.

Test for Normal Distribution

The results for the Shapiro-Wilk test are presented in Table 10. Normal distribution in the differences between pre- and post-intervention values for PA-level can be assumed for the control group, since the result is *not statistically significant* (> 0.05), but not for the participants, since the p-value shows *significant results* (p = 0.043 < 0.05).

Table 10: Results of the Shapiro-Wilk test for normal distribution in physical activity difference pre- and post-intervention among the participant and control group.

Group	W	df	p
Participants (n = 24)	0.914	24	0.043
Control (n = 7)	0.884	7	0.243

Note: *W* =Test statistics, *df* = Degrees of freedom, *p* = Significance.

Analysis of Significant Differences in Physical Activity Level Pre- and Post-Intervention

For the analysis of significant differences in PA level pre- and post-intervention, the Wilcoxon signed-rank Test (non-parametric) was used for the participants (n = 24) and the dependent t-test (parametric) for the control group (n = 7).

For the participants (n = 24), the underlying hypotheses for the Wilcoxon signed-rank test were as follows:

- **Null Hypothesis (H_0):** There is no significant difference in PA level between the pre- and post-intervention measurements in the group of participants.
- **Alternative Hypothesis (H_1):** There is a significant difference in PA level between the pre- and post-intervention measurements in the group of participants.

In the group of participants (n = 24), PA level was significantly higher post-intervention (Mdn = 2555.50) than pre-intervention (Mdn = 1806.16), z = 2.31, p = 0.021, r = 0.33. Thus, the null hypothesis can be rejected and the alternative hypothesis, that there is a significant difference in PA level between the pre- and post-intervention measurements, can be accepted. The effect size r = 0.33 indicates a medium effect (Cohen, 1988).

For the control group (n = 7), the hypotheses for the dependent t-test were formulated as follows:

- **Null Hypothesis (H_0):** There is no significant difference in physical activity level between the pre- and post-intervention measurements in the control group.
- **Alternative Hypothesis (H_1):** There is a significant difference in physical activity level between the pre- and post-intervention measurements in the control group.

In the control group, no significant difference was found in PA-level between post-intervention (M = 3567.43, SE = 1122.55) and pre-intervention measures (M = 4692.86, SE = 934.03), t (6) = 1.25, p = 0.257, r = 0.45. Thus, the null hypothesis can be retained.

5.2.2 Stress Level

To further answer the research question "*Is there a significant difference in physical activity level, stress level and subjective well-being following the 8-week intervention among participants who completed at least half of the digital prevention course?"* with the help of statistical analysis, the variable SL will be observed in this section. To determine whether an

observed effect (if detected) could be attributable to the intervention, a control group (n = 7) was incorporated into the statistical analysis.

Descriptive Statistics

Table 11 and Figure 12 summarize the most important descriptive values of the variable within the participant group and control group. The mean with standard deviation, median and mode of each group at both time points (t1 = pre intervention; t2 = post intervention) are listed in Table 11 and the median values are visualized in the Figure 12.

Table 11: Descriptive statistics for stress level among the participant and control group, pre- and post-intervention.

Time Point	Group	M (SD)	Mdn	Mo*	n
Pre-Intervention	Participants	1.71 (0.90)	4	4	24
	Control	4.57 (0.79)	5	5	7
Post-Intervention	Participants	2.83 (1.13)	3	3	24
	Control	3.00 (1.53)	3	1	7

Note*: M* = Mean, *SD* = Standard deviation, *Mdn* = Median, *Mo* = Mode, *n* = number of participants.

*Multiple modes exist. Smallest value is depicted.

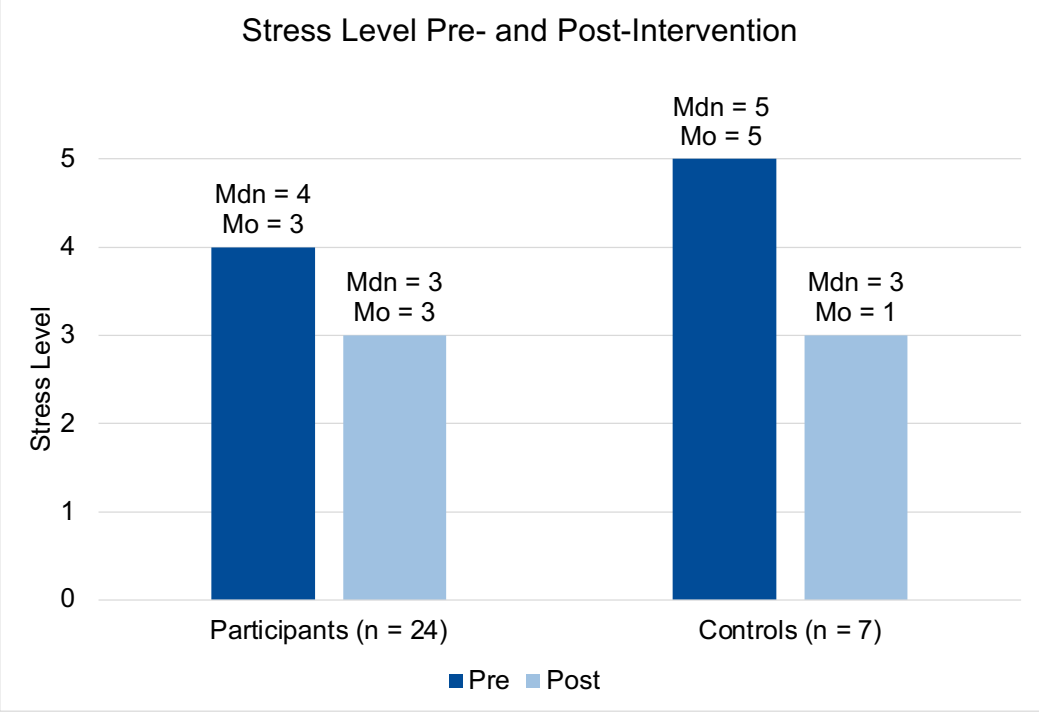

Figure 12: Visualization of stress level among the participant and control group, pre- and post-intervention.

From Table 11 and Figure 12 it can be seen that both the median and mode of the SL in the participant group decreased following the intervention. Additionally, a reduction in both the median and mode SL was observed at time point 2 in the control group. Since SL was

measured on an ordinal scale, testing for normal distribution is not necessary. Therefore, the non-parametric Wilcoxon signed-rank test was applied to assess significant differences between pre- and post-intervention SL.

Analysis of Significant Differences in Stress Level Pre- and Post-Intervention

For the analysis of significant differences in SL pre- and post-intervention, the Wilcoxon signed-rank test was used for both groups.

For the participants (n = 24), the underlying hypotheses were as follows:

- **Null Hypothesis (H_0):** There is no significant difference in the stress level between the pre- and post-intervention measurements in the group of participants.
- **Alternative Hypothesis (H_1):** There is a significant difference in the stress level between the pre- and post-intervention measurements in the group of participants.

In the group of participants (n = 24), the SL was significantly lower post-intervention (Mdn = 3) than pre-intervention (Mdn = 4), z = -2.99, p = 0.003, r = 0.43. Thus, the null hypothesis can be rejected and the alternative hypothesis, that there is a significant difference in SL between the pre- and post-intervention measurements, can be accepted. The effect size r = 0.43 indicates a medium effect (Cohen, 1988).

For the control group (n = 7), the hypotheses were formulated as follows:

- **Null Hypothesis (H_0):** There is no significant difference in the stress level between the pre- and post-intervention measurements in the control group.
- **Alternative Hypothesis (H_1):** There is a significant difference in the stress level between the pre- and post-intervention measurements in the control group.

In the group of controls (n = 7) there was no significant difference in SL between post-intervention (Mdn = 3) and pre-intervention measurements (Mdn = 5), z = -1.90, p = 0.058, r = 0.51. Thus, the null hypothesis can be retained.

5.2.3 Subjective Well-Being

To further answer the first research question "*Is there a significant difference in physical activity level, stress level and subjective well-being following the 8-week intervention among participants who completed at least half of the digital prevention course?"* with the help of statistical analysis, the variable of subjective well-being will be observed in this section. To

determine whether an observed effect (if detected) could be attributable to the intervention, a control group (n = 7) was incorporated into the statistical analysis.

Descriptive Statistics

Table 12 and Figure 13 summarize the most important descriptive values of the SWB score within the participant group and control group. The mean values with standard deviation of each group at both time points (t1 = pre intervention; t2 = post intervention) are listed in Table 12 and visualized in Figure 13.

Table 12: Descriptive statistics for subjective well-being scores among the participant and control group, pre- and post-intervention.

	Group	M	SD	n
Time point 1	Participants	13.33	3.35	24
	Control	15.14	3.13	7
Time point 2	Participants	17.83	3.02	24
	Control	17.71	3.64	7

Note: *M* = Mean, *SD* = Standard deviation, *n* = Number of participants.

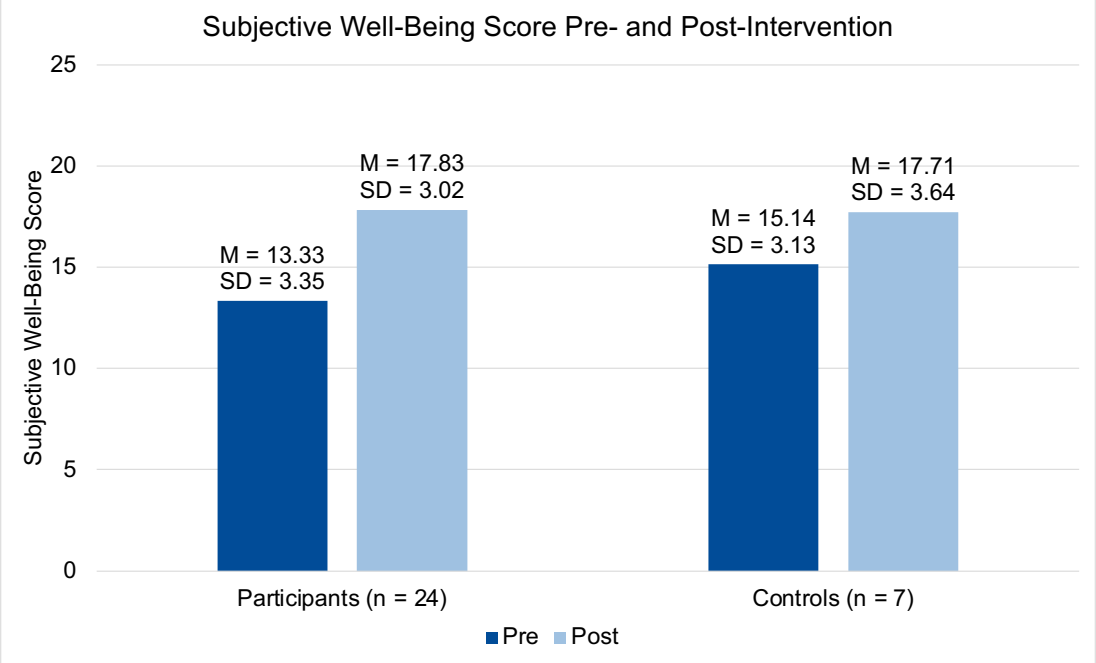

Figure 13: Visualization of subjective well-being scores among the participant and control group, pre- and post-intervention.

From Table 12 and Figure 13 it can be observed that there was an increase in the mean SWB score in both groups. At time point 1 the participants had a lower SWB score as the

controls, however, at time point 2, the participants had a higher SWB score than the controls. Therefore, the participants had a higher increase in mean SWB scores. The following section describes the results of the tests for normal distribution of the differences between pre- and post-intervention scores for SWB in both groups. This assessment was used to determine the appropriateness of using parametric or non-parametric statistical tests.

Test for Normal Distribution

The results for the Shapiro-Wilk test are presented in Table 13. Normal distribution in the differences between pre- and post-intervention values for SWB score can be assumed for both groups, since the results were *not statistically significant* (> 0.05).

Table 13: Results of the Shapiro-Wilk test for normal distribution in subjective well-being difference pre- and post-intervention among the participant and control group.

Group	W	df	p
Participants (n=24)	0.954	24	0.323
Control (n=7)	0.092	7	0.340

Note: *W* =Test statistics*, df* = Degrees of freedom*, p* = Significance.

Analysis of Significant Differences in Subjective Well-Being Score Pre- and Post-Intervention

For the analysis of significant differences in SWB scores pre- and post-intervention, the dependent t-test was used for both groups.

For the participants (n = 24), the underlying hypotheses for the dependent t-test were as follows:

- **Null Hypothesis (H_0):** There is no significant difference in subjective well-being scores between the pre- and post-intervention measurements in the group of participants.
- **Alternative Hypothesis (H_1):** There is a significant difference in subjective well-being scores between the pre- and post-intervention measurements in the group of participants.

On average, the participants had a significantly higher mean SWB score post-intervention (M = 17.83, SE = 0.62) than pre-intervention (M = 13.33, SE = 0.68), t (23) = 5.47, p < 0.001, r = 0.75. Thus, the null hypothesis can be rejected and the alternative hypothesis, that there is a significant difference in SWB scores between the pre- and post-intervention measurements, can be accepted. The effect size r = 0.75 indicates a large effect (Cohen, 1988).

For the control group (n = 7), the hypotheses for the dependent t-test were formulated as follows:

- **Null Hypothesis (H_0):** There is no significant difference in subjective well-being scores between the pre- and post-intervention measurements in the control group.
- **Alternative Hypothesis (H_1):** There is a significant difference in subjective well-being scores between the pre- and post-intervention measurements in the control group.

In the control group, no significant difference was found in mean SWB scores post-intervention (M = 17.71, SE = 1.38) and pre-intervention (M = 15.14, SE = 1.18), t (6) = 1.56, p = 0.169, r = 0.54. Thus, the null hypothesis can be retained.

5.2.4 Bivariate Analysis

To further evaluate the effectiveness of the digital prevention course on the variables of PA level, SL and SWB scores, bivariate analyses were conducted. With that, the second research question *"Is there a significant correlation between the number of completed course units in the 8-week digital prevention course and the changes in physical activity level, stress level and subjective well-being among the participants?"* will be answered. This analysis utilized both pre- and post-intervention values for these variables and also the difference between those values. Only the data from participants (n = 34) who completed the post-intervention measures were included. The analysis specifically examined the correlation between the metric variable of completed course units and the aforementioned variables. In the course of this analysis the correlations between the main variables (PA, SL, SWB) were investigated as well.

Test for Normal Distribution

To assess the appropriate test, the metric variables were tested for normal distribution in the sample of n = 34 participants, using the Shapiro-Wilk test. The results of the Shapiro-Wilk test are summarized in Table 14. As shown in Table 14, normal distribution can be assumed for the post-intervention SWB score, SWB score difference and PA level difference ($p > 0.05$). However, since the variable of completed course units is not normally distributed, Spearman correlation analysis is used for all variables (Field, 2009).

Table 14: Results of the Shapiro-Wilk test for normal distribution within completed course units, physical activity and subjective well-being.

Variable	W	df	p
Completed Units	0.838	34	< 0.001
Physical Activity (pre)	0.868	34	< 0.001
Physical Activity (post)	0.814	34	< 0.001
Physical Activity (difference)	0.952	34	0.140
Subjective Well-Being (pre)	0.922	34	0.018
Subjective Well-Being (post)	0.952	34	0.146
Subjective Well-Being (difference)	0.949	34	0.113

Note: W = Test statistics, *df* = Degrees of freedom, *p* = Significance.

Bivariate Analysis

Table 15 shows the correlation matrix for the results from the Spearman correlation analysis. A significant negative correlation was found between PA (post) and the completed course units, r = -0.51, p = 0.002. This correlation can be interpreted as a strong correlation (Cohen, 1988). A significant positive correlation was found between PA (post) and PA (pre), r = 0.55, p < 0.001. This correlation can be interpreted as a strong correlation as well (Cohen, 1988). Furthermore, a significant negative correlation was found between SL (difference) and SL (pre), r = -0.46, p = 0.003. This correlation can be interpreted as a strong correlation (Cohen, 1988). A significant positive correlation was found between SL (difference) and SL (post), r = 0.78, p < 0.001. This correlation can be interpreted as a strong correlation (Cohen, 1988). The SWB (pre) showed a significant positive correlation with PA (pre), r = 0.47, p = 0.005. This correlation can be interpreted as moderate to strong correlation (Cohen, 1988). The SWB (pre) also showed a significant positive correlation with PA (post), r = 0.34, p = 0.049. This correlation can be interpreted as a moderate correlation (Cohen, 1988). For the SWB (difference) a significant negative correlation was found between various variables, being PA (pre) (r = -0.53, p = 0.001), a significant positive correlation with PA (difference) (r = 0.44, p = 0.009), a significant negative correlation with SL (difference) (r = -0.36, p = 0.035), a significant negative correlation with SWB (pre) (r = -0.56, p < 0.001) and a significant positive correlation with SWB (post) (r = 0.59, p < 0.001). The correlation with PA (pre) and SWB (pre) and SWB (post) can be interpreted as strong, while the correlation with PA (difference) and SL (difference) can be interpreted as moderate (Cohen, 1988). Therefore, the null hypotheses (“There is no significant correlation”) for these variables can be rejected and the alternative hypotheses (“There is a significant correlation”) can be accepted.

Table 15: Correlation matrix of the Spearman correlation analysis between completed course units and physical activity, stress level and subjective well-being.

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Completed Course Units	-									
2. Physical Activity (pre)	-0.32	-								
3. Physical Activity (post)	-0.51**	0.55***	-							
4. Physical Activity (difference)	-0.10	-0.46**	0.33	-						
5. Stress Level (pre)	-0.15	0.03	0.22	-0.17	-					
6. Stress Level (post)	-0.20	0.24	0.03	-020	0.13	-				
7. Stress Level (difference)	-0.08	0.27	-0.07	-0.28	-0.50**	0.78***	-			
8. Subjective Well-Being (pre)	-0.19	0.47**	0.34*	-0.21	-0.33	-0.1	0.19	-		
9. Subjective Well-Being (post)	0.10	-0.15	0.26	0.29	0.20	-0.32	-0.26	0.26	-	
10. Subjective Well-Being (difference)	0.22	-0.53**	-0.08	0.44**	0.28	-0.24	-0.36*	-0.56***	0.59***	-

Note: Correlations are presented by the Spearman correlation coefficient.
*p < 0.05; **p < 0.01; ***p < 0.001.

5.3 Factors for Participation in Prevention Course

This chapter presents the results of the bivariate analyses examining which factors are associated with the number of course units completed post-intervention. The third research question, being "*Which factors are significantly associated with the number of completed course units within the 8-week digital prevention course?"* was assessed using bivariate analyses. For that, potential factors which might have influenced the regular participation in the digital prevention course were assessed. The ordinal and metric pre-intervention variables included in this bivariate analysis are described in Table 16.

Table 16: Descriptive statistics for pre-intervention factors.

Variable (ordinal)	Mdn	M (SD)	n
Age	3.00	2.91 (1.06)	45
Motivation to Participate	4.00	3.76 (0.93)	45
Fun doing Physical Activity	4.00	3.40 (1.14)	45
Stress Level (Pre)	4.00	3.84 (1.02)	45
Variable (metric)		**M (SD)**	**n**
Subjective Health Status (pre)		6.33 (2.06)	45
Physical Activity (pre)		2386.47 (1916.59)	45
Subjective Well-Being (pre)		13.73 (3.23)	45

Note: Mdn = Median, *M* = Mean, *SD* = Standard deviation, *n* = number of participants.

Nominal variables were also incorporated in the analysis. The description of these variables can be found in the previous chapter 5.1.1 “Sample Description”. For certain nominal variables, dummy coding was utilized to make them dichotomous variables, being age, gender, study course, and prior Exergame experience to incorporate them into the analysis. For age the recoded value of 1 was assigned to age 18 to 23 and the value of 0 to age 24 to 30. For gender a recoded value of 1 was assigned to female and 0 to male. For study course a recoded value of 1 indicated enrollment in a health-related study course, while 0 indicated no enrollment in such a course. For prior Exergame experience a value of 1 represented having experience and 0 indicated no experience. With that, point-biserial correlations were calculated.

Additionally, to examine whether and which causes of inactivity and stress were associated with the number of completed course units, point-biserial correlation analyses were performed for these variables, as well as for coping strategies. Point-biserial correlations were selected for this analysis due to the multiple response sets, where categories were coded as 0 (not selected) and 1 (selected). For these variables, the pre-intervention and post-intervention data were used.

Since the variable completed course units is not normally distributed, the test for normal distribution of the other metric variables was skipped. For the bivariate analyses with the ordinal and metric variables, Spearman correlation analysis (non-parametric) was used. The point-biserial correlation was employed for the dichotomous nominal variables, despite the number of course units not being normally distributed. This test is known for its robustness against deviations from normality (Field, 2009).

Bivariate Analysis

Table 17 summarizes the results from the bivariate analyses. Only the significant correlations for the reasons of inactivity, stress, and coping measures were included, as including all categories of those variables would have resulted in an overly large table. The complete output from SPSS for the bivariate analyses are attached in appendix V.

The results indicated a significant negative correlation with a moderate effect between completed course units and fun doing PA, $r = -0.32$, $p = 0.033$, a significant negative correlation with a moderate effect between completed course units and pre-intervention subjective health status, $r = -0{,}36$, $p = 0.016$. A significant negative correlation with a moderate effect was found between completed course units and pre-intervention PA Level, $r = -0.30$, $p = 0.041$. A significant negative correlation with a moderate effect was found between

completed course units and health restrictions as reason for inactivity (pre), r = -0.39, p = 0.009. A significant positive correlation was found between completed course units and finances as reason for stress, r = 0.33, p = 0.026. A significant positive correlation with a moderate effect was found between completed course units and lack of motivation as reason for inactivity (post), r = 0.40, p = 0.020. Besides those significant correlations, no significant correlations were found (p > 0.05). Therefore, the null hypotheses ("There is no significant correlation") for correlations between the described variables can be rejected and the alternative hypotheses ("There is a significant correlation") can be accepted.

Table 17: Results of the Spearman correlation analysis and point-biserial correlation analysis.

Variables	*r*	p
Completed Units*Age[b]	0.02	0.934
Completed Units*Gender[b]	0.28	0.063
Completed Units*Study-Course[b]	0.00	1.000
Completed Units*Exergame Experience[b]	0.107	0.511
Completed Units*Fun doing PA[a]	-0.32	0.033*
Completed Units*Subjective Health Status[a]	-0.36	0.016*
Completed Units*Physical Activity[a]	-0.30	0.041*
Completed Units*Subjective Well-Being[a]	-0.12	0.444
Completed Units*Stress Level[a]	-0.13	0.393
Completed Units*Reason Inactivity (pre): Health Restrictions[b]	-0.39	0.009*
Completed Units*Stress Reason (pre): Finances[b]	0.33	0.026*
Completed Units*Reason Inactivity (post): Lack of Motivation[b]	0.40	0.020*

Note: *r* = Correlation coefficient, *p* = Significance, * = Significant p-value, [a]Spearman correlation, [b]Point-biserial correlation.

5.4 Rating of the Perceived Effectiveness of the Prevention Course

This chapter presents the results of the descriptive analyses evaluating participants' ratings of the perceived effectiveness of the digital prevention course on PA, SL and SWB. Bivariate analyses results for the analyses of correlation between completed course units and perceived effectiveness are also presented in this chapter.

The fourth research question of this thesis, being "*How do the participants perceive the effectiveness of the 8-week digital prevention course on improving physical activity level, stress level and subjective well-being? How do they rate the effectiveness on physical activity level and stress-level in comparison to other health promotion measures at university?"* will be answered with a descriptive analysis of these variables. For that, all n = 27 participants, who completed at least one unit of the prevention course, were included.

General Perceived Effectiveness of the Prevention Course

The mean response of the students who participated in the prevention course (n = 27) for the rating of the perceived general effectiveness of the digital prevention course, with a 5-point scale was M = 3.59 (SD = 0.75). The majority of participants selected a score of '4' (n = 14; 51.9 %). No participant perceived the prevention course as ineffective.

Perceived Effectiveness of the Prevention Course on Physical Activity

In terms of effectiveness, the participants were asked to rate the perceived effect of the digital prevention course on their general PA level. They could rate the perceived effect on a scale from 1 ("no effect") to 5 ("significant effect"). The mean rating of the perceived effect on PA was M = 3.3 (SD = 0.94). The majority of participants selected a score of '3' (n = 11; 40.7%). 1 participant (n = 1; 3.7%) indicated they perceived no effect and 2 participants (n = 2; 7.4%) indicated they perceived a significant effect. The participants were furthermore asked to specify on the effect the digital prevention course had (if there was an effect) on their PA. For that, categories were given from which the participants were able to choose multiple categories. Overall, n = 23 participants answered this item. The following described percentages reflect the *percent of cases*. Mostly the participants indicated the effect of increased PA through playing Exergames (n = 12; 52.2%). 10 participants (n = 10, 43.5%) indicated the effect of raising awareness of the importance of PA and 10 participants (n = 10, 43.5%) indicated the effect of more joy in movement. Additionally, 3 participants (n = 3; 13.0%) indicated another effect, with the option of stating the effect. Those effects were "More moving breaks in between. The games were great for that", "Additional balance in everyday life, for example during long university- or workdays" and "Variety in everyday life through the games".

Perceived Effectiveness of the Prevention Course on Stress Level

In terms of effectiveness, the participants were asked to rate the perceived effect of the digital prevention course on their SL. They could rate the perceived effect on a scale from 1 ("negative effect") to 5 ("positive effect"). The mean rating of the perceived effect on SL was M = 3.19 (SD = 0.79). The majority of participants selected a score of '3' (n = 16; 59.3%). No participant indicated a negative effect and 2 participants (n = 2; 7.4%) indicated a positive effect. To further investigate the effect of the digital prevention course on SL, the participants were asked if they experienced less stress since they used the digital prevention course. The majority of participants (n = 17; 63.0%) indicated, that they were not less stressed since participating in the prevention course. However, 6 participants (n = 6; 22.2%) indicated, that they were less stressed since they used the prevention course. The participants were furthermore asked to specify on the effect the digital prevention course had (if

there was an effect) on their SL. For that, categories were given from which the participants were able to choose multiple categories. Overall, n = 6 participants answered this item. The following described percentages reflect the *percent of cases*. Mostly the participants indicated the effect of more motivation (n = 4; 66.7%), while 3 participants (n = 3; 50.0%) indicated the effect of more fun, 2 participants (n = 2; 33.3%) the effect of variety in daily routine and 1 participant (n = 1; 16.7%) indicated the effect of stress management through more PA. Also, 1 participant (n = 1; 16.7%) indicated another effect, with the option of stating the effect. This effect was “Balancing out everyday work- and university-life”.

Perceived Effectiveness of the Prevention Course on Subjective Well-Being

To assess the effectiveness of the digital prevention course on SWB, the participants were asked to rate the perceived effect of the digital prevention course on physical and mental well-being. The participants could rate the statement “I had the feeling that the digital prevention course was good for my physical well-being” on a 5-point scale from 1 (“does not apply at all’) to 5 (“fully applies”). The mean score was M = 3.70 (SD = 0.82). The most frequently selected score was ‘3’ (n = 11; 40.7%). No participant indicated to have a strong disagreement with the statement and 5 participants (n = 5; 18.5%) indicated a tendency towards a strong agreement with the statement. The participants were furthermore asked to rate the perceived effect of the digital prevention course on the mental well-being, by rating the statement “I had the feeling that the digital prevention course was good for my mental well-being.” on a 5-point scale from 1 (“does not apply at all”) to 5 (“fully applies”). The mean score was M = 3.52 (SD = 0.75). The majority of participant selected a score of ‘3’ (n = 14; 51.9%). No participant indicated to have a strong disagreement with the statement and three participants (n = 3; 11.1%) indicated a tendency towards a strong agreement with the statement.

Fun and Motivation

The participants were asked whether they had fun doing PA on a 5-point scale. The mean score was M = 3.96 (SD = 0.85), with a most frequent score of ‘4’ (n = 11, 40.7%). In terms of motivation through the prevention course, the participations could also rate their motivation on a 5-point scale. The mean score was M = 3.7 (SD = 0.95), with a most frequent score of ‘4’ (n = 10, 37.0%).

The following Figure 14 illustrates the results of the descriptive analysis on participants' ratings of the perceived effectiveness of the digital prevention course.

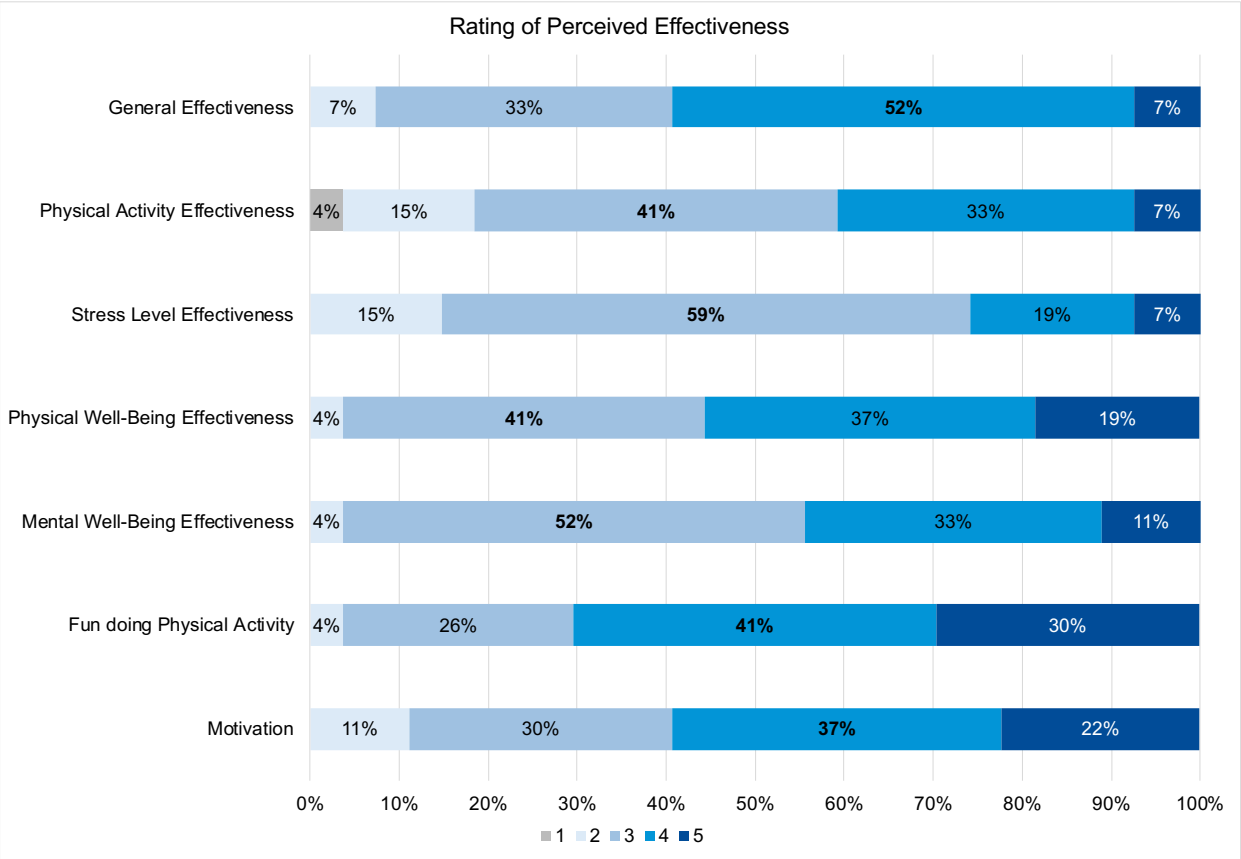

Figure 14: Summary of participant ratings on the perceived effectiveness of the course.

Comparison of Prevention Course to other Health Promotion Measures at University in Motivation and Effectiveness

Lastly, the participants were asked to rate the prevention course in comparison to other health promotion measures at university in terms of motivation and effectiveness, if they have participated in such before. In terms of motivation in comparison to other health promotion measures at university, the most frequent rating was, that the digital prevention course was perceived as equally motivating (n = 10; 37.0%). Also, 2 participants (n = 2; 7.4%) rated the digital prevention course as less motivating and 7 participants (n = 7; 25.9%) rated it as more motivating. However, 8 participants (n = 8; 29.5 %) did not answer the question. In terms of effectiveness in comparison to other health promotion measures at university, the most frequent rating was, that the digital prevention course was perceived as equally effective (n = 8; 29.6%), while 7 participants (n = 7; 25.9%) rated the digital prevention course as less effective and 5 participants (n = 5; 18.5%) as more effective. Also, 7 participants (n = 7; 25.9 %) did not answer the question.

Bivariate Analysis

The fifth research question, being "*Is there a significant correlation between the number of completed course units within the 8-week digital prevention course and the perceived effectiveness of the digital prevention course on physical activity level, stress level and subjective well-being, as well as fun and motivation?"* was assessed using bivariate analyses. This analysis utilized the variable of the number of completed course units and the variables described in the previous chapter. Only data from participants (n = 27) who completed at least one unit of the prevention course were included, as only they were able to rate the perceived effectiveness of the course. Due to the ordinal nature of these variables, the Spearman correlation analysis was utilized.

Table 18 shows the correlation matrix for the results from the Spearman correlation analysis. A significant positive correlation was found between completed course units and the perceived effectiveness on PA, $r = 0.52$, $p = 0.005$. This correlation can be interpreted as a strong correlation (Cohen, 1988). Various correlations were found with the perceived effectiveness on PA. A significant positive correlation was found between the perceived effectiveness rating on PA and SL, $r = 0.64$, $p < 0.001$. The perceived effectiveness on PA and on physical well-being show a significant positive correlation as well, $r = 0.64$, $p < 0.001$. Furthermore, the perceived effectiveness on PA and the perceived effectiveness on mental well-being also show a significant positive correlation, $r = 0.59$, $p = 0.001$. A significant positive correlation was found between perceived effectiveness on PA and perceived effectiveness on motivation, $r = 0.83$, $p < 0.001$. All correlations can be interpreted as strong correlations (Cohen, 1988). Furthermore, a significant positive correlation was found between the perceived effectiveness on physical well-being and the perceived effectiveness on SL, $r = 0.39$, $p = 0.46$. This correlation can be interpreted as moderate correlation (Cohen, 1988). A significant positive and strong correlation was found between the perceived effectiveness on physical well-being and on mental well-being, $r = 0.81$, $p < 0.001$. The effectiveness on motivation shows a significant positive correlation with the perceived effectiveness on SL, $r = 0.55$, $p = 0.003$, on physical well-being, $r = 0.70$, $p < 0.001$, and on mental well-being, $r = 0.63$, $p < 0.001$. These correlations can be interpreted as strong correlations (Cohen, 1988). Therefore, the null hypotheses ("There is no significant correlation") for these variables can be rejected and the alternative hypotheses ("There is a significant correlation") can be accepted.

Table 18: Correlation matrix for the Spearman correlation analysis between completed course units and perceived effectiveness.

Variables		1.	2.	3.	4.	5.	6.	7.
1.	Completed Course Units	-						
2.	Effectiveness Physical Activity	0.52**	-					
3.	Effectiveness Stress Level	0.37	0.64***	-				
4.	Effectiveness Physical Well-Being	0.02	0.64***	0.39*	-			
5.	Effectiveness Mental Well-Being	0.13	0.59**	0.34	0.81***	-		
6.	Fun doing Physical Activity	-0.18	-0.23	-0.16	-0.25	-0.35	-	
7.	Motivation through course	0.35	0.83***	0.55**	0.70***	0.63***	-0.23	-

Note: Correlations are presented by the Spearman correlation coefficient.
*p < 0.05; **p < 0.01; ***p < 0.001.

5.5 Rating of Feasibility and Suitability of the Prevention Course

To assess the sixth research question, being "*Do participants perceive the 8-week digital prevention course as a feasible and suitable measure for university students?"* a descriptive analysis of those variables was conducted. The results of the descriptive analysis are described in this chapter.

The participants (n = 27) were asked to rate if they were able to integrate the digital prevention course in their everyday life well on a 5-point scale with 1 indicating bad integrability and 5 indicating good integrability. The mean score was M = 4.04 (SD = 0.94) and the most frequently selected score was '5' (n = 11; 40.7%). Furthermore, the participants were asked to rate if they would further use the digital prevention course, if there was a bigger variety of workouts in the Ergogym and Exergames available on a scale from 1 ("no, never") to 5 ("yes, all the time"). The mean score was M = 3.48 (SD = 0.98). The most frequently selected score was '4' (n = 13; 48.1%). No participant indicated that they would not use it further, while 3 participants (n = 3; 11.1%) indicated they would use it further "all the time"'. Moreover, the participants were asked to rate if they would recommend the digital prevention course to their fellow students on a 5-point scale. The mean score was M = 4.15 (SD = 0.90). The most frequently selected scores were '4' (n = 11; 40.7%) and '5' (n = 11; 40.7%). No participant indicated that they would probably not recommend the digital prevention

course to their fellow students. The variable of technical issue rating was also included to analyze feasibility. The participants were asked to rate the frequency of these issues on a 5-point. The mean score was M = 2.48 (SD = 1.31) with a most frequent rating of '1' (n = 8; 29.6%) and least frequent rating of '5' (n = 2; 7.4%). Figure 15 depicts the summary of ratings for the feasibility items. In terms of technical issues, the participants who have had technical issues had the opportunity to state those. Due to the qualitative nature of the data, responses were systematically categorized and coded to provide a comprehensive overview of the findings. The responses (n = 22; 81.5%) to the question were grouped into recurring themes. Table 19 summarizes the themes, number of mentions of those themes and example quotes.

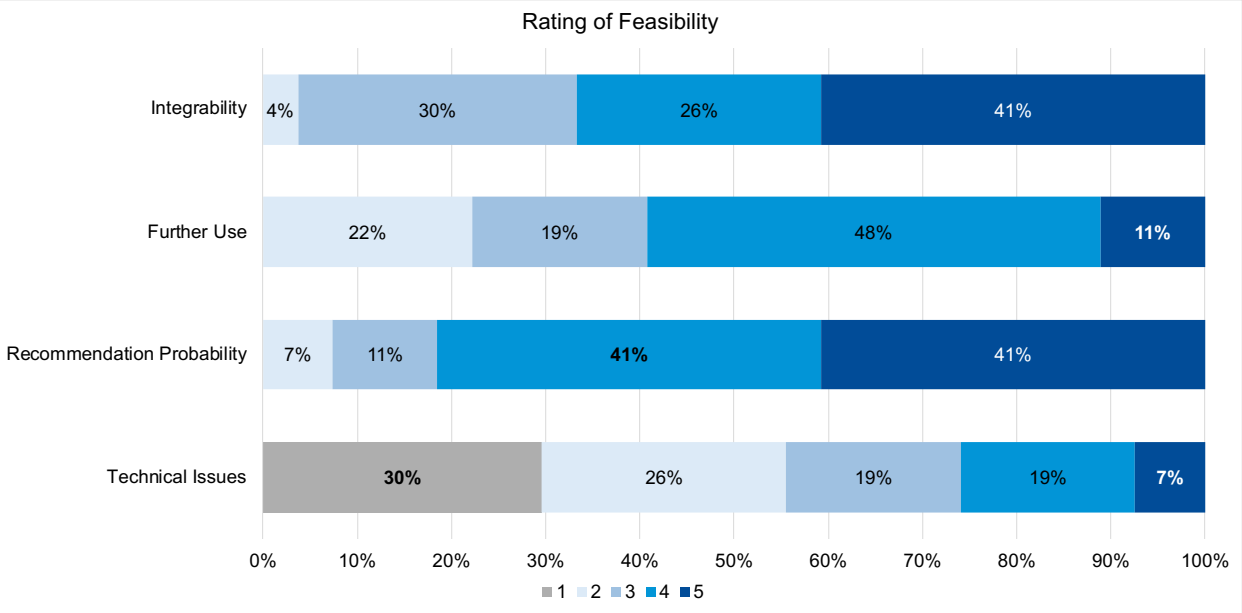

Figure 15: Summary of participant ratings on the feasibility.

Table 19: Qualitative findings on technical issues in the prevention course.

Theme	Mentions	Description	Example Quotes
Long Loading Times / Game Freezing	15	Many participants mentioned that the games took too long to load, which affected the overall experience. Several participants experienced issues where games would freeze or fail to load, particularly with specific games like "City Hopper".	"Long loading times" "Sometimes it took a long time to load the games" "Game freezes, movements not recognized"
Performance Issues (Lagging)	4	Some participants reported performance issues, such as lag or the game slowing down, often due to device limitations.	"Lagging (performance)" "Laptop was too slow at times"
Camera/Device Problems	3	Several participants encountered issues with their device's camera, particularly in poor lighting, which affected gameplay.	"Camera of my device wasn't good enough" "With bad lighting, the camera recognized movements poorly"

Note: Some respondents mentioned more than one theme. Quotes were translated from German into English.

Lastly, the participants were asked to specify whether they think that the digital prevention course with Exergames is a fitting health promotion measure for university students via an open-ended question. The responses were also systematically categorized and coded to provide a comprehensive overview of the findings. The responses (n = 27; 100%) to the question, whether the digital prevention course with Exergames could be a fitting health promotion measure for university students were grouped into recurring themes. Table 20 summarizes the themes, number of mentions of those themes and example quotes.

Table 20: Qualitative findings on the suitability of the prevention course as a health promotion measure for university students.

Theme	**Mentions**	**Description**	**Example Quotes**
Enjoyment and Motivatio	9	The participants would say the digital prevention course is a fitting health promotion measure for university students since the course was enjoyable and motivating, especially due to the interactive and playful elements.	*"Yes, it increases motivation." "Yes, it is fun and easy to integrate because it is digital."*
Ease of Integration	10	The participants would say the digital prevention course is a fitting health promotion measure for university students since the course was perceived as easy to integrate into daily life, particularly due to its digital and flexible nature.	*"Yes, because it is quick and digital. You don't have to leave the house." "It's easy to use and fun."*
Target Audience: Unsporty Individuals	6	The course was seen as more appropriate for individuals who are not very active or just starting to engage in activity.	*"Yes, it's suitable for unfit people." "It's more for those just beginning to engage in PA." "Yes, especially as a motivational factor to start changing behavior with regard to PA."*
Flexibility and Convenience	8	The participants would say the digital prevention course is a fitting health promotion measure for university students due to the ability to complete the course at home.	*"Yes, because it's flexible and can be done from home." "It's quick and flexible to do."*
Limitations: Lack of Challenge	5	Some felt the course lacked intensity or depth, especially for athletic individuals, which is why they would say that the digital prevention course is not a fitting health promotion measure for already fit students.	*"It's fun but not really proper exercise." "There should be more than one session per week."*

Note: Some respondents mentioned more than one theme. Quotes were translated from German into English.

6 Discussion

The main aim of this study was to assess whether a digital prevention course with Exergames has an effect on PA, SL and the SWB of university students in Germany. Furthermore, the aim was to assess whether the participants rate the digital prevention course as a feasible and effective health promotion measure for university students.

A total of 45 university students completed the pre-intervention questionnaire, while 34 students participated in the post-intervention questionnaire. By matching participant IDs across both data sets, 11 participants were identified as dropouts. Of the initial sample, 27 participants engaged in at least one unit of the prevention course, with 24 of them participating regularly, which was defined as completing at least half of the intervention. Additionally, 7 participants completed both the pre- and post-intervention questionnaires without engaging in the intervention. This group was designated as the control group for the inferential statistical analyses. Findings of the inferential statistical analyses, mainly using the dependent t-test and the Wilcoxon signed-rank test, within this thesis have shown that after the 8-week intervention, students who regularly participated in the prevention course demonstrated significantly higher levels of PA, lower SL and improved SWB in comparison to the baseline measurement prior to the intervention. The strongest effect was observed in the variable of SWB. In the control group, no significant changes in the main variables were observed after the 8-week period, although the descriptive data indicated improvements for all variables. Similar results have already been found within previous studies, showing that exergaming can increase PA level (Davis et al., 2022; Feodoroff et al., 2019; P.-T. Wu et al., 2015; Y.-S. Wu et al., 2022; Y. Zhao et al., 2024), help with stress and its health consequences (Pallavicini et al., 2021; Viana et al., 2021) and also improve the components within the SWB (Marques et al., 2023). However, the bivariate analyses showed, that there was no significant correlation between the course participation (number of completed course units) and the changes within those variables in the group of participants. This suggests that the positive changes observed in the inferential analyses cannot be directly attributed to the participation in the digital prevention course with Exergames. These improvements may have resulted from other factors, potentially acting as confounders, which could not be assessed within this thesis. Nevertheless, other correlations were found with the variable of course participation.

A negative and strong correlation was found with the PA level after intervention. Initially, this seems contra-intuitive, as increased participation in a prevention program for PA would be expected to lead to a higher PA level. A plausible interpretation could be, that participants

with lower PA level were more likely to engage actively in the course, possibly because they found the intervention to be relevant and beneficial, driving them to complete more units. It may also reflect the possibility that the intervention might not have been intense enough to raise the PA level for some participants by the end of the study. This interpretation could also be supported by the fact that the group of participants showed lowest PA level in comparison with the control group and also the group of dropouts. Adding to that, negative and moderate correlations were also found between completed course units and the subjective health status prior to intervention, the enjoyment of PA after intervention, health restrictions as reason for physical inactivity prior to the intervention and the lack of motivation as reason for inactivity after intervention. It can be concluded that students with lower subjective health status, low enjoyment of PA, less health restrictions and lack of motivation rather tend to participate in such an intervention as presented in this thesis. This was also found in various other studies, which highlighted that the use of Exergames as health promotion measure can effectively promote exercise adherence, particularly among sedentary individuals, through the increase of enjoyment and motivation (Davis et al., 2022; Gu et al., 2023). Studies from Lampert (2017) and Schwier and Seyda (2022) have shown that the use of gamification for health topics can lead to more interest in a health-related topic and thus (intrinsically) motivate and reach individuals who cannot otherwise be reached with conventional health offers (Lampert, 2017; Schwier & Seyda, 2022). The results presented within this thesis indicate similar results. Overall, the improvement in the main variables can still be seen as positive, since even a minor change can lead to various improvements in different health parameters, as previous studies have shown (Arem et al., 2015; Wen et al., 2011).

In addition to measuring and analyzing pre- and post-intervention data, the participants were asked if they *perceived* an effect on their PA, SL and SWB. The results indicate that most participants gave positive ratings for the overall effectiveness of the course, as well as its impact on physical well-being, enjoyment of PA and motivation. However, for the effectiveness in improving PA levels, reducing SL and enhancing mental well-being, participants generally provided neutral ratings, suggesting a moderate or uncertain perceived impact in these areas, supporting the previously described findings. Furthermore, the participants rated the prevention course as equally motivating and equally effective compared to other health promotion measures for university students. Bivariate analyses were also conducted with the variables of ratings of perceived effectiveness and course participation. The results revealed a significant and strong positive correlation between the number of completed units and the perceived effectiveness on PA. This indicates that as participants completed more units, they perceived a greater impact on their PA level. Moreover, the results showed intercorrelations in the variables of perceived effectiveness on PA, SL and

SWB, specifically strong correlations between the perceived effect on PA and the perceived effectiveness on SL, physical well-being and mental well-being. This supports the findings of various studies, showing intercorrelations between PA and SL (Aldana et al., 1996; Jonsdottir et al., 2010; Klaperski, 2018; Lovell et al., 2015; Lutz et al., 2010; Oaten & Cheng, 2005; Roemmich et al., 2003; Schnohr et al., 2005; Sonnentag & Jelden, 2009; Stults-Kolehmainen & Sinha, 2014) and also between PA and SWB (Buecker et al., 2021; Dyrbye et al., 2017; Fox, 1999; Herbert et al., 2020; Panza et al., 2019; Penedo & Dahn, 2005; Wicker & Frick, 2016). However, the results from this study do not prove these intercorrelations, as this was only observed in terms of the perceived effectiveness and the intercorrelations are very complex. Furthermore, no causal relationships can be concluded from the data in general.

Additional factors that could have influenced course participation, such as age, gender, study course and prior experience with Exergames, were also analyzed with bivariate analyses. However, no significant correlations were found between these variables and the level of course participation. In the descriptive analyses, the reasons for inactivity, reasons for stress and coping measures were observed. From that it could be seen that most participants experienced stress because of exams and the multiple burden of study and work at the same time prior to the intervention. These results are consistent with the research conducted by Meyer et al. (2023) and Heuse and Risius (2022). These studies found similar reasons for stress among university students. After the intervention, the reports of exam-related stress and the fear of poor grades decreased by approximately 10% and the number of participants who indicated to not have stress increased by 17%. This may indicate that participants had higher exam pressure before the intervention, which maybe declined afterwards because the exam period ended. The reduction in stress could have led to more motivation and time for PA. This could have potentially affected the improvements seen across all groups. However, this relationship could not be thoroughly explored, since more information and data on potential confounding variables were not collected and were not the primary focus of this thesis.

Besides the analysis of the effectiveness of the digital prevention course, the feasibility and acceptance of the digital prevention course were assessed as well. Overall, it can be said that the participants rated the feasibility positively and indicated that they would potentially use it further if the course had more content in terms of Exergames and workouts. However, it must be noted that different technical issues were reported, which made participation less enjoyable and feasible. The most frequently mentioned issues were long game loading times and performance problems due to insufficient device capabilities. This raises

concerns about feasibility. Although a sufficient result within the system check prior to the intervention was a requirement to participate, and all participants confirmed that their devices met the necessary requirements, some technical issues were still reported. It is essential that the course remains accessible to *all* students without being hindered by technical difficulties. The participants also stated if they see the digital prevention course as a suitable health promotion measure for university students through an open-ended question. From the qualitative data important conclusions can be drawn. As previously indicated by the quantitative findings, participants also expressed that the course is particularly suitable for students who are not yet physically active and are seeking for motivation to engage in PA. However, some participants felt that the course lacked intensity, which makes the course less suitable for already physically active students, which underscores the previous findings and conclusions. Furthermore, based on the responses regarding the suitability of the intervention as a health promotion measure, it can be concluded that the digital prevention course could be a suitable health promotion measure due to its enjoyable, motivating and flexible nature, which made it easy for the participants to integrate into daily life. This aligns with findings from various other studies, which emphasize the ease of use and integration, as well as the motivational aspects of digital interventions (Davis et al., 2022; Xu et al., 2021).

Overall, it has to be highlighted that the exclusive use of the digital prevention course for the promotion of physical activity without any other activities should be seen critically. Solely using the digital prevention course would not lead to meeting the WHO recommendations for health promoting PA, as the prevention course only covers 45 minutes of PA per week (World Health Organisation (WHO), 2020). The PA through the digital prevention course can be rather seen as light PA. However, some studies have already pointed out that the WHO recommendations overlook the inclusion of light physical activity, highlighting the importance of recognizing its potential benefits (Wicker & Frick, 2016). Nevertheless, the results of this study suggest that the digital prevention course can motivate individuals, particularly those with low PA levels and subjective health, to begin changing their health behaviors. This aligns with Bandura's Social Cognitive Theory and Ajzen's Theory of Planned Behavior, which emphasize the importance of motivation, self-efficacy and intention in behavior change (Bandura, 1997; Godin & Kok, 1996; Hagger et al., 2002). By providing information and support in a digital format, the course can help participants build the confidence needed to adopt healthier behaviors. Exergames have the ability to enhance health by improving knowledge, attitudes and motivation, as well as fostering self-efficacy and social support through exercise groups or challenges. These changes could further lead to

better health behaviors and physical improvements (Krath et al., 2021; Lieberman, 1997, 2001).

However, limitations of the present study need to be discussed before final conclusions can be drawn.

6.1 Limitations

One of the greatest limitations of the presented study was the sample size. In the pre-intervention survey 45 participants took part. However, in the intervention itself only 27 participants engaged in at least one unit of the course, while 24 participants completed at least half of the course. Out of those 24 participants, only 12 participants stated that they completed the whole digital prevention course, which is not enough to conclude effectiveness of an intervention. The calculated required sample size prior to the intervention was N = 54 to achieve an estimated Power of 0.95. The study achieved less than half of the necessary sample size for the intervention group, which compromises the statistical power of the results. Furthermore, the low level of participation raises questions about whether observed changes are a result of the prevention course. This certainly has a huge impact on the results of the study as the aim was to examine the effectiveness of the participation in the digital prevention course with Exergames on PA, SL and SWB. Generally, how the bivariate analyses have also shown already, the observed changes within the t-tests and Wilcoxon signed-rank tests cannot be attributed to the participation in the digital prevention course anyway. Moreover, a control group of seven participants was included, as these participants completed both questionnaires and not the intervention itself. However, this control group was not initially planned. The small size of the group also prevents from attributing the observed insignificant changes to the low participation level. In general, including a control group with an adequate sample size would enhance the statistical power and significance of the results when evaluating the effectiveness of an intervention. Moreover, there is a possibility that the inclusion of incentives might have helped raising the participation rates, which is why this would be recommended for further research.

More great limitations of the presented study were methodological constraints and data limitations. The used method of digital questionnaires with only self-reported data might not have captured all dimensions of the main variables and the actual values could have been different when measuring objectively. Examples of objective methods for assessing PA include the use of accelerometers, heart rate monitoring or fitness trackers. For SL, the options could involve measuring cortisol levels, blood pressure or heart rate variability. Although SWB is subjective anyways, it could be evaluated through various biomarkers or

functional magnetic resonance imaging (fMRI) (Silfee et al., 2018; Strath et al., 2013; Sylvia et al., 2013). However, these methods were not feasible for this intervention due to limited resources and the need for in-person testing, which could have further reduced participation in the study. Moreover, the measurement of subjective and self-reported data could have introduced biases, such as the social desirability bias or recall bias. This could have led to overestimation or underestimation of behaviors and experiences. It is uncertain whether participants actually completed the course units or if they simply claimed to have done so. This could further contribute to inaccuracies in the data. No (objective) data were collected within the course itself for data protection reasons, which is why it could not be checked how many units were actually completed by the participants. Additionally, even though standardized questionnaires were used within the study, the questionnaires bring their own limitations. This might for example be not covering all dimensions of a certain variable, especially since the questionnaires and questions used to assess PA, SL and SWB were overall short, which is practical, but this could lead to a lack of important information. This also might have led to distortion and incorrectness of the data. Adding to that, the questions on the general course evaluation, especially on the feasibility and acceptance of the intervention, were created by the ergofox GmbH and, so far, only used for internal evaluation of projects. Therefore, those questions have not been tested on validity and / or reliability before, which is why those results must be interpreted with caution as well. Lastly, the lack of randomization is an additional methodological limitation, as it may introduce selection bias. Participants in the intervention group could have characteristics, like being more fit and active or having an initial interest in Exergames. This might have influenced the outcomes independently of the course. Using randomization for the groups would help ensure comparability and to get a clearer understanding of the intervention's specific effects. However, like already outlined, the control group was not planned.

Another limitation of the study was the potential impact of confounding variables. Although factors like reasons for physical inactivity, stressors and coping measures were evaluated, the analyses did not reveal any significant correlations with the course participation. However, these variables could have influenced other outcomes. For instance, participants may have had more time to engage in PA after an exam period, which could explain the observed increases in PA and SWB, as well as the reduction in SL. Therefore, there is a possibility that factors unrelated to the intervention could have contributed to the positive outcomes rather than the intervention itself. The controlling for these confounders would provide a clearer picture of the intervention's actual effect, but this was not the focus of the current study. The primary aim was to evaluate the overall effectiveness of the course and not to identify potential external influences on the main variables. Moreover, addressing

confounding factors would have required a more comprehensive research design and would have extended the scope of the study. Due to the limited number of studies in this specific field, the identification and controlling for confounders is challenging. However, this would be an important consideration for future research.

This also goes in hand with the next limitation, being temporal constraints. The digital prevention course was implemented within a time where most universities in Germany had examination phases, as this could potentially lead to less participation and distortion of the results. In terms of temporal constraints, it also must be mentioned that the intervention was only implemented for eight weeks with one unit per week, which is not efficient to achieve a significant effect. Financial and resource constraints need to be mentioned as well, as this study was conducted by only one researcher and insufficient financial resources. Due to this, the resources for the recruitment were limited as well. The initial plan was to include the digital prevention course into lectures at university and the Exergames in general as an active break to achieve more participation. However, due to financial and structural barriers, this was not possible to implement in the study within this master thesis. To achieve higher participation from university students in future projects, this could be seen as potential improvement.

All the aforementioned limitations affect the internal validity of the study. Additionally, the external validity is also limited due to the small sample size and its specific characteristics. Most participants were enrolled in health-related study programs, mostly in the federal state of Hamburg, which may not accurately represent the broader university student population in Germany. Moreover, the specific context of the intervention and the Exergames developed by ergofox GmbH cannot be generalized to other Exergame interventions or to health promotion measures for university students in general. It is also important to note that it is already criticized that the findings from studies evaluating the effectiveness of Exergames are inconsistent, primarily due to the use of various types of Exergames in this studies and since most studies are short-term (Wiemeyer, 2010). This issue was not solved in the current study, since the Exergames provided by ergofox GmbH are different from those used in previous research. This further complicates the comparability and generalizability of the results.

Lastly, it is important to note that certain variables which were collected in the questionnaires were not included in the analyses of this thesis. Those variables include the general course evaluation, which could be insightful for the ergofox GmbH itself to further improve

the course, but not relevant for the analysis of the effectiveness of the course. However, a short descriptive analysis is attached in appendix IV of this thesis.

Besides the discussed limitations, the study shows the strength that it is the first study in Germany that deals with the effectiveness of a digital prevention course with Exergames as a health promotion measure for university students. It provides first results for the effectiveness and feasibility of such an intervention. Furthermore, it should be mentioned that the ergofox GmbH solely provided the digital prevention course with Exergames - they did not participate in the study in any other way. This can be seen as positive, since even though this thesis is a cooperation with a company, the researcher still worked independently and was responsible for the whole study without any other influences.

Based on the results of this thesis, recommendations for actions and further research can be made that are discussed in the following.

6.2 Recommendations and Actions for Further Research

Based on the findings and limitations of this study, several recommendations and actions for further research can be proposed. Future studies should aim for a larger and a more diverse sample size, including participants from various study courses or specifically comparing the effectiveness of such an intervention between different study courses. This would improve the generalizability of the findings and allow more robust statistical analyses, such as regression analyses, which could not be implemented within this presented study. Furthermore, conducting longitudinal studies would provide insights into the long-term effect of Exergames on PA, SL and SWB. The assessment of an extended period could help to assess sustainability and adherence to the intervention. Moreover, implementing a randomized controlled trial design would help eliminate selection bias and establish a cause-effect relationship between the intervention and outcomes. A randomized controlled trial can also ensure comparability between groups and strengthen the internal validity of the study. Furthermore, a very important recommendation would be to incorporate objective measurements for the assessment of the outcomes. This would provide a more accurate evaluation of the intervention’s effectiveness. Adding to that, future research should focus on the identification and the controlling of otential confounding variables that may influence the outcomes. A more comprehensive approach to data collection could assist to clarify the direct effects of the intervention. Moreover, the intervention, or in the case of this presented study the digital prevention course, should consider the improvement of the intervention through more intensity and variety, for example including multiple sessions per week and in incorporating a wider range of Exergames. This would address the concerns mentioned about the intensity and effectiveness of the current program, making it also suitable for individuals

with a different level of PA. Another important finding within this study was the role of motivation. It would be beneficial to pay more attention to this dimension, as it is important for health promotion and behavior change. This could be assessed using models like the Social Cognitive Theory and the Theory of Planned Behavior. Moreover, comparative studies could be a recommendation for further research, comparing different Exergames or comparing Exergames to different types of health promotion for PA.

In general, for the implementation of such projects and health promotion measures at universities for university students, it is recommended to integrate those as an integral part of a course in which the students can achieve credit points. With that, there would be additional motivation to participate, and it would be integrated into the schedule of the students already, without them having to make time for the intervention. With that, higher participation could be achieved, and the recruitment would be made easier. This could especially be beneficial for first-year university students, since studies have shown that this population has problems to stay physically active due to the transition phase from secondary to tertiary education (Diehl & Hilger, 2016).

By implementing these recommendations, future research and projects can build upon the findings of this study and with that contribute to a deeper understanding of the effectiveness of digital prevention courses with Exergames. Moreover, the ergofox GmbH can further improve their digital prevention course and Exergames, for example by extending the courses components with more content and variability and by solving technical performance issues. This would make the digital prevention course with Exergames more suitable and feasible for university students. Additionally, the questions used within this study, which are not yet standardized could be part of a study as well, in which the items on feasibility and the general course evaluation could be validated for further research.

7 Conclusions

This study is the first to examine the effectiveness and feasibility of a digital prevention course with Exergames for university students in Germany. The findings provide indications that participants who participated regularly in the digital prevention course had significant improvements in PA, SL and SWB after the intervention compared to the baseline measurement, particularly in SWB. However, no significant correlations were found between the number of completed course units and these positive outcomes. This suggests the influence of confounders which were not assessed within this study. However, the participants of the digital prevention course rated the course to be feasible and a suitable health promotion measure for university students, especially for students who are not physically active yet

and need an enjoyable and motivating measure to start engaging in more PA. The participants rated it rather unsuitable for already physically active individuals, which underscores the findings within the analyses of this study. Several limitations impacted this study's internal and external validity, including a small sample size, reliance on self-reported data and the lack of a comparable control group. These limitations highlight the need for more comprehensive research. Future studies should consider larger and more diverse samples, including objective measurement techniques and exploring the long-term effects of such an intervention. Additionally, addressing potential confounding variables is necessary to confirm the specific effects on PA, SL and SWB.

Overall, this thesis contributes to the emerging body of literature supporting the use of digital intervention and the use of Exergames as health promotion measure, also among university students. The positive perception of the digital prevention course suggests the suitability as health promotion measure particularly for less physically active students. With improvements and adaptions based on the participant feedback and the results within this study, such digital interventions with Exergames hold the potential to foster healthier behaviors of university students.

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Appendix

Appendix I: Study Information and Privacy Policy

Studieninformation und Datenschutzerklärung	Hochschule für Angewandte Wissenschaften Hamburg *Hamburg University of Applied Sciences*

Liebe*r Studieninteressent*in,

Vielen Dank für dein Interesse an der Studie

Evaluierung der Wirksamkeit eines 8-wöchigen digitalen Präventionskurses mit exergames auf die körperliche Aktivität und Stressbewältigung bei Studierenden.

Die Studie wird im Rahmen der Masterarbeit von Alina Bart durchgeführt. Der digitale Präventionskurs wurde in Zusammenarbeit mit der ergofox GmbH konzipiert und bereitgestellt.

Die folgende Studieninformation soll dich über den Studienablauf, Besonderheiten und die Wahrung des Datenschutzes aufklären. Lies die Studieninformation sorgfältig und vollständig durch und nimm dir ausreichend Zeit, bevor du dich für eine Teilnahme entscheidest. **Die Teilnahme an diesem Studienprojekt ist vollkommen freiwillig und kann jederzeit widerrufen werden.** Bei dieser Studie werden keine Arzneimittel oder Medizinprodukte getestet.

Hintergrund der Studie:
Die Studie untersucht einen digitalen Präventionskurs, der darauf abzielt, die Gesundheit von Studierenden vor dem Hintergrund steigender Belastungen wie Stress und körperlicher Inaktivität zu fördern. Ein 8-wöchiger digitaler Präventionskurs mit exergames wurde von der ergofox GmbH entwickelt, um diesen Herausforderungen entgegenzuwirken. Der Kurs besteht aus wöchentlichen Theorie- und Praxiseinheiten über 8 Wochen, die automatisch freigeschaltet werden. Jede Einheit dauert etwa 45 Minuten und umfasst theoretische Inhalte zu Gesundheitsthemen sowie Praxisübungen mit Ergogym und drei verschiedenen exergames. Der Kurs konzentriert sich auf verschiedene Körperbereiche über den Verlauf von 8 Wochen. Teilnehmende benötigen ein funktionsfähiges Endgerät mit integrierter oder externer Webcam, um die exergames zu spielen. Vor der Registrierung müssen sie einen Technik-Check durchführen, welcher über eine Website bereitgestellt wird. Der Kurs startet voraussichtlich Mitte Mai. Am Starttag wird der Link zum Kurs versendet.

Ziel der Studie:
Die Studie hat das Ziel, den 8-wöchigen digitalen Präventionskurs zu evaluieren und dessen Effektivität in verschiedenen Bereichen zu untersuchen. Dies umfasst die Auswirkungen auf den individuellen Gesundheitszustand der Teilnehmenden, ihre Akzeptanz und Motivation, die Integration des Kurses in den Studienalltag sowie die Unterscheidung des Kurses im Vergleich zu anderen Gesundheitsförderungsmaßnahmen für Studierende.
Die Evaluation des Präventionskurses dient ebenfalls dazu, Verbesserungsmöglichkeiten für die Weiterentwicklung des Kurses zu identifizieren. Die Anpassung und Weiterentwicklung dieses Kurses ist allerdings nicht Bestandteil der Studie und der Masterthesis.

Methodik zur Messung der Effektivität:
Zur Messung der Effektivität und der Evaluation des digitalen Präventionskurses werden digitale vorher- und nachher-Fragebögen genutzt. Der Link zum vorher-Fragebogen wird mit dem Link zur Kursregistrierung per E-Mail zugeschickt. Die Fragebögen sind anonymisiert[1], sodass sie nicht auf einzelne Personen zurückführbar sind. Der nachher-Fragebogen wird nach 8-Wochen per E-Mail zugesendet oder kann durch das Einscannen eines QR-Codes auf der Kursplattform nach Abschluss des Präventionskurses geöffnet und ausgefüllt werden. Vor Ausfüllen des Fragebogens wird nochmals über Rechte und den Datenschutz informiert und aufgefordert per Checkbox einzuwilligen. Für die Datenerhebung wird das Programm „SoSci Survey“ genutzt.

[1] **Anonymisieren** ist das Verändern personenbezogener Daten derart, dass die Einzelangaben über persönliche oder sachliche Verhältnisse nicht mehr oder nur mit einem unverhältnismäßig großen Aufwand an Zeit, Kosten und Arbeitskraft einer bestimmten oder bestimmbaren natürlichen Person zugeordnet werden können.

Risiken:
Es bestehen keine Risiken bei der Teilnahme an der Studie.

Datenschutzerklärung

Bewegungsreise mit exergames (ExerVenture)

Bei der Teilnahme an Ergogames (=exergames von ergofox) wird das Spiel in erster Linie durch Körperbewegungen gesteuert, welche von der Kamera Ihres Endgeräts erfasst werden. Diese Daten werden lokal auf Ihrem Endgerät zur Steuerung des Ergogames verarbeitet und nicht gespeichert.

Die Teilnehmenden registrieren sich mit Namen und Emailadresse per klassischen double-opt-in Verfahren über die ergofox Website und erklären sich per Checkbox damit einverstanden, an der Studie teilzunehmen sowie, dass ihre Daten durch die ergofox GmbH verarbeitet werden. Die Teilnehmenden bekommen zum Start des Kurses einen Registrierungslink zugesendet. Hierzu sind die mit einem Sternchen versehenen Angaben erforderlich als auch die Festlegung eines Passworts. Bei allen diesen Angaben handelt es sich um Pflichtangaben, welche zur Erbringung des Onlinekurses „Bewegungsreise“ zwingend benötigt werden (Art. 6 Abs. 1 S. 1 lit. b DSGVO). Im Profil können die Teilnehmenden die Ergebnisse und Statistiken zu ihren durchlaufenen Ergogames abrufen.

Im Zusammenhang mit der Durchführung des Onlinekurses können auch weitere Daten erhoben werden (Evaluations-Fragebögen), welche zwar keine Voraussetzung für die Teilnahme selbst sind, welche aber hilfreich sein können und sich etwa auch auf die Auswertung auswirken können – sog. optionale Daten (Art. 6 Abs. 1 S. 1 lit. a DSGVO).

Diese Daten werden für die Masterthesis genutzt. Die Fragebögen werden mithilfe der Online-Plattform "SoSci Survey" digital bereitgestellt. Vor dem Ausfüllen des Fragebogens werden die Teilnehmenden über ihren Datenschutz und Anonymität der Daten informiert und müssen durch das Opt-in-Verfahren ihre Zustimmung zur Teilnahme geben. .

Datensicherheit, Datenweitergabe und Datenlöschung bei Ergogames

Alle ergofox IT-Systeme, in denen Ihre personenbezogenen Daten gespeichert und verarbeitet werden, sind durch strenge Maßnahmen geschützt und nur einem ausgewählten und zusätzlich geschulten Mitarbeiterkreis zugänglich. Wir unterhalten aktuelle technische und organisatorische Maßnahmen zur Gewährleistung der Datensicherheit, insbesondere zum Schutz Ihrer personenbezogenen Daten vor Gefahren bei Datenübertragungen sowie vor unbefugter Kenntniserlangung durch Dritte. Diese werden dem aktuellen Stand der Technik entsprechend jeweils angepasst.

Eine Weitergabe Ihrer personenbezogenen Daten an Dritte erfolgt grundsätzlich nicht, es sei denn,

- vorrangige Rechtsvorschriften sehen eine Datenübermittlung an Empfänger von öffentlichen Stellen vor;
- wir setzen Auftragsverarbeiter gem. Art. 28 DSGVO ein (etwa zum Hosting einer Anwendung), die von uns sorgfältig ausgewählt und beauftragt wurden;
- die Daten sind erforderlich zur Geltendmachung, Ausübung oder Verteidigung von Rechtsansprüchen und es besteht kein Grund zur Annahme, dass Sie ein überwiegendes schutzwürdiges Interesse am Unterbleiben der Weitergabe Ihrer Daten haben;
- Ihre ausdrückliche Einwilligung zu einer Weitergabe Ihrer Daten an externe Stellen liegt vor.

Auf Ihre bei Ihrem Profil gespeicherten Daten haben keine anderen Teilnehmenden ohne Kenntnis Ihres Passworts Zugriff. Bitte wählen Sie ein ausreichend komplexes Passwort und halten Sie Ihr Passwort geheim.

Die zu Ihrem Profil gespeicherten personenbezogenen Daten und Statistiken beim digitalen Präventionskurs mit exergames werden 12 Wochen nach Anlegen des Profils anonymisiert, sodass Einzelangaben über persönliche oder sachliche Verhältnisse nicht mehr einer bestimmten oder bestimmbaren

natürlichen Person zugeordnet werden können. Sie haben jederzeit die Möglichkeit, ihr Profil löschen zu lassen. Bitte wenden Sie sich hierzu per E-Mail (zu finden unter „Verantwortlicher“) an uns.

Widerruf von Einwilligungen
Sofern Sie uns gegenüber Einwilligungen abgegeben haben, können Sie diese jederzeit mit Wirkung für die Zukunft widerrufen.

Widerspruch gegen eine Datenverarbeitung
Soweit wir die Verarbeitung Ihrer personenbezogenen Daten auf eine Interessenabwägung gem. Art. 6 Abs. 1 S. 1 lit. f DSGVO stützen, können Sie Widerspruch gegen die Verarbeitung einlegen. Bei Ausübung eines solchen Widerspruchs bitten wir um Darlegung der Gründe, weshalb wir Ihre personenbezogenen Daten nicht wie von uns durchgeführt verarbeiten sollten. Im Falle Ihres begründeten Widerspruchs prüfen wir die Sachlage und werden entweder die Datenverarbeitung einstellen bzw. anpassen oder Ihnen unsere zwingenden schutzwürdigen Gründe aufzeigen, aufgrund derer wir die Verarbeitung fortführen.
Sie können der Verarbeitung Ihrer personenbezogenen Daten für Zwecke der Werbung und Datenanalyse jederzeit widersprechen.
Ihren Widerruf oder Widerspruch können Sie uns unter den Kontaktdaten unter „Verantwortlicher“ zusenden.

Ihre Rechte
Sie haben gegenüber uns folgende Rechte hinsichtlich der Sie betreffenden personenbezogenen Daten:

- Recht auf Auskunft, ob wir Daten über Ihre Person verarbeiten. Falls wir Daten über Ihre Person verarbeiten, haben Sie das Recht Auskunft über die Art und Umstände der Datenverarbeitung zu erlangen (Art. 15 DSGVO),
- Recht auf Berichtigung unrichtiger Daten (Art. 16 DSGVO) oder Recht auf Löschung Ihrer Daten, sofern die Voraussetzungen des Art. 17 Abs. 1 DSGVO erfüllt sind,
- Recht auf Einschränkung der Verarbeitung (Art. 18 DSGVO),
- Recht auf Widerspruch gegen die Verarbeitung unter den oben genannten Bedingungen (Art. 21 DSGVO),
- Recht auf Datenübertragbarkeit unter den Voraussetzungen des Art. 20 DSGVO.

Sie haben zudem das Recht, sich bei einer Datenschutz-Aufsichtsbehörde über die Verarbeitung Ihrer personenbezogenen Daten durch uns zu beschweren.

Die Evaluation

Art der erhobenen Daten in der Vorher-Nachher Befragung:
Im Rahmen der Evaluation werden soziodemografische Daten sowie Informationen zu Ihrem subjektiven Gesundheitsstatus, Stress und körperlicher Aktivität abgefragt. Zusätzlich werden Daten zur Evaluation des Kurses erfasst.

Datenschutz und Ihre Rechte in der Vorher-Nachher Befragung:
Ihre Teilnahme an der digitalen Evaluation ist freiwillig. Alle erhobenen Daten werden gemäß den Datenschutzbestimmungen behandelt und Ihre Rechte als betroffene Person werden gewährleistet.
Alle erhobenen Daten werden anonymisiert gespeichert und sind nicht auf einzelne Personen zurückzuführen. Die von Ihnen erstellte ID dient lediglich zu wissenschaftlichen Zwecken und hat keine Verbindung zu Ihren personenbezogenen Daten aus dem Präventionskurs. Es ist nicht möglich, anhand der Evaluation Rückschlüsse auf Ihre personenbezogenen Daten oder Ihre Kursdaten zu ziehen. Die soziodemografischen Daten (Geschlecht, Alter, etc.) dienen lediglich der Stichprobenbeschreibung. Für die Effektevaluation des Präventionskurses werden Gruppenstatistiken herangezogen, wobei keine individuellen Vorher-Nachher-Vergleiche durchgeführt werden.

Die Daten werden ausschließlich für den Zweck der Studie verwendet und nicht an Dritte weitergegeben.

Erhebung und Verarbeitung von Daten aus der Vorher-Nachher Befragung:
Im Rahmen dieser digitalen Evaluation werden anonymisierte Daten erhoben, die für die Durchführung der Studie erforderlich sind. Ihre Daten werden ausschließlich für wissenschaftliche Zwecke verwendet und unterliegen strengen Datenschutzrichtlinien.

Zweck der Datenerhebung in der Vorher-Nachher Befragung:
Die Datenerhebung dient der Evaluation eines digitalen Präventionskurses zur Förderung der körperlichen Aktivität und Stressbewältigung bei Studierenden. Die gesammelten Daten werden zur Analyse und Auswertung der Wirksamkeit des Kurses herangezogen.

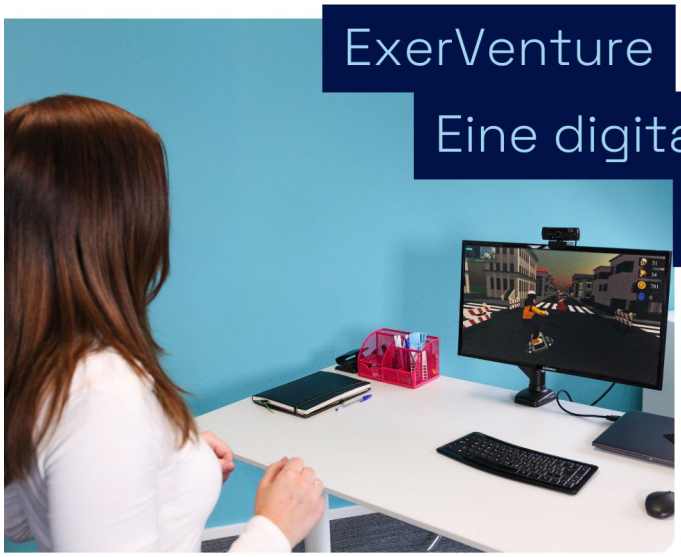
Speicherdauer und Löschung der Daten aus der in der Vorher-Nachher Befragung:
Die anonymisierten Daten werden nur so lange gespeichert, wie es für den Zweck der Studie erforderlich ist. Nach Abschluss der Studie werden alle Daten gelöscht. Die maximale Speicherdauer auf der SoSci-Survey Plattform beträgt 12 Monate. Nach Ablauf der 12 Monate werden die Daten automatisch gelöscht.

Verantwortlicher / Kontaktadresse und Kontaktpersonen für Rückfragen oder Anmerkungen:
Alina Bart
[redacted]

Bei Fragen zum Präventionskurs und Datenschutz:
[redacted]
Datenschutzbeauftragter: datenschutzanfragen@xdsb.de oder unter unserer Postadresse mit dem Zusatz „der Datenschutzbeauftragte“

Appendix II: Flyer used for Recruitment

Digitaler Präventionskurs für Studierende



ExerVenture

Eine digitale Bewegungsreise

mit exergames

evaluiert im Rahmen der Master-Arbeit von Alina Bart

Kosten-los!

ergofox

Werde aktiv!

Erlebe Bewegung neu mit exergames

Tauche ein in die interaktive Bewegungsreise mit exergames! Über 8 Wochen hinweg wirst du Teil einer aufregenden Reise sein, bei der jede Woche eine neue Einheit auf dich wartet.

Erweitere dein Wissen über wichtige Gesundheitsthemen und setze es direkt in die Praxis um. Mit spannenden ergogym-Sessions und einer Vielzahl von exergames erlebst du Bewegung auf eine motivierende und unterhaltsame Weise!

Du hast Interesse? Super! Dann scanne den QR Code oben rechts für weiterführende Informationen!

Hier gehts zu mehr Infos und der Anmeldung!

Mach mit!

Der digitale Präventionskurs ist zeitlich und räumlich flexibel durchführbar! Du brauchst nur einen Computer, Laptop oder Tablet mit integrierter oder externer Webkamera.

- **Beginn**: Juni/Juli 2024
- **Dauer**: 8 Wochen
- Beantwortung eines Fragebogens vor und nach dem Präventionskurs

Kontakt Alina Bart · [redacted]

Appendix III: Variables and Data Levels

Table 1: Summary of Variables and Data Levels.

Main variables	Variables and Data Level
Demographic data (pre)	- Age (ordinal) - Gender (nominal) - Highest graduation (ordinal) - Study course (nominal) - Federal state of studies (nominal) - Way of recruitment (nominal)
Physical Activity (pre and post) ➔ IPAQ = MET min/week	*IPAQ includes different variables.* ➔ *MET / Minutes / week (score = metric))* + Sedentary time per day (ordinal) + Fun doing physical exercise (ordinal) – *additional variable to the IPAQ*
Well-Being (pre and post)	- Subjective state of health (metric) - Subjective well-being (WHO 5) (score → metric)
Stress Level (pre and post)	- Stress-level (ordinal) - Reason for stress (nominal) – *multiple responses possible* - Methods against Stress (nominal) - *multiple responses possible*
Prior Exergame Experience and Motivation (pre)	- Prior experience in Exergames (nominal) o If yes, which exergame? (open-ended) - Motivation to participate in study (metric) - Worries about study (open-ended = nominal)
Use of Course (post)	- Units completed (0 to 8) (metric) o If 0 to 7: Reason for unregular use? (nominal + open-ended) - Regular use (nominal) - Unit repetition (nominal) - *multiple responses possible* - Liking of the course (ordinal) - Reason for participation in the study (nominal) - *multiple responses possible*
Perceived Effectiveness (post)	- Effectiveness of the course (ordinal) - Rating of mental demand (ordinal) - Rating of the effectiveness of the course on physical wellbeing (ordinal) - Rating of the effectiveness of the course on mental wellbeing (ordinal) - Rating of motivation through the course (ordinal) - Rating of effect of course on physical activity (ordinal) o If positive: How did the course help? (nominal) - Rating of effect of course on stress level (ordinal) - Less stress since course started (nominal) o If yes: How did the course help? (nominal) - Rating of motivation in comparison to other health promotion measures at university for physical activity (nominal) - Rating of effectiveness in comparison to other health promotion measures at university for stress (nominal)
General Rating of the Course (post)	- Liking of Ergogym (ordinal) o If no, why? (open-ended) - Rating of intensity of Ergogym (nominal) - Appropriate training stimulus rating (metric) - Liking of Exergames (ordinal) o If no, why? (open-ended = nominal) - Rating of intensity of Exergames (nominal) - Pleasant physical activity (ordinal) - Motivation through challenge (ordinal) - Rating in in comparison to other training methods (ordinal) - Use of theory (nominal) o If no, why? (open-ended) - Rating, whether theory was helpful (ordinal) - Rating, whether theory was understandable (ordinal)
Feasibility Rating (post)	- Rating of integrability (ordinal) - Fitting prevention measure for university students? (open-ended question = qualitative) - Further use (ordinal) - Recommendation to fellow students (ordinal) - Technical issue rating (ordinal) o If yes, which? (open-ended = qualitative)
Other (post)	- Rating of navigation through the platform (ordinal) - Was the study adequately communicated? (ordinal) - What was most useful? (nominal) - Improvement suggestions (open-ended = qualitative)

Appendix IV: General Course Evaluation

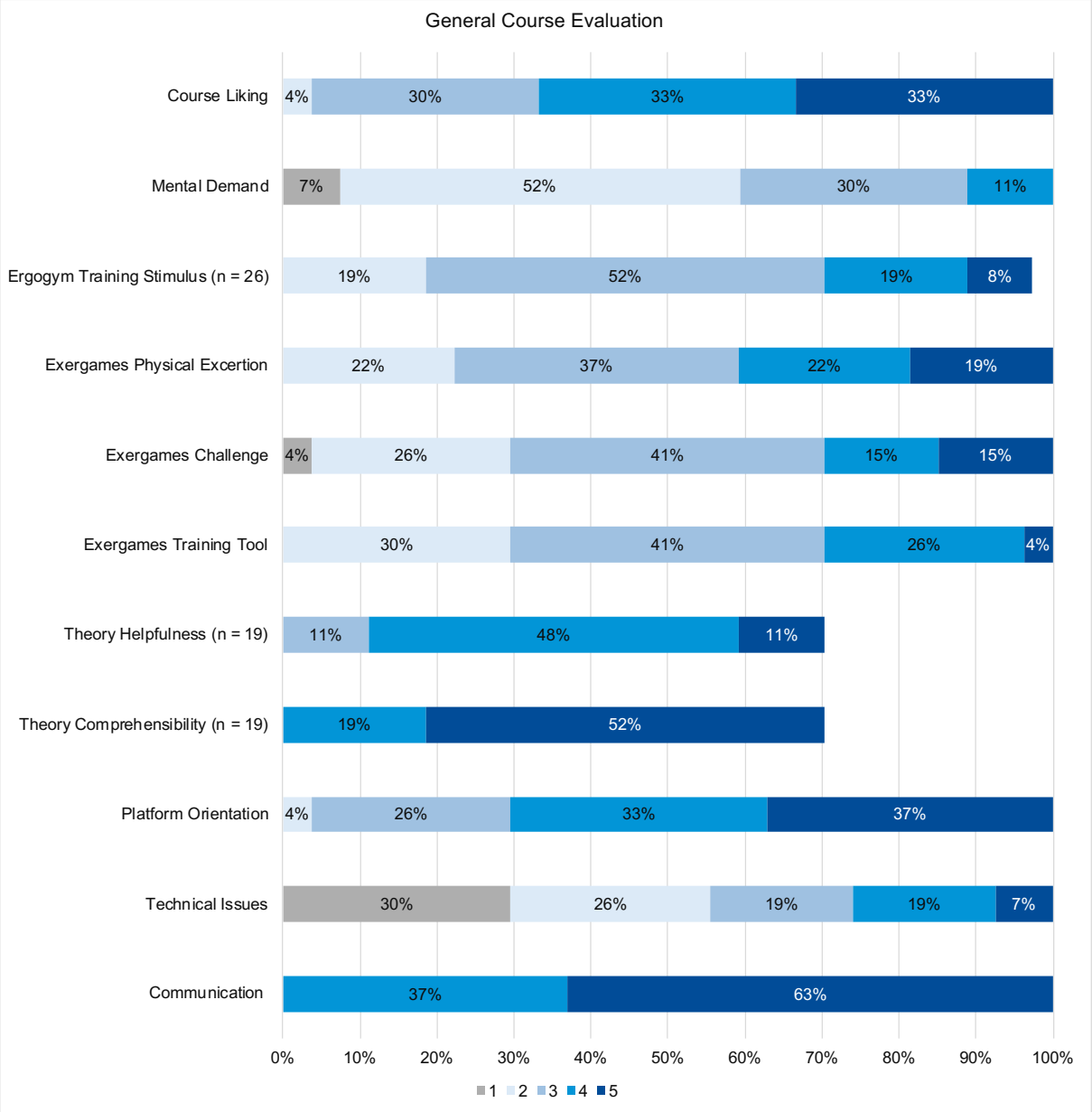


Figure 1: Summary of items for the General Course Evaluation (N = 27).

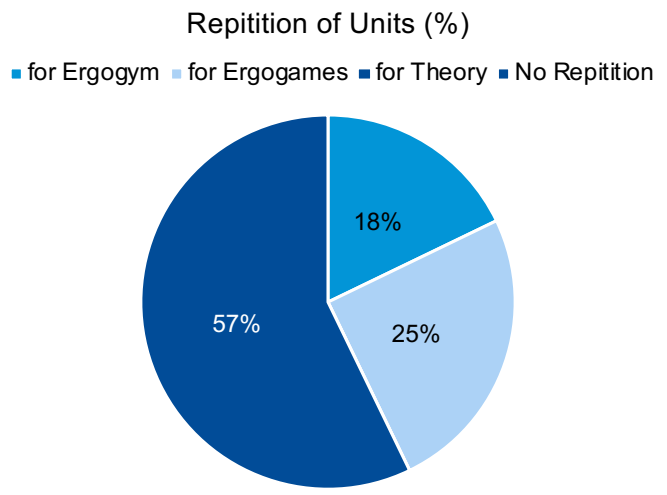


Figure 2: Pie-Chart of Reason for Repetition of Units.

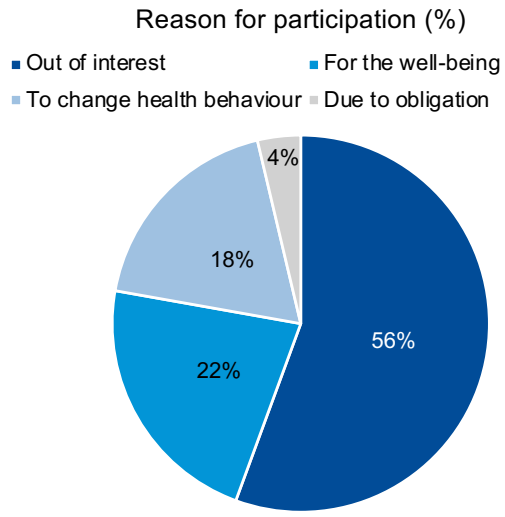


Figure 3: Pie-Chart of Reason for participation.

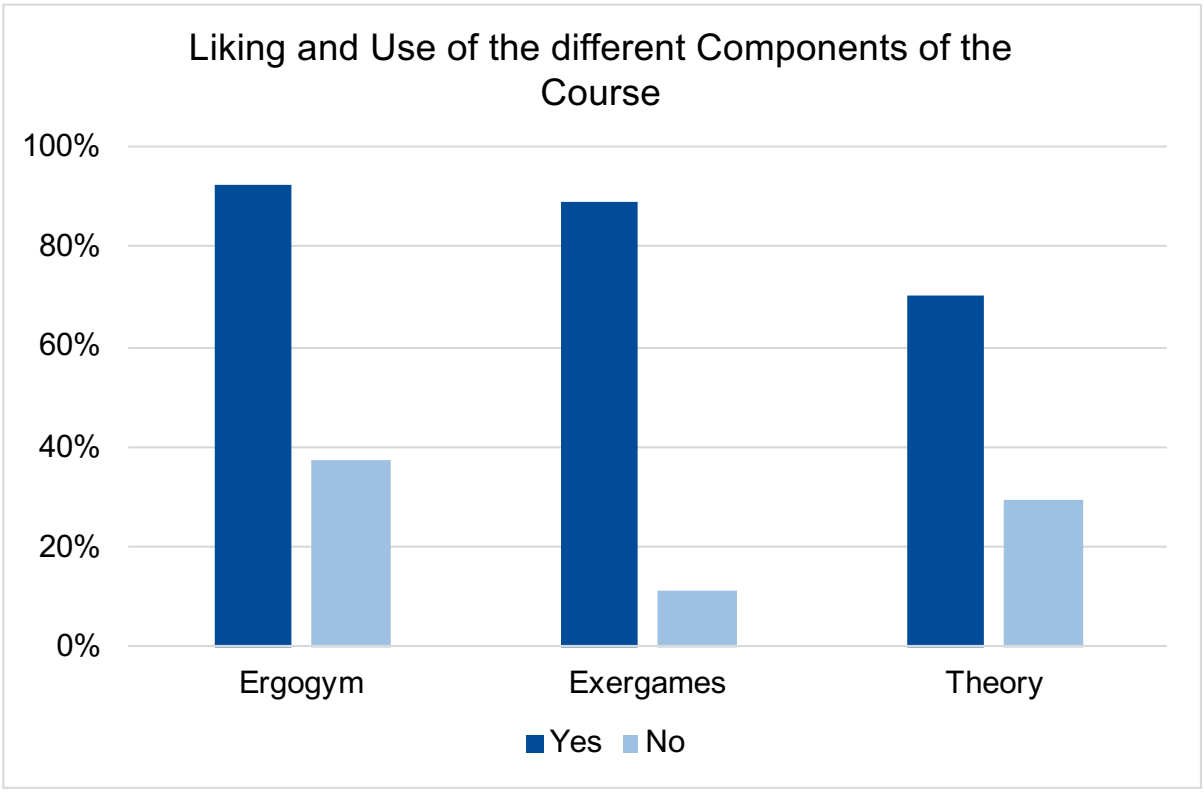


Figure 4: Graphical Visualization for the Liking and Use of Course-Components.

Table 2: Summary of Suggestions for Improvement.

Theme	Mentions	Description	Example Quotes
More Variety in Games / Exercises	10	Participants frequently requested a wider selection of games and exercises. Multiplayer options were also suggested for enhanced engagement.	"More games" "More variety in exercises and games. Multiplayer would be cool" "More games, more workouts"
Increased Intensity	7	Many participants felt the physical activities were not challenging enough and suggested increasing the intensity of the exercises and games.	"It should be more physically demanding" "Higher intensity" "More intense games and higher intensity"
Technical Issues	6	Multiple mentions of technical problems, including motion detection issues, slow loading times and game responsiveness.	"Technical issues, recognizing movements" "Better reaction time of the games" "Faster game loading"
Structured Flow and Accessibility	4	Suggestions to improve the flow of exercises (for example minimizing interruptions) and to make the technology standard more accessable.	"Run exercises consecutively without interruptions" "Easier technical access" "More focus on short breaks in daily life"
General Satisfaction	3	Some participants expressed overall satisfaction with the course, without suggesting any significant improvements.	"Everything was great" "Everything was top-notch"

Note: Some respondents mentioned more than one theme. Quotes were translated from German into English.

Appendix V: Supplementary Output from SPSS

Descriptive Results for Reasons for Inactivity, Stress and for Coping Strategies

$ReasonInactivity_Pre Frequencies

Correct Groups New Code			Responses N	Responses Percent	Percent of Cases
Regular	$ReasonInactivity_Pre[a]	Ursachen Inaktivität: Ich bin körperlich aktiv und treibe Sport	10	25.0%	41.7%
		Ursachen Inaktivität: Zeitmangel	10	25.0%	41.7%
		Ursachen Inaktivität: Fehlende Motivation	11	27.5%	45.8%
		Ursachen Inaktivität: Mangelnder Zugang zu Sporteinrichtungen	2	5.0%	8.3%
		Ursachen Inaktivität: Unbehagen beim Sport	3	7.5%	12.5%
		Ursachen Inaktivität: Mangelnde soziale Unterstützung	3	7.5%	12.5%
		Ursachen Inaktivität: Sonstiges	1	2.5%	4.2%
	Total		40	100.0%	166.7%
Not regular	$ReasonInactivity_Pre[a]	Ursachen Inaktivität: Ich bin körperlich aktiv und treibe Sport	3	100.0%	100.0%
	Total		3	100.0%	100.0%
Control	$ReasonInactivity_Pre[a]	Ursachen Inaktivität: Ich bin körperlich aktiv und treibe Sport	4	33.3%	57.1%
		Ursachen Inaktivität: Zeitmangel	2	16.7%	28.6%
		Ursachen Inaktivität: Fehlende Motivation	3	25.0%	42.9%
		Ursachen Inaktivität: Gesundheitliche Einschränkungen	2	16.7%	28.6%
		Ursachen Inaktivität: Mangelnde soziale Unterstützung	1	8.3%	14.3%
	Total		12	100.0%	171.4%
Drop-Out	$ReasonInactivity_Pre[a]	Ursachen Inaktivität: Ich bin körperlich aktiv und treibe Sport	2	10.5%	18.2%
		Ursachen Inaktivität: Zeitmangel	5	26.3%	45.5%
		Ursachen Inaktivität: Fehlende Motivation	7	36.8%	63.6%
		Ursachen Inaktivität: Gesundheitliche Einschränkungen	3	15.8%	27.3%
		Ursachen Inaktivität: Unbehagen beim Sport	1	5.3%	9.1%
		Ursachen Inaktivität: Sonstiges	1	5.3%	9.1%
	Total		19	100.0%	172.7%

a. Dichotomy group tabulated at value 1.

$ReasonStress_Pre Frequencies

Correct Groups New Code			Responses N	Responses Percent	Percent of Cases
Regular	$ReasonStress_Pre[a]	Stressursachen: Prüfungen	17	24.3%	70.8%
		Stressursachen: Angst vor schlechten Noten	9	12.9%	37.5%
		Stressursachen: Zu schwieriger oder zu umfangreicher Lernstoff	5	7.1%	20.8%
		Stressursachen: Finanzielle Sorgen	8	11.4%	33.3%
		Stressursachen: Die Mehrfachbelastung durch Studium und nebenbei arbeiten	17	24.3%	70.8%
		Stressursachen: Die Mehrfachbelastung durch Studium und Familie	6	8.6%	25.0%
		Stressursachen: Schlechte zeitliche Verteilung von Lehrveranstaltungen	1	1.4%	4.2%
		Stressursachen: Private Konflikte	6	8.6%	25.0%
		Stressursachen: Sonstige	1	1.4%	4.2%
	Total		70	100.0%	291.7%
Not regular	$ReasonStress_Pre[a]	Stressursachen: Prüfungen	2	22.2%	66.7%
		Stressursachen: Angst vor schlechten Noten	1	11.1%	33.3%
		Stressursachen: Zu schwieriger oder zu umfangreicher Lernstoff	2	22.2%	66.7%
		Stressursachen: Die Mehrfachbelastung durch Studium und nebenbei arbeiten	3	33.3%	100.0%
		Stressursachen: Private Konflikte	1	11.1%	33.3%
	Total		9	100.0%	300.0%
Control	$ReasonStress_Pre[a]	Stressursachen: Prüfungen	2	16.7%	28.6%
		Stressursachen: Angst vor schlechten Noten	1	8.3%	14.3%
		Stressursachen: Finanzielle Sorgen	1	8.3%	14.3%
		Stressursachen: Die Mehrfachbelastung durch Studium und nebenbei arbeiten	4	33.3%	57.1%
		Stressursachen: Private Konflikte	2	16.7%	28.6%
		Stressursachen: Sonstige	2	16.7%	28.6%
	Total		12	100.0%	171.4%
Drop-Out	$ReasonStress_Pre[a]	Stressursachen: Ich habe keinen Stress	1	3.0%	9.1%
		Stressursachen: Prüfungen	9	27.3%	81.8%
		Stressursachen: Angst vor schlechten Noten	4	12.1%	36.4%
		Stressursachen: Zu schwieriger oder zu umfangreicher Lernstoff	5	15.2%	45.5%
		Stressursachen: Fehlende Rückzugsmöglichkeiten an der Hochschule	1	3.0%	9.1%
		Stressursachen: Die Mehrfachbelastung durch Studium und nebenbei arbeiten	7	21.2%	63.6%
		Stressursachen: Die Mehrfachbelastung durch Studium und Familie	2	6.1%	18.2%
		Stressursachen: Schlechte zeitliche Verteilung von Lehrveranstaltungen	1	3.0%	9.1%
		Stressursachen: Private Konflikte	2	6.1%	18.2%
		Stressursachen: Sonstige	1	3.0%	9.1%
	Total		33	100.0%	300.0%

a. Dichotomy group tabulated at value 1.

$Coping_Pre Frequencies

Correct Groups New Code			Responses N	Responses Percent	Percent of Cases
Regular	$Coping_Pre[a]	Stressabbau: Mit Freunden oder Familie treffen	12	15.0%	50.0%
		Stressabbau: Spazieren gehen / rausgehen	15	18.8%	62.5%
		Stressabbau: Sport treiben	14	17.5%	58.3%
		Stressabbau: Im Internet surfen oder Videospiele spielen	8	10.0%	33.3%
		Stressabbau: Fernsehen	15	18.8%	62.5%
		Stressabbau: Entspannungstechniken (Yoga, autogenes Training, etc.)	10	12.5%	41.7%
		Stressabbau: Ein Glas Wein oder Bier trinken	4	5.0%	16.7%
		Stressabbau: Rauchen (jegliche Form ? Zigarette, E-Zigarette, Shisha, etc.)	1	1.3%	4.2%
		Stressabbau: Cannabis konsumieren	1	1.3%	4.2%
	Total		80	100.0%	333.3%
Not regular	$Coping_Pre[a]	Stressabbau: Mit Freunden oder Familie treffen	1	9.1%	33.3%
		Stressabbau: Spazieren gehen / rausgehen	1	9.1%	33.3%
		Stressabbau: Sport treiben	2	18.2%	66.7%
		Stressabbau: Im Internet surfen oder Videospiele spielen	2	18.2%	66.7%
		Stressabbau: Fernsehen	2	18.2%	66.7%
		Stressabbau: Entspannungstechniken (Yoga, autogenes Training, etc.)	1	9.1%	33.3%
		Stressabbau: Ein Glas Wein oder Bier trinken	1	9.1%	33.3%
		Stressabbau: Rauchen (jegliche Form ? Zigarette, E-Zigarette, Shisha, etc.)	1	9.1%	33.3%
	Total		11	100.0%	366.7%
Control	$Coping_Pre[a]	Stressabbau: Mit Freunden oder Familie treffen	3	16.7%	42.9%
		Stressabbau: Spazieren gehen / rausgehen	2	11.1%	28.6%
		Stressabbau: Sport treiben	4	22.2%	57.1%
		Stressabbau: Im Internet surfen oder Videospiele spielen	3	16.7%	42.9%
		Stressabbau: Fernsehen	2	11.1%	28.6%
		Stressabbau: Entspannungstechniken (Yoga, autogenes Training, etc.)	1	5.6%	14.3%
		Stressabbau: Rauchen (jegliche Form ? Zigarette, E-Zigarette, Shisha, etc.)	1	5.6%	14.3%
		Stressabbau: Cannabis konsumieren	2	11.1%	28.6%
	Total		18	100.0%	257.1%
Drop-Out	$Coping_Pre[a]	Stressabbau: Ich habe keinen Stress	1	3.0%	9.1%
		Stressabbau: Mit Freunden oder Familie treffen	6	18.2%	54.5%
		Stressabbau: Spazieren gehen / rausgehen	7	21.2%	63.6%
		Stressabbau: Sport treiben	3	9.1%	27.3%
		Stressabbau: Im Internet surfen oder Videospiele spielen	5	15.2%	45.5%
		Stressabbau: Fernsehen	4	12.1%	36.4%
		Stressabbau: Entspannungstechniken (Yoga, autogenes Training, etc.)	4	12.1%	36.4%
		Stressabbau: Ein Glas Wein oder Bier trinken	1	3.0%	9.1%
		Stressabbau: Rauchen (jegliche Form ? Zigarette, E-Zigarette, Shisha, etc.)	1	3.0%	9.1%
		Stressabbau: Sonstiges	1	3.0%	9.1%
	Total		33	100.0%	300.0%

$ReasonInactivity_Post Frequencies

Correct Groups New Code			Responses N	Responses Percent	Percent of Cases
Regular	$ReasonInactivity_Post[a]	Ursachen Inaktivität: Ich bin körperlich aktiv und treibe Sport	14	41.2%	58.3%
		Ursachen Inaktivität: Zeitmangel	6	17.6%	25.0%
		Ursachen Inaktivität: Fehlende Motivation	10	29.4%	41.7%
		Ursachen Inaktivität: Mangelnder Zugang zu Sporteinrichtungen	1	2.9%	4.2%
		Ursachen Inaktivität: Mangelnde soziale Unterstützung	1	2.9%	4.2%
		Ursachen Inaktivität: Sonstiges	2	5.9%	8.3%
	Total		34	100.0%	141.7%
Not regular	$ReasonInactivity_Post[a]	Ursachen Inaktivität: Ich bin körperlich aktiv und treibe Sport	3	100.0%	100.0%
	Total		3	100.0%	100.0%
Control	$ReasonInactivity_Post[a]	Ursachen Inaktivität: Ich bin körperlich aktiv und treibe Sport	6	75.0%	85.7%
		Ursachen Inaktivität: Gesundheitliche Einschränkungen	1	12.5%	14.3%
		Ursachen Inaktivität: Sonstiges	1	12.5%	14.3%
	Total		8	100.0%	114.3%

a. Dichotomy group tabulated at value 1.

$ReasonStress_Post Frequencies

Correct Groups New Code			Responses N	Responses Percent	Percent of Cases
Regular	$ReasonStress_Post[a]	Stressursachen: Ich habe keinen Stress	7	17.1%	29.2%
		Stressursachen: Prüfungen	7	17.1%	29.2%
		Stressursachen: Angst vor schlechten Noten	1	2.4%	4.2%
		Stressursachen: Finanzielle Sorgen	7	17.1%	29.2%
		Stressursachen: Die Mehrfachbelastung durch Studium und nebenbei arbeiten	12	29.3%	50.0%
		Stressursachen: Die Mehrfachbelastung durch Studium und Familie	2	4.9%	8.3%
		Stressursachen: Private Konflikte	4	9.8%	16.7%
		Stressursachen: Sonstige	1	2.4%	4.2%
	Total		41	100.0%	170.8%
Not regular	$ReasonStress_Post[a]	Stressursachen: Ich habe keinen Stress	1	10.0%	33.3%
		Stressursachen: Prüfungen	2	20.0%	66.7%
		Stressursachen: Angst vor schlechten Noten	1	10.0%	33.3%
		Stressursachen: Zu schwieriger oder zu umfangreicher Lernstoff	1	10.0%	33.3%
		Stressursachen: Finanzielle Sorgen	1	10.0%	33.3%
		Stressursachen: Die Mehrfachbelastung durch Studium und nebenbei arbeiten	2	20.0%	66.7%
		Stressursachen: Die Mehrfachbelastung durch Studium und Familie	1	10.0%	33.3%
		Stressursachen: Private Konflikte	1	10.0%	33.3%
	Total		10	100.0%	333.3%
Control	$ReasonStress_Post[a]	Stressursachen: Ich habe keinen Stress	3	25.0%	42.9%
		Stressursachen: Finanzielle Sorgen	2	16.7%	28.6%
		Stressursachen: Die Mehrfachbelastung durch Studium und nebenbei arbeiten	4	33.3%	57.1%
		Stressursachen: Private Konflikte	2	16.7%	28.6%
		Stressursachen: Sonstige	1	8.3%	14.3%
	Total		12	100.0%	171.4%

a. Dichotomy group tabulated at value 1.

$Coping_Post Frequencies

Correct Groups New Code			Responses N	Responses Percent	Percent of Cases
Regular	$Coping_Post[a]	Stressabbau: Ich habe keinen Stress	6	8.7%	25.0%
		Stressabbau: Mit Freunden oder Familie treffen	15	21.7%	62.5%
		Stressabbau: Spazieren gehen / rausgehen	14	20.3%	58.3%
		Stressabbau: Sport treiben	12	17.4%	50.0%
		Stressabbau: Im Internet surfen oder Videospiele spielen	4	5.8%	16.7%
		Stressabbau: Fernsehen	9	13.0%	37.5%
		Stressabbau: Entspannungstechniken (Yoga, autogenes Training, etc.)	7	10.1%	29.2%
		Stressabbau: Ein Glas Wein oder Bier trinken	1	1.4%	4.2%
		Stressabbau: Cannabis konsumieren	1	1.4%	4.2%
	Total		69	100.0%	287.5%
Not regular	$Coping_Post[a]	Stressabbau: Ich habe keinen Stress	1	9.1%	33.3%
		Stressabbau: Mit Freunden oder Familie treffen	2	18.2%	66.7%
		Stressabbau: Spazieren gehen / rausgehen	2	18.2%	66.7%
		Stressabbau: Sport treiben	2	18.2%	66.7%
		Stressabbau: Im Internet surfen oder Videospiele spielen	1	9.1%	33.3%
		Stressabbau: Fernsehen	1	9.1%	33.3%
		Stressabbau: Entspannungstechniken (Yoga, autogenes Training, etc.)	1	9.1%	33.3%
		Stressabbau: Ein Glas Wein oder Bier trinken	1	9.1%	33.3%
	Total		11	100.0%	366.7%
Control	$Coping_Post[a]	Stressabbau: Ich habe keinen Stress	1	5.3%	14.3%
		Stressabbau: Mit Freunden oder Familie treffen	4	21.1%	57.1%
		Stressabbau: Spazieren gehen / rausgehen	1	5.3%	14.3%
		Stressabbau: Sport treiben	3	15.8%	42.9%
		Stressabbau: Im Internet surfen oder Videospiele spielen	3	15.8%	42.9%
		Stressabbau: Fernsehen	2	10.5%	28.6%
		Stressabbau: Entspannungstechniken (Yoga, autogenes Training, etc.)	2	10.5%	28.6%
		Stressabbau: Ein Glas Wein oder Bier trinken	1	5.3%	14.3%
		Stressabbau: Cannabis konsumieren	2	10.5%	28.6%
	Total		19	100.0%	271.4%

a. Dichotomy group tabulated at value 1.

Tests for Normal Distribution (Research Question 1)

Test for Normal Distribution in Metric Variables (Participant Group; n = 24)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PhysicalActivityDifference	.201	24	.013	.914	24	.043
SWB_Difference	.109	24	.200*	.954	24	.323

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Test for Normal Distribution in Metric Variables (Control Group; n = 7)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PhysicalActivityDifference	.227	7	.200*	.884	7	.243
SWB_Difference	.223	7	.200*	.902	7	.340

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Test Results for Participants (n = 24) for Research Question 1

Wilcoxon Signed-Rank Test (Participants; n = 24) – Physical Activity.

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	24
Test Statistic	231.000
Standard Error	34.998
Standardized Test Statistic	2.314
Asymptotic Sig.(2-sided test)	.021

Ranks

		N	Mean Rank	Sum of Ranks
PA Level MET/Minutes/Week Post – PA Level MET/Minutes/Week PRE	Negative Ranks	7[a]	9.86	69.00
	Positive Ranks	17[b]	13.59	231.00
	Ties	0[c]		
	Total	24		

a. PA Level MET/Minutes/Week Post < PA Level MET/Minutes/Week PRE
b. PA Level MET/Minutes/Week Post > PA Level MET/Minutes/Week PRE
c. PA Level MET/Minutes/Week Post = PA Level MET/Minutes/Week PRE

Wilcoxon Signed-Rank Test (Participants; n = 24) – Stress Level.

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	24
Test Statistic	15.000
Standard Error	20.597
Standardized Test Statistic	-2.986
Asymptotic Sig.(2-sided test)	.003

Ranks

		N	Mean Rank	Sum of Ranks
Stress Level Post – Stress Level Pre	Negative Ranks	14[a]	9.86	138.00
	Positive Ranks	3[b]	5.00	15.00
	Ties	7[c]		
	Total	24		

a. Stress Level Post < Stress Level Pre
b. Stress Level Post > Stress Level Pre
c. Stress Level Post = Stress Level Pre

Dependent T-Test (Participants; n = 24) – Subjective Well-Being.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	SWB WHO5 Score Post	17.83	24	3.017	.616
	SWB WHO5 Score Pre	13.33	24	3.345	.683

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	SWB WHO5 Score Post & SWB WHO5 Score Pre	24	.200	.175	.350

Paired Samples Test

		Paired Differences					t	df	Significance One-Sided p	Significance Two-Sided p
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper				
Pair 1	SWB WHO5 Score Post – SWB WHO5 Score Pre	4.500	4.032	.823	2.797	6.203	5.467	23	<.001	<.001

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval Lower	95% Confidence Interval Upper
Pair 1	SWB WHO5 Score Post – SWB WHO5 Score Pre	Cohen's d	4.032	1.116	.596	1.621
		Hedges' correction	4.170	1.079	.576	1.568

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Test Results for Controls (n = 7) for Research Question 1

Dependent T-Test (Controls; n = 24) – Physical Activity and Subjective Well-Being.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	SWB WHO5 Score Post	17.71	7	3.638	1.375
	SWB WHO5 Score Pre	15.14	7	3.132	1.184
Pair 2	PA Level MET/Minutes/Week Post	4692.86	7	2471.219	934.033
	PA Level MET/Minutes/Week PRE	3567.4286	7	2969.99567	1122.55285

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	SWB WHO5 Score Post & SWB WHO5 Score Pre	7	.180	.350	.700
Pair 2	PA Level MET/Minutes/Week Post & PA Level MET/Minutes/Week PRE	7	.632	.064	.128

Paired Samples Test

		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			One-Sided p	Two-Sided p
Pair 1	SWB WHO5 Score Post – SWB WHO5 Score Pre	2.571	4.353	1.645	-1.455	6.598	1.563	6	.085	.169
Pair 2	PA Level MET/Minutes/Week Post – PA Level MET/Minutes/Week PRE	1125.42857	2377.11238	898.46403	-1073.03371	3323.89085	1.253	6	.128	.257

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval Lower	Upper
Pair 1	SWB WHO5 Score Post – SWB WHO5 Score Pre	Cohen's d	4.353	.591	-.239	1.380
		Hedges' correction	5.012	.513	-.207	1.199
Pair 2	PA Level MET/Minutes/Week Post – PA Level MET/Minutes/Week PRE	Cohen's d	2377.112	.473	-.329	1.242
		Hedges' correction	2736.633	.411	-.286	1.079

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Wilcoxon Signed-Rank Test (Controls; n = 7) – Stress Level.

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	7
Test Statistic	1.500
Standard Error	4.743
Standardized Test Statistic	-1.897
Asymptotic Sig.(2-sided test)	.058

Ranks

		N	Mean Rank	Sum of Ranks
Stress Level Post – Stress Level Pre	Negative Ranks	5[a]	3.90	19.50
	Positive Ranks	1[b]	1.50	1.50
	Ties	1[c]		
	Total	7		

a. Stress Level Post < Stress Level Pre
b. Stress Level Post > Stress Level Pre
c. Stress Level Post = Stress Level Pre

Supplementary Output for Research Question 2

Spearman Correlation Analysis Results

Correlations

			Correct Metric Variable	PA Level MET/Minutes/ Week PRE	PA Level MET/Minutes/ Week Post	PhysicalActivityDifference	Stress Level Pre	Stress Level Post	Stress_Difference	SWB WHO5 Score Pre	SWB WHO5 Score Post	SWB_Difference
Spearman's rho	Correct Metric Variable	Correlation Coefficient	1.000	−.320	−.512**	−.103	−.146	−.197	−.075	−.189	.104	.218
		Sig. (2-tailed)	.	.065	.002	.562	.409	.265	.673	.283	.558	.215
		N	34	34	34	34	34	34	34	34	34	34
	PA Level MET/Minutes/Week PRE	Correlation Coefficient	−.320	1.000	.551**	−.456**	−.027	.243	.272	.472**	−.146	−.525**
		Sig. (2-tailed)	.065	.	<.001	.007	.880	.167	.120	.005	.409	.001
		N	34	34	34	34	34	34	34	34	34	34
	PA Level MET/Minutes/Week Post	Correlation Coefficient	−.512**	.551**	1.000	.332	.223	.028	−.068	.340*	.245	−.077
		Sig. (2-tailed)	.002	<.001	.	.055	.206	.874	.700	.049	.162	.664
		N	34	34	34	34	34	34	34	34	34	34
	PhysicalActivityDifference	Correlation Coefficient	−.103	−.456**	.332	1.000	.171	−.206	−.280	−.211	.285	.440**
		Sig. (2-tailed)	.562	.007	.055	.	.333	.243	.109	.230	.103	.009
		N	34	34	34	34	34	34	34	34	34	34
	Stress Level Pre	Correlation Coefficient	−.146	−.027	.223	.171	1.000	.129	−.495**	−.330	.020	.284
		Sig. (2-tailed)	.409	.880	.206	.333	.	.466	.003	.057	.913	.103
		N	34	34	34	34	34	34	34	34	34	34
	Stress Level Post	Correlation Coefficient	−.197	.243	.028	−.206	.129	1.000	.780**	−.013	−.320	−.237
		Sig. (2-tailed)	.265	.167	.874	.243	.466	.	<.001	.942	.065	.178
		N	34	34	34	34	34	34	34	34	34	34
	Stress_Difference	Correlation Coefficient	−.075	.272	−.068	−.280	−.495**	.780**	1.000	.193	−.257	−.362*
		Sig. (2-tailed)	.673	.120	.700	.109	.003	<.001	.	.273	.143	.035
		N	34	34	34	34	34	34	34	34	34	34
	SWB WHO5 Score Pre	Correlation Coefficient	−.189	.472**	.340*	−.211	−.330	−.013	.193	1.000	.257	−.595**
		Sig. (2-tailed)	.283	.005	.049	.230	.057	.942	.273	.	.142	<.001
		N	34	34	34	34	34	34	34	34	34	34
	SWB WHO5 Score Post	Correlation Coefficient	.104	−.146	.245	.285	.020	−.320	−.257	.257	1.000	.587**
		Sig. (2-tailed)	.558	.409	.162	.103	.913	.065	.143	.142	.	<.001
		N	34	34	34	34	34	34	34	34	34	34
	SWB_Difference	Correlation Coefficient	.218	−.525**	−.077	.440**	.284	−.237	−.362*	−.595**	.587**	1.000
		Sig. (2-tailed)	.215	.001	.664	.009	.103	.178	.035	<.001	<.001	.
		N	34	34	34	34	34	34	34	34	34	34

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Supplementary Output for Research Question 3

Spearman Correlation Analysis Results

Correlations

			Completed Course Units	Fun doing PA	Subjective Health Status PRE	PA Level MET/Minutes/ Week PRE	SWB WHO5 Score Pre	Stress Pre
Spearman's rho	Completed Course Units	Correlation Coefficient	1.000	-.318*	-.358*	-.306*	-.117	-.130
		Sig. (2-tailed)	.	.033	.016	.041	.444	.393
		N	45	45	45	45	45	45
	Fun doing PA	Correlation Coefficient	-.318*	1.000	.402**	.398**	.246	-.045
		Sig. (2-tailed)	.033	.	.006	.007	.104	.769
		N	45	45	45	45	45	45
	Subjective Health Status PRE	Correlation Coefficient	-.358*	.402**	1.000	.634**	.429**	-.102
		Sig. (2-tailed)	.016	.006	.	<.001	.003	.505
		N	45	45	45	45	45	45
	PA Level MET/Minutes/Week PRE	Correlation Coefficient	-.306*	.398**	.634**	1.000	.401**	-.158
		Sig. (2-tailed)	.041	.007	<.001	.	.006	.299
		N	45	45	45	45	45	45
	SWB WHO5 Score Pre	Correlation Coefficient	-.117	.246	.429**	.401**	1.000	-.420**
		Sig. (2-tailed)	.444	.104	.003	.006	.	.004
		N	45	45	45	45	45	45
	Stress Pre	Correlation Coefficient	-.130	-.045	-.102	-.158	-.420**	1.000
		Sig. (2-tailed)	.393	.769	.505	.299	.004	.
		N	45	45	45	45	45	45

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Point-biserial Correlation Analysis Results (Dummy Variables)

Correlations

		Completed Course Units	Dummy for Age	Dummy for Gender	Dummy for Study Course	Dummy for Exergames
Completed Course Units	Pearson Correlation	1	.014	.280	.000	.133
	Sig. (2-tailed)		.927	.063	1.000	.383
	N	45	45	45	45	45
Dummy for Age	Pearson Correlation	.014	1	-.283	-.100	.094
	Sig. (2-tailed)	.927		.059	.513	.537
	N	45	45	45	45	45
Dummy for Gender	Pearson Correlation	.280	-.283	1	.283	.161
	Sig. (2-tailed)	.063	.059		.059	.292
	N	45	45	45	45	45
Dummy for Study Course	Pearson Correlation	.000	-.100	.283	1	.000
	Sig. (2-tailed)	1.000	.513	.059		1.000
	N	45	45	45	45	45
Dummy for Exergames	Pearson Correlation	.133	.094	.161	.000	1
	Sig. (2-tailed)	.383	.537	.292	1.000	
	N	45	45	45	45	45

Point-biserial Correlation Analysis Results (Reason for Inactivity, Reason for Stress, Coping Measures)

Correlations

		Completed Course Units
Ursachen Inaktivität: Ich bin körperlich aktiv und treibe Sport	Pearson Correlation	.031
	Sig. (2-tailed)	.838
	N	45
Ursachen Inaktivität: Zeitmangel	Pearson Correlation	.091
	Sig. (2-tailed)	.551
	N	45
Ursachen Inaktivität: Fehlende Motivation	Pearson Correlation	-.120
	Sig. (2-tailed)	.433
	N	45
Ursachen Inaktivität: Gesundheitliche Einschränkungen	Pearson Correlation	-.387
	Sig. (2-tailed)	.009
	N	45
Ursachen Inaktivität: Mangelnder Zugang zu Sporteinrichtungen	Pearson Correlation	.150
	Sig. (2-tailed)	.324
	N	45
Ursachen Inaktivität: Unbehagen beim Sport	Pearson Correlation	.218
	Sig. (2-tailed)	.151
	N	45
Ursachen Inaktivität: Mangelnde soziale Unterstützung	Pearson Correlation	.124
	Sig. (2-tailed)	.415
	N	45

Correlations

		Completed Course Units
Stressursachen: Ich habe keinen Stress	Pearson Correlation	-.165
	Sig. (2-tailed)	.278
	N	45
Stressursachen: Prüfungen	Pearson Correlation	.141
	Sig. (2-tailed)	.356
	N	45
Stressursachen: Angst vor schlechten Noten	Pearson Correlation	.113
	Sig. (2-tailed)	.461
	N	45
Stressursachen: Zu schwieriger oder zu umfangreicher Lernstoff	Pearson Correlation	-.075
	Sig. (2-tailed)	.624
	N	45
Stressursachen: Fehlende Rückzugsmöglichkeiten an der Hochschule	Pearson Correlation	-.165
	Sig. (2-tailed)	.278
	N	45
Stressursachen: Digitale Lehre	Pearson Correlation	.
	Sig. (2-tailed)	.
	N	45
Stressursachen: Finanzielle Sorgen	Pearson Correlation	.332
	Sig. (2-tailed)	.026
	N	45
Stressursachen: Die Mehrfachbelastung durch Studium und nebenbei arbeiten	Pearson Correlation	.076
	Sig. (2-tailed)	.617
	N	45
Stressursachen: Die Mehrfachbelastung durch Studium und Familie	Pearson Correlation	.098
	Sig. (2-tailed)	.520
	N	45
Stressursachen: Schlechte zeitliche Verteilung von Lehrveranstaltungen	Pearson Correlation	.021
	Sig. (2-tailed)	.889
	N	45
Stressursachen: Private Konflikte	Pearson Correlation	.057
	Sig. (2-tailed)	.712
	N	45

Correlations

		Completed Course Units
Stressabbau: Ich habe keinen Stress	Pearson Correlation	-.165
	Sig. (2-tailed)	.278
	N	45
Stressabbau: Mit Freunden oder Familie treffen	Pearson Correlation	-.009
	Sig. (2-tailed)	.954
	N	45
Stressabbau: Spazieren gehen / rausgehen	Pearson Correlation	.138
	Sig. (2-tailed)	.366
	N	45
Stressabbau: Sport treiben	Pearson Correlation	.182
	Sig. (2-tailed)	.233
	N	45
Stressabbau: Im Internet surfen oder Videospiele spielen	Pearson Correlation	-.203
	Sig. (2-tailed)	.180
	N	45
Stressabbau: Fernsehen	Pearson Correlation	.128
	Sig. (2-tailed)	.401
	N	45
Stressabbau: Entspannungstechniken (Yoga, autogenes Training, etc.)	Pearson Correlation	.227
	Sig. (2-tailed)	.134
	N	45
Stressabbau: Ein Glas Wein oder Bier trinken	Pearson Correlation	.098
	Sig. (2-tailed)	.523
	N	45
Stressabbau: Rauchen (jegliche Form ? Zigarette, E-Zigarette, Shisha, etc.)	Pearson Correlation	-.086
	Sig. (2-tailed)	.576
	N	45
Stressabbau: Cannabis konsumieren	Pearson Correlation	-.160
	Sig. (2-tailed)	.295
	N	45
Stressabbau: Ein Beruhigungsmittel nehmen	Pearson Correlation	.
	Sig. (2-tailed)	.
	N	45

Supplementary Output for Research Question 5

Spearman Correlation Analysis Results

Correlations

			Correct Metric Variable	Effectiveness PA	Effectiveness Stress	Effectiveness Physical Well-Being	Effectiveness Mental Well-Being	Fun PA Post	Effectiveness Motivation
Spearman's rho	Correct Metric Variable	Correlation Coefficient	1.000	.522**	.367	.020	.130	-.178	.345
		Sig. (2-tailed)	.	.005	.060	.923	.518	.375	.078
		N	27	27	27	27	27	27	27
	Effectiveness PA	Correlation Coefficient	.522**	1.000	.644**	.636**	.588**	-.227	.828**
		Sig. (2-tailed)	.005	.	<.001	<.001	.001	.256	<.001
		N	27	27	27	27	27	27	27
	Effectiveness Stress	Correlation Coefficient	.367	.644**	1.000	.387*	.340	-.157	.550**
		Sig. (2-tailed)	.060	<.001	.	.046	.082	.434	.003
		N	27	27	27	27	27	27	27
	Effectiveness Physical Well-Being	Correlation Coefficient	.020	.636**	.387*	1.000	.808**	-.253	.704**
		Sig. (2-tailed)	.923	<.001	.046	.	<.001	.203	<.001
		N	27	27	27	27	27	27	27
	Effectiveness Mental Well-Being	Correlation Coefficient	.130	.588**	.340	.808**	1.000	-.350	.626**
		Sig. (2-tailed)	.518	.001	.082	<.001	.	.073	<.001
		N	27	27	27	27	27	27	27
	Fun PA Post	Correlation Coefficient	-.178	-.227	-.157	-.253	-.350	1.000	-.286
		Sig. (2-tailed)	.375	.256	.434	.203	.073	.	.147
		N	27	27	27	27	27	27	27
	Effectiveness Motivation	Correlation Coefficient	.345	.828**	.550**	.704**	.626**	-.286	1.000
		Sig. (2-tailed)	.078	<.001	.003	<.001	<.001	.147	.
		N	27	27	27	27	27	27	27

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix VI: Documentation of used AI-tools

Table 3: Documentation of AI-tools.

AI-tool	Used for	Why	When	Link
DeepL / DeepL Write (free versions)	DeepL: Translation from German texts into English DeepL Write: Searching for synonyms and alternative formulations	DeepL: Translation of articles and other information and decide on usage DeepLWrite: To avoid using the same words and formulations	DeepL: Documenting and assessing qualitative data, which were collected on German and had to be translated into English - a translator was used to avoid mistranslations + For literature research and selection DeepL Write: When the same phrases were used too frequently and there was a need for alternative vocabulary. No passages within this thesis were generated by AI.	https://www.deepl.com/de/translator + https://www.deepl.com/de/write *It was not possible to provide documentation since DeepL does not save all of the individual outputs.* *If required, the use of DeepL can be explained in more detail by the researcher on request.*
Scribbr	Plagiarism Check	Review of eventual and unintended plagiarism in the Master thesis - no significant changes were made after the check	24.10.2024	Premium-Plagiarism-Check Number 5047732 *(Can be sent upon request)*

Declaration of Academic Honesty

I declare that I have specifically marked all passages in this written thesis that are taken verbatim from other authors, as well as the explanations of my work that are closely based on the ideas of other authors, and that I have cited the corresponding sources. In addition, I assure that when using AI-supported writing tools, I have listed these tools in full in the section “Documentation of used AI-tools” with their product name, the source of supply and information on the functions of the software used and the scope of use. Excluded from this are those AI-supported writing tools that were classified as non-notifiable by my responsible examination office up to the time of submission of my thesis. During the whole process of the creation of this thesis, I worked independently throughout and retained control over the use of AI-supported writing tools.

Hamburg, the _____