Truls Torvik

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Truls Torvik

NTNU
Norwegian University of
Science and Technology
Faculty of Social and Educational Sciences
Department of Sociology and Political Science

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Truls Torvik

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Supervisor: Ingar Mehus
Co-supervisor: Silvana Bucher Sandbakk

Norwegian University of Science and Technology
Department of Sociology and Political Science

Abstract

Background: Physical activity is associated with reduced risk of noncommunicable diseases such as obesity, and mortality, even though this seems to be commonly known, more and more people struggles with reaching the activity levels recommended by national and international guidelines. Exercise self-efficacy has in many studies been shown to be a valid predictor of behavior change towards an active/non-sedentary lifestyle. Using mHealth services to self-monitor activity levels and promote physical activity is an innovative approach that needs further assessment.

Objective: The aim of this master thesis was to test if the implementation of a mHealth behavior change tool in an exercise intervention would encourage exercise self-efficacy and increase levels of physical activity.

Methods: The study was a two-arm randomized controlled trial in 26 previously inactive adults. The study group was given access to an activity-watch and an app for self-monitoring and motivation for physical activity, while the control group received standard care, i.e. instructions to follow national guidelines for physical activity without further supervision. The endpoints in this study was assessed by a questionnaire put together of scales assessing the different outcomes. The scales was the Exercise Self-Efficacy Scale (ESES), HUNT 1 PA-Q and Quality of Life 5 (N-QoL5) at baseline and after 3 weeks.

Results: Repeated measures ANOVA revealed no statistically significant effect of the intervention on exercise self-efficacy (study group insignificant increase from 6.52±1.49 to 6.94±1.58 ($p=0.255$), against the control groups insignificant decrease from 6.22±1.80 to 5.83±1.69 ($p=0.229$). The between-group effect in exercise self-efficacy during the intervention was insignificant ($p>0.103$). For physical activity-levels no significant between-group differences was found ($p>0.449$). But a significant change was measured with time ($p<0.005$). With simple effects testing it was found that the study group increased their physical activity-levels ($p<0.012$) significantly. No effects were found for secondary outcome quality of life.

Conclusion: This study showed no statistically significant increase in exercise self-efficacy, the study group increased their physical activity levels because of their increase in frequency of sessions and not because of an increase in intensity of training.

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1.0 Introduction

In recent decades physical inactivity and a sedentary lifestyle have been associated with increased risk of chronic diseases, particularly diabetes and cardiovascular diseases (Van der Ploeg, Chey, Korda, Banks, & Bauman, 2012; Wilmot et al., 2012). The Norwegian Directorate of Health and the World Health Organization recommend at least 150 minutes of moderate-intensity physical activity per week, or 75 minutes of vigorous-intensity exercise per week should be done to improve cardiorespiratory and muscular fitness, bone health and prevent the risk of non-communicative diseases and depression (World Health Organization, 2010). Worldwide, 23% of the adult population do not meet the physical activity requirements (World Health Organization, 2019a). Therefore, to find modern effective strategies to increase participation in physical activity is an essential public health objective.

Smartphone apps have a high potential and can be a promising approach to increase adherence to physical activity recommendations. Worldwide, activated mobile phones are more numerous than citizens, with around 63% of the global adult population possessing at least one smartphone in 2017 (Romeo et al., 2019). Smartphones are relatively inexpensive and allow users to engage with health information technology in any environment and at any time (Sarasohn-Kahn, 2010). They are equipped with advanced technological features, most notably their internet connection, GPS and inbuilt accelerometers (Wu, Dasgupta, Ramirez, Peterson, & Norman, 2012). Smartphones also include the feature of creating individualized and interactive apps that collect real-time data is present (Riley et al., 2011). These features, together with the high usage and convenience of smartphones, make them an attractive tool for researchers to deliver physical activity interventions. The effects of mobile health (mHealth) services on behavior change have caught the attention of scientists and practitioners, primarily to alter motivation and change behavior in many fields. mHealth is the use of information and communication technologies to promote health.

This study implemented the mHealth behavior change application with the aim of improving exercise self-efficacy and promoting physical activity. Self-efficacy is widely studied in clinical, educational, sporting and other areas, and is defined as people's judgment of their own capabilities to organize and execute specific behavior or actions (Bandura, 1977). Self-efficacy is claimed to be a strong great predictor of adherence to exercise programs (McAuley, Courneya, Rudolph, & Lox, 1994). The theory of self-efficacy is built upon the belief that people generally try challenges or tasks they believe they can accomplish, and that they will not try if they believe they will fail (Bandura, 1977).

2.0 Physical activity

"*Physical activity is defined as every movement that is produced by contraction of the skeletal muscle and that substantially increases energy expenditure"* (Caspersen, Powell, & Christenson, 1985, p. 126). Physical activity is part of everyday life and is classified as behavior. Walking, mowing the lawn, cleaning the house etc., as well as sport and exercise, are all examples of physical activity. The national guidelines for physical activity in Norway state that adults and older people should be active for at least 150 min with moderate intensity or 75 minutes at high intensity per week (Helsedirektoratet, 2019). Objectively registered physical activity shows that one out of three (32%) Norwegians over 20 years adheres to the minimum recommendations for physical activity of the Norwegian Directorate of health. The analysis conducted by the Directorate shows some socioeconomic and gender differences. These results are most crucial for men, in that men with only compulsory school perform almost half the activity of those with the highest education (Helsedirektoratet, 2016).

2.1 Benefits of physical activity

Physical activity is one of the most important actions individuals of all ages can conduct to enhance their own health. In the USA, an estimated 117 billion US dollars in yearly health care costs and about 10 percent of premature mortality are associated with inadequate physical activity (Carlson, Adams, Yang, & Fulton, 2018; Carlson, Fulton, Pratt, Yang, & Adams, 2015; Lee et al., 2012). The Physical Activity Guidelines (PAG) for Americans, 2nd edition (Piercy et al., 2018) explicitly state that physical activity promotes normal growth and development and can make people feel, function and sleep better and reduce the risk of many chronic diseases. Some health benefits can start instantly after physical activity, and even short or small amounts physical activity are profitable. Additionally, research shows that nearly everyone benefits: males or females of all races and ethnicities, young children to older adults, women who are pregnant or postpartum, people living with a chronic condition or a disability and people who want to reduce their risk of disease. The evidence of regular physical activity is well established and research continues to provide evidence into what works to increase physical activity, at both the individual and the community levels (Piercy et al., 2018).

Research into physical activity and health throughout the lifecycle suggests that the health status of physically active people is much better than those who are physically inactive (Dalene, Nystad, & Ekelund, 2019). Physical activity has been shown to give a string of health benefits for adults and can prevent metabolic syndrome, type 2 diabetes, cardio-vascular disease, several forms of cancer and premature death (Arem et al., 2015; Moore et al., 2016; Rasmussen et al., 2016; Zhang et al., 2017). Several large meta-analysis of studies including self-reported physical activity show a prospective association with premature mortality (Arem et al., 2015; Ekelund, Brown, et al., 2019; Ekelund et al., 2016; O'Donovan, Lee, Hamer, & Stamatakis, 2017). These results were also harmonized by a new meta-analysis where physical activity was measured with an accelerometer, which strengthens the evidence (Ekelund, Tarp, et al., 2019). This study showed that the relationship between physical activity and premature death is much stronger than previously believed. The study also showed that even low-intensity physical activity, such as for light walking, helps reducing the risk for premature death, and that the total amount of physical activity seems to be more important than the intensity of the physical activity.

Many short-term Randomized Controlled Trials (RCTs) with healthy subjects and with patients with myocardial infarction have found some evidence for benefits of physical activity on myocardial infarction risk markers and surrogate endpoints. However, there is a notable lack of high-quality RCTs on long-term effects of physical activity on mortality and morbidity in both healthy and myocardial infarction populations (Belardinelli, Georgiou, Cianci, & Purcaro, 1999; O'Connor et al., 2009; Wing et al., 2013).

One RCT compared group-mediated cognitive behavioral interventions (which included training on how to identify and overcome barriers to being active to encourage self-regulation), with a traditional exercise-based cardiac rehabilitation program. The study showed that those in the cognitive behavioral intervention group showed a greater increase in fitness, and better adherence to an active lifestyle, than the traditional cardiac rehabilitation exercise group. It was also shown that the intervention group had a greater increase in self-efficacy at post-intervention (Rejeski et al., 2003). Therefore, targeted behavior training that includes increasing self-efficacy and assisting patients and participants to identify and overcome barriers to being active may be proven invaluable to cardiac rehabilitation and exercise programs. Additionally, action planning, reinforcing efforts towards the desired behavior, and providing instruction have been shown to be effective in ensuring adherence and long-term maintenance of physical activity (Foster, Munoz, Crabtree, Leslie, & Gorely, 2019).

The association between physical activity and overweight/obesity is complex because the body weight is affected by energy-intake. The association can be seen from the different aspects: (1) prevent weight-gain, (2) losing weight, and (3) preventing weight-gain after weight loss. Recent research has shown that physical activity levels need to be two to three times higher than the general recommendations to reach meaningful effects in all of these three perspectives (Ekelund et al., 2017; Swift, Johannsen, Lavie, Earnest, & Church, 2014; Swift et al., 2018). But it is also important to underline that physical activity has positive effects on cardiometabolic risk factors and reduces the risk of early death in overweight (BMI 25.0-29.9) or obese (BMI > 30) persons, even if body weight does not decline (Ekelund et al., 2015; Swift et al., 2018). The “fat but fit”-paradox suggests that there is emerging evidence to indicate that a moderate to high cardiorespiratory fitness might counteract the negative effects of obesity on many health outcomes (Ortega, Ruiz, Labayen, Lavie, & Blair, 2018).

A systematic review of 12 cohort studies from the USA and Europe (1.44 million participants) concluded that leisure-time physical activity was associated with reduced risk of many types of cancer. It is important to emphasize that in this study these results were regardless of body size or smoking history, which supports the generalizability of these findings (Moore et al., 2016).

Physical activity with high intensity, and especially strength-training, is essential to reach optimal bone mass in the age of 20s and 30s, and thereafter prevent the age-related reduction in bone mineral density and preventing osteoporosis and osteoporotic fractures (Piercy et al., 2018).

Even though the evidence base is somewhat weaker, it has been shown that regular physical activity can reduce the risk for depression and reduce the scope of depressive symptoms (Piercy et al., 2018). Further, it seems to increase stress management and improve the quality of sleep. It is also possible that physical activity can reduce the risk for dementia, but questions have been raised around the strength of these findings. A study by Kivimäki et al. (2019), which included more than 400 000 persons, showed that the physical activity earlier in life did not prevent people from getting dementia and that early stages of dementia lead to reduced physical activity.

For the older population (>65 years), in addition to the same health benefits as for younger adults, it is very important to underline that physical activity is crucial for maintaining and improving endurance, muscular strength and balance at elder. This can help prevent falls, improve everyday functions such as getting up from a chair and increasing walking speed (De Vries et al., 2012; Gillespie et al., 2012; Giné-Garriga, Roqué-Fíguls, Coll-Planas, Sitja-

Rabert, & Salvà, 2014). It has been shown that individual training decreases the loss of physical function in older people (Frändin et al., 2016) and several meta-analysis of RCTs have shown that training reduces the risks for falls and the number of falls in seniors (El-Khoury, Cassou, Charles, & Dargent-Molina, 2013; Guirguis-Blake, Michael, Perdue, Coppola, & Beil, 2018; Sherrington et al., 2019; Tricco et al., 2017). One meta-analysis found that training reduced the fall rate in the older people by 23% (Sherrington et al., 2019).

In general, it is important to emphasize that relatively minor increases in physical activity in inactive individuals will lead to significant reductions in the risk for chronic disease and mortality (Warburton & Bredin, 2016). A sedentary (from the Latin sedere, "to sit") lifestyle leads to very low metabolic rates. Sedentary behaviors such as watching TV or sitting in an a vehicle typically involve low levels of energy expenditure in the range of 1.0 to 1.5 METs. Scientists have begun to focus on the physiological, medical and public health impact of extensive sitting. Relative to the large body of knowledge about the acute and chronic effects of exercise, there is very little research on the cellular signals, physiological responses, and disease outcomes caused by prolonged sitting and sedentary behaviors.

Non-exercise activity thermogenesis (heat production) is generally a much greater component of total energy expenditure than exercise and any type of brief, yet frequent, muscular contraction throughout the day may be necessary to short-circuit unhealthy molecular signals causing metabolic diseases.

After decades of studying physical activity we know that it has positive effects, but we may then ask why people do not follow the global and national recommendations for physical activity.

2.2 PAI

Personalized activity intelligence (PAI), is an easily understandable metric of physical activity. PAI has been developed with the aim of quantifying how much activity is needed each week to reduce the risk of premature cardiovascular disease. PAI is associated with reduced risk of premature death from all causes and especially from cardiovascular disease, which is the leading cause of death in the world (Abubakar, Tillmann, & Banerjee, 2015). Obtaining a value of 100 PAI per week gave a similar reduction in risk of dying regardless of meeting the current recommendations for physical activity. PAI can be incorporated in self-assessment heart rate devices to self-monitor the activity levels needed to achieve maximum health benefits (Nes, Gutvik, Lavie, Nauman, & Wisløff, 2017). PAI is an algorithm derived from the HUNT Fitness Study (n = 4631), and was validated against the general HUNT population (n = 39,298) aged 20-74 years. The PAI was divided into three sex-specific groups (<50, 51-99 and >100), and an inactive group (0 PAI) was used as the reference. PAI may have a huge potential to motivate people to become and remain physically active, as it is an easily understandable and scientifically proven metric that could inform potential users of how much physical activity is needed to reduce the risk of premature cardiovascular disease and death (Nes et al., 2017).

3.0 Self-efficacy

The late 1970s saw a change of focus in health psychology toward Bandura's social-cognitive theory (SCT) and more precise self-efficacy. Until the late 70s, the focus was mainly around learning through the consequences of one's own actions (Luszczynska & Schwarzer, 2005). Self-efficacy is defined as people's judgment of their own capabilities to organize and execute a specific behavior or action, and the theory is built upon the belief that people generally try challenges or tasks they believe they can accomplish, and that they will not try if they believe they will fail. Self-efficacy is the key construction in SCT. People with a strong feeling of self-efficacy might have the belief in accomplishment in many situations. A strong feeling of self-efficacy and the belief in accomplishment rather than failure can reduce stress and the risk of depression (Bandura, 1997). Bandura points out that a strong sense of personal efficacy is related to better health, higher achievements, and more social integration. By contrast, people with lower self-efficacy may doubt their ability to succeed in specific situations or tasks, and may see them as threats. Bandura claims that even small barriers can make people with low self-efficacy avoid tasks and will thus prevent them from accomplishing tasks. With a low self-efficacy, it is easy to give up and lose faith in own capabilities.

Bandura highlights self-efficacy as the most important factor for behavioral change. According to Bandura (1997), behavior change is facilitated by an individual sense of control. Bandura (1997) then argues that high self-efficacy can create an optimistic view of one's own capability to deal with stress, tasks or specific behavior. It shows a greater feeling of control over one's environment and the ability to master challenges. On the other hand, people with low perceived self-efficacy will often have pessimistic thoughts about their accomplishments, and this is often associated with depression, anxiety, and helplessness. Self-efficacy affects how a person interprets situations here and now, and it also affects how people visualize and construct future situations (Bandura, 1997). Perceived ability in a task may enhance or disrupt the motivation to act or perform a behavior. Self-efficacy affects the intention for behavioral change. It has an effect on working towards a specific goal, and having the stamina to keep trying when encountering barriers or setbacks (Schwarzer & Fuchs, 1995). Patients may experience challenges both due to the symptoms and the uncertainty of their illness. This may affect their self-efficacy in terms of being physically, reaching goals or change their behavior by improving their coping strategies. Self-efficacy expectations can be subject to external and internal influences and are therefore a suitable target for manipulation and intervention strategies (McAuley, Mailey, Szabo, & Gothe, 2013). The self-efficacy theory was proposed to account for the different results achieved by diverse methods used in clinical psychology for the treatment of anxiety (McAuley, 1992). Since then it has expanded into covering several domains of psychological functioning, including health behavior and physical activity, as well as in sport and exercise. McAuley and Mihalko (1998) suggest that different types of self-efficacy can generally be divided into two wide categories or components of the self-efficacy construction: one is a task component and the other a regulatory component. The individuals belief in his/hers ability to perform a specific behavior is the task component. Task self-efficacy in relation to physical activity has been commonly measured using items asking about belief in one's ability to adhere to physical activity at different levels of intensity, frequency and duration (exercise self-efficacy) (Kosteli, Cumming, & Williams, 2018). The regulatory component of self-efficacy refers to beliefs in one's ability to cope with difficulties built into the performance of complex behavior. Regulatory self-efficacy for physical activity has commonly been measured using questionnaires about belief in one's ability to be active despite common barriers to physical activity such as bad weather and fatigue (barriers efficacy) (Kosteli et al., 2018).

3.1 Sources of perceived self-efficacy

Self-efficacy is highly changeable, and perceived self-efficacy may vary due to different variables such as mood, environment or encouragement (Bandura, 1997). He identifies four main ways in which self-efficacy can be affected. Self-efficacy could be learned through personal experience (mastery experience), or by seeing others perform (social modeling); it may also be affected by one's and physical/emotional state and by verbal persuasion (Bandura, 1997; Stroebe, Jonas, & Hewstone, 1988).

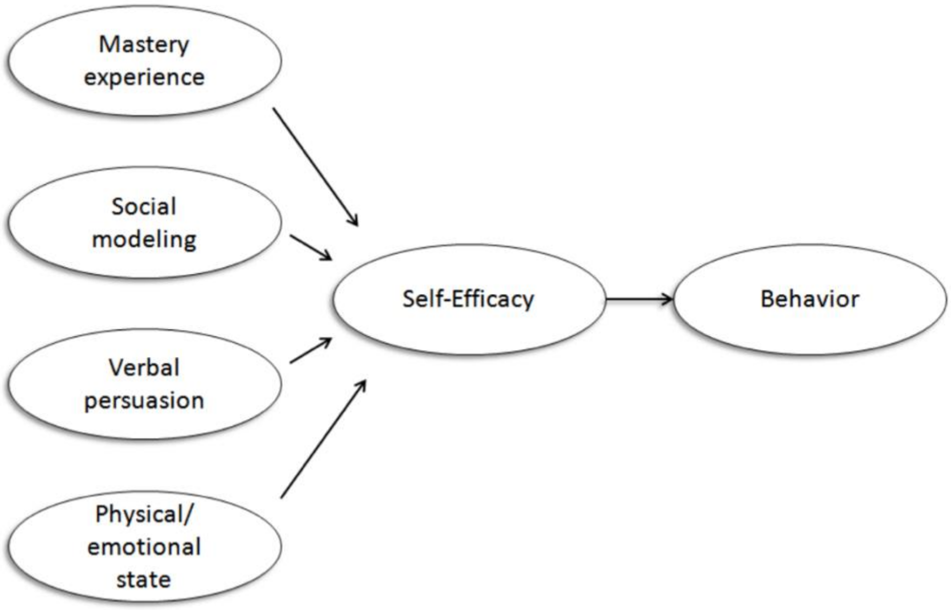

Figure 1: Illustration of the elements that affect self-efficacy and thereby behavior, from Bandura, 1997.

Mastery experience is suggested to be the greatest source of self-efficacy (McAlister, Perry, & Parcel, 2008). Previous success or performance in a task or behavior may develop into a positive belief in the capability to engage in that or similar behaviors or tasks. The individual's history of successful experience develops confidence and typically increases self-efficacy. However, multiple factors might influence how experiences are cognitively processed. Social modeling/vicarious experiences may also affect self-efficacy, where people observe others comparable to themselves being successful in a behavior or task. In that way, they can learn and increase their belief in their ability to perform the same behavior (McAlister et al., 2008). If previous experience is missing or if people doubt their ability to succeed, self-efficacy might be developed through vicarious experience. Rehabilitation approaches are often organized in groups where participants have the opportunity to learn from each other (McAlister et al., 2008).

Verbal persuasion can affect self-efficacy. Being encouraged by others with words such as "come on, you can do this" can boost perceived self-efficacy and therefore result in specific behavior (McAlister et al., 2008). According to Bandura (1997), self-talk is also a type of verbal persuasion, as the persuasion can just as well come from oneself as from others. Feedback and support from social groups can help to increase self-efficacy, but the compliments or feedback has to be realistic for the receiver to trust it. Positive encouragement and feedback can boost self-efficacy, while negative feedback might weaken it. However, verbal persuasion does not affect self-efficacy as much as mastery experience. In addition, verbal persuasion has only a short-term effect if it is not followed by actual successes. Physical and emotional states are also factors that influence self-efficacy (McAlister et al., 2008). Further on McAlister et al. (2008) stated that happiness and excitement are positive emotions that might increase self-efficacy, while negative states like depression or anxiety might weaken it. The authors also pointed out that the emotional states can exert an influence even though it is not related to the task at hand.

3.2 Physical activity and exercise self-efficacy

The activities people choose to pursue, the degree of effort they expend in pursuit of their goals, and the levels of endurance when meeting failures, setbacks and difficulties are theorized to be influenced by efficacy expectations (McAuley et al., 2013). Self-efficacy as a predictor and a mediator has been comprehensively studied in both patients and healthy individuals (McAuley et al., 2013). Harris, Owen, Victor, Adams, and Cook (2009) examined objective physical activity measures and a broad range of health, psychological and anthropometric variables. They found that a lower accelerometer step count was independently predicted by low exercise self-efficacy. Self-efficacy has been demonstrated to be a powerful factor in the prediction of long-term maintenance of physical activity. Under challenging circumstances, a higher cognitive control system such as self-efficacy, is reported to be a significant influence on behavior (Bandura, 1989; McAuley, 1993). In a three-month lifestyle intervention for obese adults by Hankonen, Absetz, Ghisletta, Renner, and Uutela (2010), the authors found that changes in self-efficacy during the intervention period were a predictor of behavior change. There were comparable findings in a 12-month counseling intervention for older men where self-efficacy was significantly associated with changes in physical activity both directly and indirectly (Hall et al., 2010). Some studies have found a relationship between patients' exercise self-efficacy and their commitment and adherence to an exercise plan (Darawad et al., 2016; Hagger, Chatzisarantis, & Biddle, 2001; Shin, Hur, Pender, Jang, & Kim, 2006).

McAuley, Pena, and Jerome (2001) suggest that self-efficacy during an intervention provides more information than baseline measures. After the participants are exposed to a new behavior or task, they can more easily make decisions on recent experiences to form accurate judgments about future success. This was supported by Wilbur, Vassalo, Chandler, McDevitt, and Miller (2005), who found that levels of self-efficacy at baseline did not predict exercise adherence during the maintenance phase. Importantly, individuals who improved their self-efficacy during the intervention period had better results in the maintenance phase (Wilbur et al., 2005). This indicates that changes that occur during rehabilitation programs can have considerable influence on future behavior. In-patient rehabilitation treatment usually only lasts for a short period of time. After finishing the treatment, it might be difficult for people to continue targeted behavior when they come home to their familiar environment and possibly their old habits. As Wilbur et al. (2005) reported, a stronger sense of self-efficacy developed during a treatment period might increase the likelihood of patients continuing to perform the same behavior at home. Commonly used treatments often emphasize the sources of self-efficacy. Rehabilitation treatments often aim at mastery experience in physical activity, and coping strategies aiming to improve daily functioning and mastery. Groups are developed for socialization and to share experiences, and activities in groups might emphasize vicarious experience. Encouragement from health therapists or other participants in the group constitutes verbal persuasion, another way to affect self-efficacy. Increased self-efficacy might already be an important part of treatment and therapy without being specifically targeted.

3.3 Measuring self-efficacy

According to Bandura's guide for creating self-efficacy scales there is no all-purpose measure of perceived self-efficacy (Bandura, 2006). Self-efficacy reflects judgment of capability for a specific behavior under specific circumstances, and the measurement of self-efficacy therefore needs to be appropriate and specific for the purpose. A researcher must develop a self-efficacy scale for a specific population, which is also tailored to the particular area of functioning. Perceived efficacy plays a key role in human functioning because it affects behavior directly and also due to its impact on other determinants such as goals and expectations, and perception of barriers and opportunities in the social environment (Bandura, 2006).

Self-efficacy measures can be labeled according to three domains; level, strength and generality (Bandura, 1997, 2006). Self-efficacy beliefs can be designated in terms of levels by the number of activities people judge themselves capable of performing above a selected cut-off value of efficacy strength. Efficacy strength incorporates efficacy level and is generally a more sensitive and informative measure than efficacy level. Strength refers to how strongly people believe they are capable of performing a behavior or action and can indicate perseverance. Individuals with weak perceived efficacy are easily stopped by difficulties, whereas people with a strong self-efficacy belief will maintain their efforts despite barriers and obstacles. Importantly, strength of perceived self-efficacy is not unquestionably linearly related to choice of behavior (Bandura, 1977), but the stronger the sense of self-efficacy, the greater the perseverance and likelihood that the chosen activity will be performed successfully. Generality can vary across types of activities, situations, and types of individuals toward whom the behavior is directed. Estimates linked to activity domains, situational contexts and social aspects reveal the patterning and degree of generality of beliefs in efficacy (Bandura, 2006). Sensed self-efficacy is a major determinant of intention and a judgment of capability for different types of achievements. Therefore, self-efficacy items should accurately reflect the construct that is being measured. Self-efficacy is concerned with perceived capability. The phrase "can do" is thus a better statement of capability than "will do", which states a form of intention (Bandura, 2006). In addition, a wide range of scores should be available to adequately capture strength.

Beliefs in efficacy influence whether people think optimistically or pessimistically and affect the course of action people choose to pursue, the challenges and goals they set for themselves and their commitment to them, etc. Meta-analyses confirm the influence of perceived self-efficacy on human self-development, adaption and change (Moritz, Feltz, Fahrbach, & Mack, 2000). When measuring sensed self-efficacy to adhere to a health-promoting exercise or physical activity routine, individuals assess how well they can get themselves to follow the routine under various impediments such as tiredness, depression, pain or having more interesting things to do. The identified challenges for the specific population must be built into the efficacy items (Bandura, 2006).

4.0 Quality of Life

The term quality of life (QoL) had its breakthrough in the 1980s and during the 90s and 00s quality of life has become a central outcome for treatment, prevention and psychosocial support (Lindholt, Ventegodt, & Henneberg, 2002). Quality of life and the good life as a concept has been widely discussed both in philosophical and psychological considerations, particularly in the Scandinavian countries (Aggernæs, 1989; Bergner, 1989; Ventegodt, 1996). Lindholt et al. (2002) integrative theory quality of life is made to make a bridge between the questionnaires already in motion and the new considerations about what the good life is. Ventegodts quality of life was presented in 1996. The theory contains a series of questions covering what Lindholts describes as the subjective, existential and objective quality of life. The existential quality of life refers to the state of humanity's inner depth – "the inner state of a person's life or the state of the soul as explained by thinkers such as

Kierkegaard, Maslow, Sartre, Antonovsky and Frankl" (Lindholt et al., 2002, p. 107). Initially three sets of QoL-questionnaires was created. QoL1 is one question simply asking how the respondent would assess their quality of life right now. QoL5 has 1, 2 and 2 questions about the subjective, objective and existential QoL. The 9-item QoL9 had three questions in each category. The process of making the questionnaires went through interviews, philosophical consideration, and after revisions, before the questions were refined to be unambiguous, independent, and different. The plan behind it was to make a questionnaire which is not gathering the same information, and collectively covering the areas of the philosophy.

5.0 mHealth services

mHealth is the use of information and communication technologies (ICT) for health. The "WHO mHealth unit" works with partners at the global, regional and national level to promote and strengthen the use of ICT in health development, from applications in the field to global governance (World Health Organization, 2019b).

E-health has considerable potential in Norway; with today's access to the Internet on smartphones and computers, almost everyone can be reached. According to Statistics Norway (SSB), 98% of the Norwegian population between 16 to 79 years has used the Internet in the last three months. It could be argued that some groups in society will be excluded, but today almost everyone can use a mHealth service. The possibilities for reaching large numbers of people are much greater today than before, and Internet-based interventions can therefore be an effective tool to achieve behavioral change.

In 2018, SSB reported that 94% of Norwegians had access to a personal computer at home, 95% had access to a smartphone and 98% had access to Internet (Statistics Norway, 2019a). Statistics from the USA indicate that consumer demand has already created an industry for mHealth applications, with around 50% of all mobile users already using a fitness application (Fox & Duggan, 2012). The use of smartphone applications to increase physical activity was recently analyzed by Bort-Roig, Gilson, Puig-Ribera, Contreras, and Trost (2014), who found that four out of five studies showed an increase by as much as 1100 steps per day, which is equivalent to around 800 meters extra. This is not a surprising finding, as mHealth technologies have previously been shown to increase physical activity through various modes of treatment ways such as pedometers, SMS messaging, email and the Internet. If this is sustained, these increases in physical activity could prove clinically significant. For example, it has been shown that a step count increase of around 2500 steps during an 18-week period is associated with a significant decrease in BMI and systolic blood pressure (Bravata et al., 2007). A study by Yates et al. (2014) study showed that each 2000 step per day increase in physical activity, maintained for a mean of 6 years, was associated with around 10% relative decrease in the occurrence of CVD. What remains to be understood, is how smartphone apps can better leverage these modes of treatment to change behavior and create adherence and habits that last. Feldman et al. (2018) proposed a model which shows how mHealth can lead to an increase in levels of physical activity.

This model shows major domains through which smartphone apps can impact physical activity include social support, behavioral change support, decision support and self-efficacy. The following sections describe how available applications target each domain to implement behavior change.

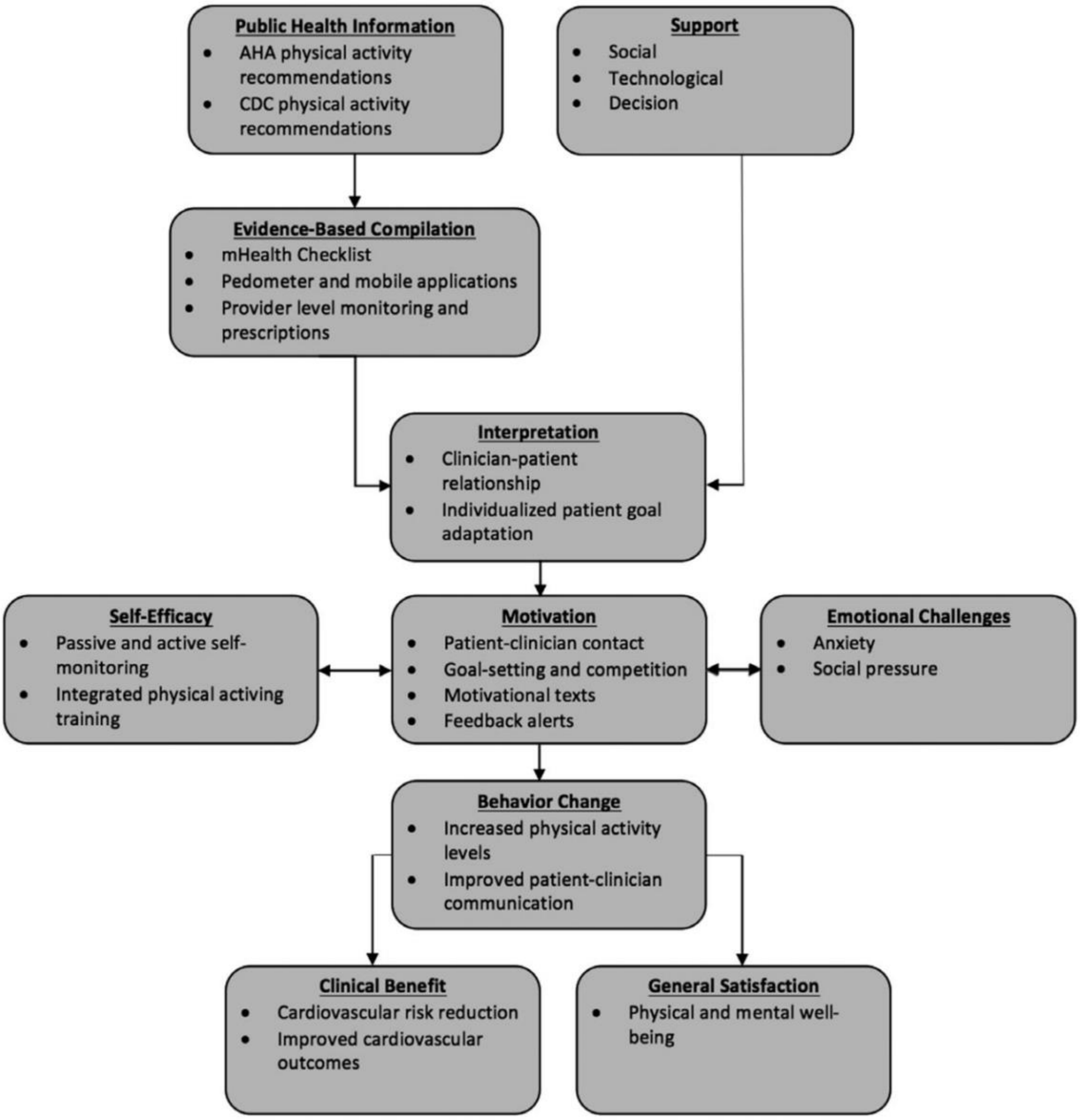

Figure 2: The mHealth behavior-change model by Feldman et al. (2018) p. 987.

5.1 Public health information

Smartphone apps can improve user knowledge through education about physical activity and build upon advice from clinicians. Smartphones utilize many behavior change techniques (BCT) to increase user knowledge, which commonly include providing credible/population-based recommendations for physical activity (Feldman et al., 2018).

Previous studies tried to change the physical activity of individuals by providing them with various educational and instructional resources; however, because of limitations such as small sample sizes and self-report, no significant increases in physical activity was reported (Hebden et al., 2013; Turner-McGrievy & Tate, 2011). Wantland, Portillo, Holzemer, Slaughter, and McGhee (2004) showed in their meta-analysis the positive effects of a web-based intervention but also found that a substantial proportion of the participants may drop out because of non-use or loss to follow-up.

5.2 Social support

Smartphone apps give us social, technological, and decision support to influence users. Social support, which is underlined in patient-facing apps, uses emotion, instrumental or informational influence to change behavior (Ryan, 2009). This is not the same as social influence, which can also have both positive and negative effects on health behavior. BCTs that use applications to create social support include allowing users to receive encouragement, facilitating approval from others, and providing the opportunity to share and compare one's accomplishments on social medias. Components of social support are present in most popular electronic activity monitors and in nearly all physical activity applications (Yang, Maher, & Conroy, 2015).

Social influence is created from peers, which may be especially important in teenage populations (Quelly, Norris, & DiPietro, 2016). Research into the efficacy of mobile app interventions has created a wide range of techniques to enable social support. Rabbi, Pfammatter, Zhang, Spring, and Choudhury (2015) found that the quality of the messages was crucial and that automated messages that were individualized, contextualized, and actionable increased walking distance significantly more than a similar amount of universal and impersonal advice. Although some studies have shown success with motivational and social support, more research is needed to find out how smartphones and applications can provide effective support to drive behavior change.

5.3 Behavioral change support

Mobile apps offer support for behavior change and decisions by prompting the user to create goals, specific plans of action and a behavioral contract (Feldman et al., 2018). In comparison with social support, it was found that physical activity apps less commonly employed behavior change and decision support techniques (Yang et al., 2015). Applications can also employ BCTs that involve forming intentions, restructuring of the environment and the provision of rewards to support user behavior. Researchers are only starting to discover the many ways smartphones can offer behavioral change and decision support. A recent randomized controlled trial of a smartphone-based mHealth intervention found that participants receiving support through clinician-created personalized text messages increased physical activity significantly over self-monitoring physical activity by 2534 more steps (Martin et al., 2015). Similar findings were shown in both the It`s life! and the Text Me trials. The It`s life! trial showed that apps with clinician-supplemented counseling sessions had a significant effect on daily physical activity levels (van der Weegen et al., 2015). The Text Me trial showed that a use of a lifestyle-focused text message service compared with usual care resulted in a modest improvement in CVD risk factors.

These studies argue that for smartphone apps to be most effective, they must serve as an extension of the clinician, rather than as a stand-alone intervention.

5.4 Self-efficacy and motivation in physical activity-apps

Self-efficacy can add to patient motivation; by contrast, a lack of self-efficacy can degrade motivation. Currently, self-efficacy measures are also somewhat underrepresented on the application market; however, paid apps make it more likely that the buyer will maintain self-monitoring. Defining self-efficacy as belief in one’s ability to succeed in certain situations or accomplish specific tasks implies that users can actively interact with their apps through self-report, manually or automatically logging physical activity and monitoring the achievement of goals.

A study by Glynn et al. (2014) demonstrated that short-term use of an app that includes physical activity tracking and goal-setting helped patients increase physical activity levels by around 1000 steps per day. Kirwan, Duncan, Vandelanotte, and Mummery (2012) found that participant engagement produced behavior change via increased physical activity for the duration of their 90-day study. Based on the literature, it seems that the patient or participant has to play an active role in self-monitoring of lifestyle modifications, and applications can help this. Feldman et al. (2018) concluded that as they continue research into apps, clinicians can consider making endorsement that patients use specific apps that incorporate selected BCT. The apps should work on several levels, not only educating, but enabling social, behavioral, and decision support, all while developing user self-efficacy. Feldman et al. (2018) concluded that patients should actively track physical activity behaviors in addition to using passive pedometer tracking. They also showed that patients would gain from the integration of social interaction onto the mHealth platform. A lasting change in behavior requires collaboration between clinician and patient, where progress towards a short-term activity goals can be monitored over time. The mActive trial, where smart texts using the name of the patient's when sending out positive reimbursement for patients reaching daily goals, and words of encouragement for patients infrequently surpassing their goals (Martin et al., 2015). By leveraging the patient-clinician relationship, the mActive trial saw nearly twice as many participants in the text-receiving arm achieve their goal of 10 000 steps per day (Martin et al., 2015).

According to Feldman et al. (2018), it is not until a patient can demonstrate that he/she can consistently achieve short-term goals that a clinician can confidently prescribe the type of long-term goals than can actually lower CVD risk.

A review by Muellmann et al. (2018) pointed out that eHealth interventions effectively promote physical activity in older adults (<55), but evidence regarding long-term effects was missing. Haberlin et al. (2018) also found in their review that the use of eHealth to promote physical activity in cancer survivors was effective. The ten studies reviewed reported improvement in physical activity, with eight out of ten studies reporting statistically significant changes. In a review of the most important BCTs implemented in the eHealth interventions, the three most used were information about health consequences, goal setting and in joint third place self-monitoring of behavior and social support (Duff et al., 2017).

In a longitudinal RCT study, the health and well-being effect of wearable self-tracking devices was examined (Stiglbauer, Weber, & Batinic, 2019). The results show that fitness tracker usage increased perceived physical health and performance, and the effect was more pronounced if users additionally used the accompanying app.

Since most physical activity interventions take place with older, sick or obese participants, the aim of this study is to shed light on the possible effects of such interventions on a group of people who struggles with sedentary behavior. A further novel aspect of this study is also the testing of the PAI measure in such an intervention. The aim of this master's thesis is to draw on both Bandura's self-efficacy theory and Feldman's mHealth behavior change model as a framework to study the effects of a mHealth exercise intervention. The research question will be as following:

Can the implementation of a mHealth service improve exercise self-efficacy and increase daily physical activity among groups with high levels of sedentary behavior?

As mHealth apps and activity trackers are intended to foster health and well-being in a holistic sense, a positive impact of health-related self-monitoring technology use may be expected.

- Hypothesis 0: Implementation of mHealth behavior change application in an exercise intervention will not lead to greater exercise self-efficacy in the intervention group than in the control group which receives standard care, i.e. instructions to follow national guidelines for physical activity without further supervision.
- Hypothesis 1: Implementation of a mHealth behavior change application in an exercise intervention will lead to greater exercise self-efficacy in intervention group than in the control group which receives standard care, i.e. instructions to follow national guidelines for physical activity without further supervision.

6.0 Method

6.1 Subjects

The first step towards testing the potential of a mHealth behavior change application in an exercise intervention for people with sedentary behavior was to publish a **recruitment** poster in CERG (Cardiac Exercise Research Group) channels (Facebook and web-page) with an invitation to join the study. The poster had information about the study aim and further practical details. It was pointed out that to be included in the study it was important that the person considered him/herself as low-active and wished to become active. After registration, all subjects were phoned to ascertain whether they were actually motivated for the study. As soon as a large enough sample was reached, we stopped recruiting and started incorporating patients into the study.

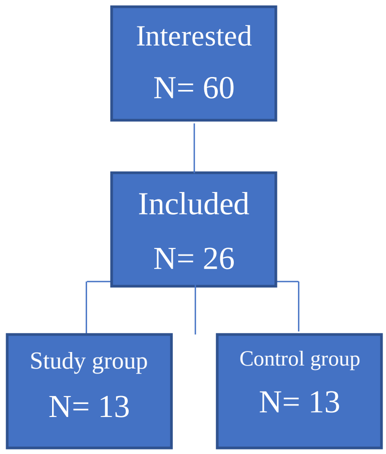

Figure 3: Flow chart of inclusion

The inclusion criteria for the study were (1) to be low-active, with a wish to become more active, (2) to have little experience of using exercise apps to self-monitor one's activity. (3) To be 21 years or above. Exclusion criteria were set to make sure the participants were able to perform the planned physical activity in the study period. (1) To include patients in the study wasn't allowed by Norwegian center for science-data (NSD) and was therefore an exclusion criterion, and (2) persons with limitations for being physically active, e.g. according to their doctor was excluded. Inclusion was terminated as soon as 26 persons had agreed to join the study. When the study started to reach the desired number of persons, a lack of male participants was detected, which made including males important at the end. The study seemed to attract female participants more than men. Only 14 out of 60 interested persons were men, and since four of them had conditions that made them medically unfit, and two of them had experience with self-monitoring physical activity with activity armbands and applications they were only eight left.

The sample of 26 persons thus consisted of eight males and 18 women, with a mean birth decade of 1970-79. In the questionnaire, age was defined in decade intervals to provide anonymity. Response 1 was for those born between 1920-1929, 2 for 1930-1939, 3 for 1940-1949, etc. until 8 for 1990-1999 which was the youngest age to be included in the study.

6.2 Study design

This study was conducted as a (RCT), which is a trial where the subjects are randomized into one of two groups: the study group study group receives the treatment or intervention being tested, while the control groups receives an alternative treatment. The study was provided with an activity watch to self-monitor activity for the intervention period, the control group got national health recommendations for physical activity. After the intervention analyses was performed to assess its effectiveness, which is the extent to which a treatment, procedure, or service does patients more good than harm. RCTs are the most relevant way of determining whether a cause-effect relation exists between the intervention and the outcome (Sibbald & Roland, 1998).

The study design in this thesis was to test the self-efficacy motivational effects of self-monitoring exercise with an app and a GPS and heart-rate enabled activity watch. The primary endpoint was thus the testing of self-efficacy, while secondary endpoints were increases in physical activity during the intervention, or changes in quality of life. All subjects were invited to an introductory meeting for the study. The meeting was conducted individually, practitioner to participant. Before the meeting the participants had received the written consent and the pre-study (T1) questionnaire. At the meeting the participants were asked to hand in the completed written consent and T1 questionnaire. Drawing lots was used as a randomization tool to place participants in either study/control group. Those who were included in the control group were instructed to follow the national physical activity recommendations and not to make any big changes in their daily life. They were then explained the importance of their contribution to this study and how important they were for both the science and the institute. The participants who were randomized to the study group were provided with the Amazfit GTS smartwatch and explained that they were only borrowing the watches since they had been paint for with tax money. A brief introduction to the watch and its possibilities for monitoring activity was given.

Three weeks later, all participants were invited to come to St. Olavs Hospital, Trondheim to complete the post-questionnaire and hand back their activity watch at St. Olavs Hospital, Trondheim. Those in the control group had the option to complete the questionnaire at home and send it back by e-mail. Because of the outbreak of the Covid-19 virus, the finalization of the study took place electronically, with all the participants responding to the questionnaire at home and sending it by e-mail.

The introductory meeting for the study was in the form of 30-min individual sessions. The study group participants were given a more comprehensive introduction to the study. Consistent with the social cognitive theory (Bandura, Adams, Hardy, & Howells, 1980), the topics of the session included short and long-term goal setting, problem-solving skills (barriers of activity), techniques for developing activity behavior, and planning for comeback after activity relapses. The goal for the study group was to reach activity levels of 100 PAI and to learn how to use PAI over longer periods. Instruction in self-monitoring was also given to enhance understanding of what was required, what the different readings meant and how to use them.

For the control group the individual sessions focused on health benefits of exercising and the recommendations for physical activity of the national health directorates.

6.3 Ethics

All subjects recruited for the study participated voluntarily. The written consent sent to the participants pre-study contained information about the study and the participants' role in it. It stated that the participation in the study was voluntary, and that they could leave it at any time without any reasoning. The participants were informed several times about what their participation in the study meant to ensure that no misunderstandings occurred. All data were treated confidentially to protect the participants' privacy. Samples and data stored that concerned the participants were only used in accordance with the purpose of the study. The study was conducted in accordance with the Helsinki Declaration (2014) and was approved by the Norwegian Centre for Research Data (NSD). Appendix 3 contains the NSD approval.

6.4 Instrumentation and measurements

The questionnaire was in the form of a paper-and-pencil survey and included assessments of health and well-being. The T1 questionnaire contained scales that measured self-efficacy physical activity, and Quality of life. The T2 questionnaire contained the same scales but the the physical activity question was changed to only ask about activity during the intervention. Because of the outbreak of the Covid19-virus, T2 also had some questions about health anxiety and health problems during the intervention which could be important factors when trying to raise activity levels for people whit little experience of exercising.

Personal info was submitted in the first part of the questionnaire. To ensure anonymization, participants were asked to create their own project ID, which was made up of the two digits in their living address, and the two last digits in their phone number. The example the participants were given was Tellefsens Street No. 14 and the phone number 98765432, which gave a project-id of 1432. They were asked to enter their gender, while their age was to be entered according to the decade in which they were born. For example, subjects born in 1990-99 had age 20, in 1980-89 age 30, etc. Educational level had five options. 1 was compulsory schooling, 2 was high school, 3 was 1-3 years of higher education, 4 was 4-5 years of higher education and 5 was 5+ years of higher education.

Self-efficacy was assessed with the Norwegian 14-item Exercise for Self-Efficacy Scale (ESES), which has been translated and tested by Sæbu (2011). It was originally part of a health promotion model (Pender, Murdaugh, & Parsons, 2006). ESES is broadly validated, for example in a study with 368 individuals with spinal cord injury by Kroll, Kehn, Ho, and Groah (2007). An example of an item is “I am confident I can be physically active no matter how tired I feel”. The response format is a 10-point Likertscale ranging from “not true” (1) to “always true” (10).

The scale is intended to assess whether the subjects can overcome daily obstacles that can prevent them from exercising (See Appendix 1: T1 questionnaire). Self-efficacy scales are constructed with the main questions containing the phrase “can do” rather than “will do”, as can is a assessment of capability while “will” is a statement of intention. Self-efficacy is concerned with perceived capability.

To test the **reliability** of the scale, a Cronbach’s alpha was calculated for the total ESES to determine internal consistency of the scale. The internal consistency of the total 14-item ESES scale was 0.90.

Quality of life was assessed by the Norwegian Quality of Life-5 (N-QoL5) scale, which is a generic and validated 5-item scale by Lindholt et al. (2002) (see Appendix 1).

QoL5 is a scale with short, general questions about percieved quality of life. The response format is a 5-point Likert scale ranging from 1 “very good” to 5 “very bad” with a neutral point in the middle. Each question is weighted equally throughout the scale. In the process of analyzing the results, Ventegodt, Merrick, and Andersen (2003) recoded the original responses from 1 to 5 into a decimal scale. The original response 1 = very good was change to 0.9, 2 = good to 0.7, 3 = neither good or bad to 0.5, 4 = bad to 0.3 and 5 = very bad to 0.1. The QoL5 is meant to cover three aspects of life quality: 1, 2 and 2 questions about subjective, objective and existential QoL.

To calculate the overall QoL the objective QoL (from Q1 and Q2) = (Q1+Q2)/2. Subjective QoL is just one item so it stands for itself = Q3. Existential QoL (from Q4 and Q5) = (Q4+Q5)/2. The overall QoL ((Q1+Q2)/2+Q3+(Q4+Q5)/2)/3.

An example of an item is "How do you consider your physical health at the moment?".

Missing data was handled according to the WHOQOL Group´s guidelines: a subscale was not calculated if any items were missing, with the exception of the questions about partners; the scale was calculated based on the four remaining questions for participants who did not answer the existential question about their relationship to their partners (Group, 1998). For simplification in the analysis, Q5 was entered with the same response as Q4, when the formula then divides the existential factor by 2, the score will be the same as when there are only four questions. Three participants did not respond to this question and all were in the control group. Subsequently, Lindholt was asked by e-mail if that was the intended way of doing it, which he confirmed.

In a bigger validation study of QoL5 with 1100 participants from a normal population, Lindholt found an average of 0.69 (Lindholt et al., 2002). This is equivalent of a score of 2 on the regular scale with the term value "good". Ventegodt et al. (2003) defined <0.55 (2.75) as considerably reduced quality of life. Ventegodt claims that a low score can be an expression of serious existential problems or a massive pressure of suffering. Moving 0.2 on the decimal scale is described as making a considerable improvement in QoL (Ventegodt et al., 2003).

It should be noted that Søren Ventegodt, one of the creators of the QoL5, was in 2005 deprived of his medical license, when the Danish Health Authority considered him to be a danger to his patients. The QoL5 has been widely validated with the Nottingham Health Profile (NHP), the Sickness Impact Profile (SIP), the self-evaluated quality of life questionnaire (SeQoL) (Lindholt et al., 2002) and the WhoQol-BREF from the World Health Organization (Muller, Skurtveit, & Clausen, 2016).

To test the **reliability** of the scale, Cronbach´s alpha was calculated for the total QoL5 to determine the internal consistency of the scale. The internal consistency of the total 14-item QOL5 scale was 0.88.

Physical activity was measured with the HUNT 1 PA-Q. The Nord-Trøndelag Health Study (HUNT) is a large prospective cohort study, which has had around 240 000 participants since inception. The questionnaires and surveys in the studies took place in four stages. The initial HUNT 1) 1984-86, 2) between 1995-97, 3) 2006-2008 and 4) 2017-2019 (ntnu.no/hunt). The questions about exercise from HUNT 1 was tested for reliability and validity by Kurtze, Rangul, Hustvedt, and Flanders (2008); they indicated that the physical activity questionnaire in HUNT 1 is an useful measure of leisure-time physical activity for men. It is also preferable to longer instruments for assessment of more vigorous physical activity (Kurtze et al., 2008). The HUNT 1 PA-Q consists of three sets of questions which measure physical exercise as the product of average frequency (0.0-5.0 points), duration (0.10-1.00 points) and intensity (1-3 points) each week, giving an index ranging from 0.00 to 15.00, with 15.00 as the best score. The HUNT 1 PA-Q indexing and each of the subscales of frequency, duration and intensity have shown acceptable test-retest reliability (Kurtze et al., 2008). The index has also shown moderate correlation with the short format IPAQ survey when used with adult males. In this study the original HUNT 1 PA-Q was used at T1 (see Appendix A), before being slightly moderated before the T2 (see appendix B) asking about the intervention period activity instead of the average weekly physical activity.

For Q1, the response 1 was coded as zero, 2 as 0.5, 3 as 1, 4 as 2.5 and 5 as 5. If any of the participants used response 1 or 2 in Q1, Q2 and Q3 was automatically coded as 0. For Q2, response 1 was coded as 1, 2 as 2 and 3 as 3. The Q3 response 1 was coded as 0.10, 2 as 0.38, 3 as 0.75 and 4 as 1.0.

In creating the physical activity-index each of the questions was totaled and a mean was found.

The **Amazfit GTS** is a relatively inexpensive activity watch. It has long battery life (daily use mode: 14 days) and comprises an accelerometer and a photoelectric heart rate sensor (Huami proprietary BioTracker™ PPG biological tracking optical sensor). The watch can perform 24-hour high-precision heart-rate monitoring as well as heart-rate interval monitoring during workouts, and give a warning if an excessively high value is detected. Steps can be monitored, along with PAI, activities, distance, calories etc. The watch can be paired with the Amazfit app to self-monitor activity. The Amazfit app allows goal-setting along with other tools.

6.5 Statistical analysis

A **power calculation** was performed to estimate how many participants the study needed to achieve the required statistical power. An a priori power analysis was conducted using G*Power 3 for Mac (Faul, Erdfelder, Lang, & Buchner, 2007) to test the difference between two independent group means using a two-tailed test, with a high effect size based on the calculations of Chao, Scherer, Wu, Lucke, and Montgomery (2013), which found the minimal important difference between the intervention group and the control group to be $\pm$1.5, with an alpha of .05. Results of the calculations showed that a total sample of 18 with two equal sized groups of n=9 was required to achieve a power of 0.80. If this analysis match reality this size would be sufficient. But since we can't rule out dropouts from the study we had to include a couple more and the project had access to 13 watches we could use, it was then decided that two groups of 13 people with a total sample size of 26 should be sufficient for the study.

The study was conducted as an RCT with two groups who were tested before and after intervention, without any covariate variables, it was decided to use repeated measures ANOVA. The analysis was performed with an intent-to-treat approach, without regard to adherence to the intervention. A two-tailed level of significance of 0.05 was used. A requirement for a t-test is that the dependent variable has to be tested for normality. To test for multivariate normality, the Shapiro-Wilks test for univariate normality was conducted. We could not reject the 0-hypothesis that the dependent variables (ESES and ESES2) were normally distributed, since the p-value was greater than 0.05. To find the between-group difference, independent sample t-tests at T1 and T2 were conducted, which found no significant difference ($p>0.05$) for the dependent variable ESES. To further test the normality, visual inspection with histograms was performed.

The statistical analysis was performed using Stata/MP 16.0 for Mac (Stata Corp, College Station, Texas, USA).

7.0 Results

Table 1: Descriptive statistics

	Study group n=12			Control group n=12			All (n=24)		
Variable	*Mean±SD*	*min*	*max*	*Mean±SD*	*min*	*max*		*min*	*max*
Age (years) (by 10)	40±12.06	20	60	39.17±9.96	20	50	39.58±10.83	20	60
Education (years of higher education)	3.92±1.00	2	5	3.58±1.44	1	5	3.75±1.22	1	5
Frequency PA (sessions per week)	1.83±1.61	0.5	2.5	1.75±1.30	0.5	2.5	1.79±1.44	0.5	5
Intensity PA (1=light, 2=medium, 3=hard)	1.33±0.78	0	2	1.33±0.78	0	2	1.33±0.76	0	2
Duration PA (in hours)	0.64±0.33	0	0.75	0.54±0.32	0	1	0.59±0.33	0	1
Total PA	1.70±2.08	0	7.5	1.97±1.67	0	5	1.84±1.85	0	7.5
ESES	6.51±1.49	4.42	8.85	6.22±1.80	4.07	9.57	6.37±1.62	4.0	9.5
Quality of life	0.58±0.21			0.63±0.16			0.61±0.18		

Note:*=significantly different between group effect at $p<0.05$. PA = Physical activity.

Table 1 shows the descriptive statistics of the means and standard deviations for the participants of the study at baseline. Gender differences was not assessed in the study but it is worth noting that study group had 5 male participants against only 2 in control group that finished the intervention. The mean response for years of higher education was close to 4 which was the response between 4 to 5 years of higher education. Education level in the group was high with 10 persons (40%) responding more than 5 years of higher education. For generalization of the study this made some challenges with only 10,0% of the Norwegian population having an university or higher education of longer character such as this group (Statistics Norway, 2019b).

Table 2: Group mean scores pre and post with standard deviation.

	Study group		Control group	
Variable	Pre n=12	Post (N=12)	Pre (N=12)	Post (N=12)
Exercise self-efficacy	6.52±1.49	6.94±1.58	6.22±1.80	5.83±1.69
Physical activity (PA)	1.70±2.09	3.61±3.11*	1.97±1.69	3.12±2.73
Frequency (times per week)	1.83±0.46	2.87±0.50*	1.75±0.38	2.29±0.33
Intensity (1=light, 2=medium, 3=hard)	1.33±0.22	1.67±0.22	1.33±0.22	1.5±0.19
Duration (in hours)	0.54±0.09	0.51±0.09	0.63±0.09	0.69±0.11
Quality of life (Qol5)	0.60±0.21	0.61±0.17	0.63±0.15	0.55±0.16

Note: *=p<0.05 for within-group differences pre to post.

A repeated measures ANOVA was run on the sample of 24 participants to determine if there were main effect differences due to group intervention method. If significant effects was found in one of the two main effects post-hoc eta-squared effect size and within-group simple effects was tested. Effect size was calculated using partial eta squared ($\eta 2$), with benchmarks of 0.0099 for small, 0.0588 for medium and 0.1379 for large (Richardson, 2011). No significant between-group effects in exercise self-efficacy over the intervention time ($F(1,22) = 2.89$, $p>0.103$) was found. For physical activity (see table 2) the ANOVA showed no main effect of instruction group: $F=(1,22) = .01$, $p>.05$. However, the main effect of time on physical activity was statistically significant: $F=(1,22) = 9.48$, $p<.01$, partial $\eta 2=.30$. The partial $\eta 2$ of .30 suggests a large effect size. Testing simple effects showed no within group effect from T1 to T2 for the control group, but the study group showed statistically significant increase ($p<0.012$). The variables frequency, intensity and duration which is the main constructs of the physical activity index showed no significant results except for study group which had an statistically significant increase ($F=(1,22) = 4.78$, $p<0.039$) in frequency. QoL5 did not change significantly for either groups ($p=0.225$), and for the changes between tests ($p=0.48$).

Table 3: Mean scores with standard deviation (SD) and change between the test points (T1-T2) for all questions (Q1-14 in the Exercise Self-Efficacy Scale (ESES)). In addition, the ESES changes (p-value) are given.

	Mean score with SD				Change	
	Study group (n=12)		Control group (n=12)		SG	CG
	T1	T2	T1	T2	T1-T2 p-value	T1-T2 p-value
Q1	6.42±0.66	7.16±0.62	7.25±0.68	5.75±0.74	.29	.04*
Q2	7.25±0.72	7.16±0.61	6.33±0.82	5.92±0.61	.90	.55
Q3	8.16±0.61	7.75±0.66	6.75±0.76	6.33±0.58	.53	.53
Q4	8.50±0.51	8.75±0.48	8.08±0.96	7.25±0.76	.70	.21
Q5	7.75±0.63	7.92±0.53	6.33±0.91	5.92±0.66	.47	.77
Q6	3.58±0.63	5.08±0.70	4.58±0.74	5.00±0.81	.04*	.56
Q7	5.5±0.69	6.42±0.65	4.92±0.80	5.75±0.88	.28	.33
Q8	6.58±0.72	6.75±0.59	6.42±0.71	5.66±0.72	.78	.22
Q9	8.25±0.65	8.75±0.63	7.33±0.82	7.50±0.83	.77	.38
Q10	7.00±0.55	7.50±0.73	6.92±0.51	5.66±0.64	.48	.08
Q11	5.16±0.73	6.25±0.54	4.75±0.83	4.50±0.73	.05	.64
Q12	7.00±0.68	7.41±0.82	7.92±1.04	7.92±0.82	.58	1.00
Q13	5.08±0.58	4.83±0.57	5.00±0.67	4.25±0.66	.69	.25
Q14	5.00±0.60	5.42±0.63	4.58±0.66	4.16±0.68	.56	.56
Sum score	6.52±1.49	6.94±1.58	6.22±1.80	5.83±1.69	.09	.36

Note: Exercise Self-Efficacy Scale scores range from 1-10, a higher score indicate a greater self-efficacy in the domain of physical activity (PA). *=P<0.05.

The difference in the individual questions between the different tests (T) and groups showed two significant changes. Q1 which examined the phrase "*I am confident I can be physically active no matter how tired I feel*" changed positively for control group (p<.04). Q6 which examined the phrase "*I am confident I can be physically active when I have visitors*" changed positively for study group (p<0.046) from T1-T2 and. Table 3 lacks significant results and shows that there were no positive effects in exercise self-efficacy between T1 and T2.

8.0 Discussion

The present study was designed to compare a two-arm physical activity intervention. The study group was given access to and instruction in using a heart-rate and GPS-enabled watch for self-monitoring of activity instead of the standardized activity recommendations given to the control group. The main outcomes in the study were changes in self-efficacy and self-reported activity. The groups were also tested for changes in quality of life during the intervention. The study faced some challenges since it was conducted during the outbreak of the Covid-19 virus in Norway; the finalization of the study was changed with the final meeting cancelled and the T2 questionnaire had to be conducted by e-mail. At T2 a section was added to the questionnaire about health worries, and several of the participants stated that they were influenced by the urging crisis and that it affected their activity.

8.1 Principal findings

No statistical differences was detected that can define which of the two treatment-arms was better for exercise self-efficacy. Evidence was found that study group increased their activity levels significantly while the control groups increase was insignificant. The study groups participants' increase in physical activity is explained by an increase in frequency of training session. The intervention created insight into how much influence a mHealth behavior change application has on self-efficacy.

8.2 Exercise self-efficacy

Previous studies have reported the close relationship between increases in exercise self-efficacy and the behavior change constituted by an increase in physical activity (Bandura, 1989; Hall et al., 2010; Hankonen et al., 2010; Harris et al., 2009; McAuley, 1993). This study did not manage to recreate these results, since the study group increased their physical activity levels significantly but their self-efficacy scores didn't. We can conclude that there is a lack of correlation between exercise self-efficacy and our implementation of a mHealth behavior change applications. The aim of this study was to see if the implementation of the mHealth app for better self-monitoring of activity was sufficient to affect self-efficacy for the participants. It is clear that this intervention didn't influence the participants enough to create the wished for effects. One possible explanation for the lack of correlation between physical activity and exercise self-efficacy might be explained by the short intervention time. The significant results found by for example Hall et al. (2010) had an intervention time of 12 months, McAuley (1993) tested a sedentary middle aged population 4 months after a 5 month trial and still showed significant effects in exercise self-efficacy. As McAuley and Mihalko (1998) proposed, in the context of relatively sedentary older adults, the participants doesn't have the skills and previous experiences necessary to evaluate appropriate efficacy expectations. When the participants then are exposed to the intervention they will recalibrate their expectations, and experience that their T1-responses was an overestimation. Further, McAuley et al. (2011) thought that in the event of a decrease in self-efficacy an increase can be expected from a mid-point and to the finalization of the study. In this regards the assesment of self-efficacy should maybe be done in three steps. If we see a decrease at all three points then it is definite that the intervetion method doesn't work. A third possible explanation is that not all exercise self-efficacy measures might be expected to have similar trajectories. For example, barriers efficacy and measures which assess efficacy for adherence to exercise may not score as high as measures which assess gradations of task. With such a short intervention time as this study had the solution of adding a mid-way test would not be a good option and the only way would be by adding more weeks to the intervention then. The third option was considered in this study but with only two out of 28 scores in the 14-point ESES questionnaire (see table 3, in Results) with a significant increase there was no need for further testing.

The intervention method can be criticized for not creating a sufficient source of social support/modeling, which is one of the most important influences on self-efficacy (Bandura, 1997). The way this has been done earlier is by sending out personalized text messages or having interaction with the study participants, including further exercise counseling. Facilitating for self-monitoring makes mastery experiences available. The PAI-score and other factors in the application was meant to affect the participants exercise self-efficacy. Verbal persuasion was done at the enrollment-meeting where the participants learnt how little activity (two times 4x4-intervals per week at perfect intensity equals 100 PAI) was needed to reach the wished-for goal. But as no follow-up was done during the intervention it is hard to know what kind of self-talk was carried out during the intervention. The last source to self-efficacy is physical/ emotional state. In this study we measured QoL which can be assessed as an emotional state which defines your wellbeing. The fact that both groups per Lindholt et al. (2002) definition scored low on quality of life and the control group during the intervention decreased to a level which is defined by Ventegodt et al. (2003) as considerably reduced quality of life. This low scores can be an expression of serious existential problems or a massive pressure of suffering. In line with McAlister et al. (2008) statement that happiness and excitement are positive emotions that might increase self-efficacy, while negative states like depression or anxiety might weaken it. With both groups responding low scores at T1 and being shaken by the urgent crisis in our society with the outbreak of the Covid19-virus it seems that at least the source, emotional state, to self-efficacy was negatively affected and could be one of the reasons for no significant increase in exercise self-efficacy. All participants in the study was enrolled before 12th of march, which was the day the Norwegian Health Directorate introduced the most serious measures Norway has had in peace-time. It is hard to see how this has not affected the participants psychological status.

Exercise self-efficacy has been shown to be good predictor of exercise adherence (Darawad et al., 2016; Hagger et al., 2001; Shin et al., 2006). This study did not create an increase in exercise self-efficacy, and therefore to make this intervention method work, alterations such as increasing the social support and increasing the intervention time could be useful. As earlier mentioned the social influence could be higher for example by using the applications "friends"-tool. The analysis of this study showed that this intervention method did not increase exercise self-efficacy and adherence for activity. We can hypothesize that most of the participants in the study will stop exercising after the intervention and go back to a sedentary/low-active lifestyle. A positive result in both self-efficacy and physical activity would have given us indices that this is a better method than standard care. Wilbur et al. (2005) reported that a stronger sense of self-efficacy developed during intervention, might give a higher probability for the patients to continue performing the same behavior at home.

8.3 Physical activity

The finding that our intervention method led to an instant increase of physical activity-levels is backed up by earlier studies (Glynn et al., 2014; Haberlin et al., 2018; Kirwan et al., 2012; Muellmann et al., 2018). For practitioners trying to encourage people to be physically active, prescribing an activity-watch can be a good way to start the intervention. This can be a time-effective way of getting people to start exercising. The time usage of giving a short introduction on how to interact with an activity-watch can be cost-effective. After all, at some point the subjects trying to become physically active have to learn how to do it on their own. The lack of length in physical activity-studies has created some questions about what actually affects a lasting life-long behavior change. When breaking down the physical activity-index into the three variables frequency, intensity and duration we can analyze which changes the participants in the study has done. In the educational part of the welcoming meeting with the study group, high intensity interval training was presented as an effective way of reaching the weekly PAI-goal. The argument was that “two sessions of 4x4 minutes at vigorous intensity with a three-minutes break” could be sufficient activity to reach the weekly goal of 100 PAI with only two sessions per week. When we analyze table 2 (see results) we can detect that although the study group has not done the opposite, their increase in intensity wasn’t significant. They kept their intensity at low to medium and instead increased their frequency of sessions per week. For people with sedentary behavior this study is one example of that trying vigorous intensity interval training on their own might be too hard/difficult and should be done under the supervision of a personal trainer or others.

Considerations by Haberlin et al. (2018) on how to create functional eHealth interventions to promote activity were taken into account in this study. Their review proposed that further studies should improve self-assessment of activity with more precise measurements which PAI is one example of. Other measurements participants were instructed to use were instant heart-rate, sleep-quality, goal setting and standardized feedback through the activity watch and app. The conclusion made by Kirwan et al. (2012) that using a smartphone application as an additional delivery method to a website-delivered physical activity intervention may increase activity was also shown to be true in this study as well.

As stated by Ryan (2009), there is a difference between social support and influence. Social support is emphasized in activity apps such as this and its aim is to encourage the user to increase physical activity. Social influence on the other hand can both have positive or negative effects on the users. A small intervention as this is dependent on someone setting a good example and that the peers being influenced see them as comparable to themselves.

When considering the definition by Ventegodt et al. (2003) of quality of life-values we see that the control group actually decreases their quality of life to a level which is defined as considerably reduced quality of life (0.55) and the study group was close to this (0.60) and considerably under the average of 0.69 (Lindholt et al., 2002). Such low scores can be an expression of serious existential problems or a massive pressure of suffering. We can hypothesize that this could be an underlying reason for at least the lack of motivation and maybe also the lack of significant increases in high intensity activity.

8.4 Methodological discussion

When planning the intervention, we studied previous trials and found some that created good self-efficacy and physical activity results in two to four weeks. Because we realized that we needed the time post-study to finish this thesis in time, we decided to perform the intervention in three weeks, which seemed sufficient. It may be discussed whether this might be too short an intervention time to create a sufficient stimuli for the participants. Performing the power-calculations with a hope of detecting a 1.5 point increase in self-efficacy might also have been somewhat over-optimistic. Therefore, the sample might have been that a little too low, but after all 13 watches was the maximum we were able to get for this thesis and therefore we decided on that. In the planning of the study we had some discussion on how to create the social influence needed to create an increase in self-efficacy. As no good method was detected we left that out and instead urged the participants to seek out good exercise partners and to commit by telling others about their participation in the study. With few male participants enrolled in the study, it might be a weakness that those participants were not spread between the two groups with five men in the study group and three in the control group. With the dropout of one male participant from the study group and none from the control group it was one participant closer to equal.

Selection bias is systematic error caused by processes used to select study sample and from factors that influence the participation in the study. The participants enrolled in this study was limited to individuals who were following Cardiac Exercise Research Groups facebook-page and were interested and willing to test a new mHealth behavior change application in a 3-week intervention. At some of the participants in the control group, there was a notable disappointment when they didn’t get to try the mHealth application and activity watch as the study group. They were thoroughly informed about this beforehand, but it seemed like some of the participants were hoping to test this new application and device. This disappointment have most likely affected the some of the control group-participants motivation in the study. We hoped that the control group would continue as they normally do but the results show that though insignificant the control group as rather high increase of physical activity.

The sample in this study was diverse. The participants had a wide range in age. With people born in all decades from the 1990s to the 1950s. Education varied from only elementary school to more than 5 years of higher education, but a very high mean was still measured for both group with the study group slightly higher (see table 1). Therefore the sample in this study was generalizable for the Norwegian population in age but not in educational level.

The scales used in the questionnaires to gather information about motivation and physical activity have been used in several contexts and with different populations. They were all validated scales and those originally in English have been translated to Norwegian and used in earlier studies before included here. The T1-questionnaire was distributed by mail and the participants were to fill it out at home to prevent any influence by the intervention. The T2 questionnaire was to be completed with the author of the study at the final meeting, but because of the outbreak of the Covid19-virus this wasn't possible. Therefore, the questionnaires were completed at home, which might have affected the responses. The planned final meeting was planned for day 21 of the study. With no date of meeting, but only emails that day 21 of the study was closing in, some of the participants "forgot" to reply to the T2-questionnaire and therefore they had to be reminded a couple of times and some of the participants used almost 7 days longer. This could have interfered with their responses. Finding similar studies was challenging as there are few mHealth interventions targeting physical activity for a sedentary population. This study will therefore contribute its knowledge to later interventions. One factor omitted in this study is the participants physical capacity pre-study. A physical test could screen the participants and test the groups heterogeneity of the groups. Before enrollment the participants were asked how active they were and if they were interested in improving their physical condition, as the only test of capacity and motivation. Knowing their physical capacity pre-test more precisely could have revealed differences crucial to this study. The individual differences in physical capacity could have influenced the study findings.

8.5 Scientific contribution

Using a mHealth behavior change application to motivate sedentary people to become physically active did not work in this intervention. The lack of evidence of statistically significant increases in self-efficacy in this study states that the planning of such interventions needs precise planning and urges the need for studies which detects what parts of a mHealth exercise intervention affects self-efficacy. Earlier studies has shown good correlations between self-efficacy and increases in physical activity. The fact that this study didn't find statistically significant correlations between self-efficacy and physical activity gives us knowledge that an instant rise in intention to train (frequency) can be found when starting self-monitoring activity, but for a lasting adherence (exercise self-efficacy) and bettering of own health by high intensity training this intervention method was not sufficient.

9.0 Conclusion

In this study we could not find evidence to reject the hypothesis that implementation of a mHealth behavior change application in an exercise intervention would not create greater exercise self-efficacy for the intervention group than the control group which received standard care, i.e. instructions to follow national guidelines for physical activity without further supervision. Therefore this study supports the above hypothesis and suggests that as the human mentality and motivation is complex and a single-stimulus like the application in hand here is not sufficient to create a lasting behavior change. Interventions trying to alter long-term adherence to physical activity has to be planned broadly to interfere with all levels of the human psychology.

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Appendix

A) T1-questionnaire

Slik fyller du ut skjemaet

Sett kryss ved ☐

Krysser du av feil sted, retter du ved å fargelegge boksen helt

Ved tallrekke fra f.eks. 1 til 5, 1 til 7 eller 1 til 10 skal du sette ring rundt det svaret du mener er mest korrekt for deg.

Opprett din egen anonymisterte prosjekt-id ved å bruke tallene i din bostedsadresse f.eks. ved Tellefsens gate 12, så bruker du 12 + de to siste siffer i ditt telefonnr eks: 98765432 så bruker du 32 og din anonymiserte prosjekt-ID blir da 1232.

Les skjemaet nøye slik at du forstå hva de forskjellige tallresponsene faktisk betyr.

Personalia

I. Prosjekt-ID: ______

II. Kjønn

Mann ☐
Kvinne ☐

III. Fødselsår:

1920 -1929 ☐

1930 -1939 ☐

1940 -1949 ☐

1950 -1959 ☐

1960 -1969 ☐

1970 -1979 ☐

1980 -1989 ☐

1990 -1999 ☐

IV. Utdanningsnivå

Grunnskole ☐

Videregående/Gymnas ☐

1-3årig høyere utdanning ☐

4-5årig høyere utdanning ☐

Mer enn 5årig utdannelse ☐

Mosjon/Fysisk aktivitet

Med mosjon mener vi at du f.eks. går tur, går på ski, svømmer eller driver trening/idrett.

1. Hvor ofte driver du mosjon?

(ta et gjennomsnitt)

- Aldri ☐
- Sjeldnere enn en gang i uka ☐
- En gang i uka ☐
- 2-3 ganger i uka ☐
- Omtrent hver dag ☐

2. Dersom du driver slik mosjon, så ofte som en eller flere ganger i uka; hvor hardt mosjonerer du?

(ta et gjennomsnitt)

- Tar det rolig uten å bli andpusten eller svett ☐
- Tar det så hardt at jeg blir andpusten og svett ☐
- Tar meg nesten helt ut ☐

3. Hvor lenge holder du på hver gang?

(ta et gjennomsnitt)

- Mindre enn 15 minutter ☐
- 15-29 minutter ☐
- 30minutter til 1 time ☐
- Mer enn 1 time ☐

Livskvalitet

4. Hvordan synes du selv din fysiske helse er for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

5. Hvordan synes du selv din psykiske helse er for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

6. Hvordan er ditt forhold til deg selv for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

7. Hvordan er ditt forhold til dine venner for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

8. Hvordan er ditt forhold til din partner for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

9. Hvordan føler du deg? Har du de to siste ukene følt deg...

	Nei	Litt	En god del	Svært mye
Trygg og rolig?	☐	☐	☐	☐
Glad og optimistisk?	☐	☐	☐	☐
Nervøs og urolig?	☐	☐	☐	☐
Plaget av angst?	☐	☐	☐	☐
Irritabel?	☐	☐	☐	☐
Nedfor/ Deprimert?	☐	☐	☐	☐
Ensom?	☐	☐	☐	☐

Mestringstro

Jeg tror at jeg kan gjennomføre planlagt fysisk aktivitet selv om...

10. ... jeg er trett

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

11. ... jeg føler meg nedtrykt

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

12. ... jeg har bekymringer

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

13. ... jeg er sint på grunn av noe

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

14. ... jeg føler meg stresset

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

15. ... jeg har venner på besøk

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

16. ... andre vil at jeg skal bli med på en annen aktivitet

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

17. ... familien min/partneren min tar mye av tiden min

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

18. ... jeg ikke finner noen å trene sammen med

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

19. ... været er dårlig

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

20. ... jeg fremdeles har mye arbeid å gjøre

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

21. ... det er et interessant program på TV

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

22. ... jeg har smerter

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

23. ... aktiviteten er vanskelig tilgjengelig for meg

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

B) T2-questionnaire

Slik fyller du ut skjemaet

Sett kryss ved ☐

Krysser du av feil sted, retter du ved å fargelegge boksen helt

Ved tallrekke fra f.eks. 1 til 5, 1 til 7 eller 1 til 10 skal du sette ring rundt det svaret du mener er mest korrekt for deg. Hvis du ønsker å svare direkte i word-dokumentet, kan du f.eks. fargelegge eller sette kryss til høyre for riktig tallrespons.

Opprett samme anonymisterte prosjekt-id som ved oppstart av studien ved å bruke tallene i din bostedsadresse f.eks. ved Tellefsens gate 12, så bruker du 12 + de to siste siffer i ditt telefonnr eks: 98765432 så bruker du 32 og din anonymiserte prosjekt-ID blir da 1232.

Les skjemaet nøye slik at du forstå hva de forskjellige tallresponsene faktisk betyr.

Personalia

I. Prosjekt-ID: ______

II. Kjønn

Mann ☐

Kvinne ☐

III. Fødselsår:

1920 -1929 ☐

1930 -1939 ☐

1940 -1949 ☐

1950 -1959 ☐

1960 -1969 ☐

1970 -1979 ☐

1980 -1989 ☐

1990 -1999 ☐

IV. Utdanningsnivå

Grunnskole ☐

Videregående/Gymnas ☐

1-3årig høyere utdanning ☐

4-5årig høyere utdanning ☐

Mer enn 5årig utdannelse ☐

Del 1

Med mosjon mener vi at du f.eks. går tur, går på ski, svømmer eller driver trening/idrett.

1. Hvor ofte under studieperioden har du mosjonert?

(ta et gjennomsnitt)

Aldri	☐
Sjeldnere enn en gang i uka	☐
En gang i uka	☐
2-3 ganger i uka	☐
Omtrent hver dag	☐

2. Dersom du drev slik mosjon, så ofte som en eller flere ganger i uka; hvor hardt mosjonerte du?

(ta et gjennomsnitt)

Tar det rolig uten å bli andpusten eller svett	☐
Tar det så hardt at jeg blir andpusten og svett	☐
Tar meg nesten helt ut	☐

3. Hvor lenge holdt du på i snitt hver gang?

(ta et gjennomsnitt)

Mindre enn 15 minutter	☐
15-29 minutter	☐
30minutter til 1 time	☐
Mer enn 1 time	☐

Del 2

4. Hvordan synes du selv din fysiske helse er for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

5. Hvordan synes du selv din psykiske helse er for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

6. Hvordan er ditt forhold til deg selv for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

7. Hvordan er ditt forhold til dine venner for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

8. Hvordan er ditt forhold til din partner for tiden?

1 2 3 4 5

Meget god = 1 Meget dårlig = 5

9. Hvordan føler du deg? Har du de to siste ukene følt deg...

	Nei	Litt	En god del	Svært mye
Trygg og rolig?	☐	☐	☐	☐
Glad og optimistisk?	☐	☐	☐	☐
Nervøs og urolig?	☐	☐	☐	☐
Plaget av angst?	☐	☐	☐	☐
Irritabel?	☐	☐	☐	☐
Nedfor/ Deprimert?	☐	☐	☐	☐
Ensom?	☐	☐	☐	☐

Del 3

Ta for deg tiden etter studieperioden når du svarer på spørsmålene her

Jeg tror at jeg kan gjennomføre planlagt fysisk aktivitet selv om...

10. ... jeg er trett

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

11. ... jeg føler meg nedtrykt

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

12. ... jeg har bekymringer

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

13. ... jeg er sint på grunn av noe

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

14. ... jeg føler meg stresset

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

15. ... jeg har venner på besøk

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

16. ... andre vil at jeg skal bli med på en annen aktivitet

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

17. ... familien min/partneren min tar mye av tiden min

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

18. ... jeg ikke finner noen å trene sammen med

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

19. ... været er dårlig

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

20. ... jeg fremdeles har mye arbeid å gjøre

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

21. ... det er et interessant program på TV

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

22. ... jeg har smerter

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

Del 4

Hvilke verktøy i Amazfit-appen brukte du mest?

24. Antall skritt per dag

1 2 3 4 5 6 7 8 9 10

Ikke nyttig = 1 Veldig nyttig = 10

25. Mengden PAI (Personal Activity Intelligence) per dag?

1 2 3 4 5 6 7 8 9 10

Ikke nyttig = 1 Veldig nyttig = 10

26. Det å kunne sette personlige mål?

1 2 3 4 5 6 7 8 9 10

Ikke nyttig = 1 Veldig nyttig = 10

27. Å kontinuerlig kunne følge dagens aktivitet?

1 2 3 4 5 6 7 8 9 10

Ikke nyttig = 1 Veldig nyttig = 10

23. ... aktiviteten er vanskelig tilgjengelig for meg

1 2 3 4 5 6 7 8 9 10

Ikke sikker = 1 Helt sikker = 10

Del 5

Hvilke verktøy i Amazfit-appen var mest motiverende for deg?

28. Antall skritt per dag

1 2 3 4 5 6 7 8 9 10

Ikke nyttig = 1 Veldig nyttig = 10

29. Mengden PAI (Personal Activity Intelligence) per dag?

1 2 3 4 5 6 7 8 9 10

Ikke nyttig = 1 Veldig nyttig = 10

30. Vekt-endring?

1 2 3 4 5 6 7 8 9 10

Ikke nyttig = 1 Veldig nyttig = 10

31. Å kontinuerlig kunne følge dagens aktivitet?

1 2 3 4 5 6 7 8 9 10

Ikke nyttig = 1 Veldig nyttig = 10

Del 6

32. Har du hatt noen helseplager/utfordringer i studieperioden?

Ja ☐ Nei ☐

33. Beskriv kort hvilke?

34. Har du vært redd for å bli syk de siste ukene?

1 2 3 4 5

I liten grad = 1 I stor grad = 5

35. Tror du dette har påvirket din aktivitet i studieperioden?

1 2 3 4 5

I liten grad = 1 I stor grad = 5

C) Approval NSD

NSD Personvern

11.02.2020 09:16

Det innsendte meldeskjemaet med referansekode 731288 er nå vurdert av NSD.

Følgende vurdering er gitt:

NSD har vurdert endringen registrert 14.01.2020.

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 11.02.20. Behandlingen kan fortsette.

Endring: Utvalgskriteriet for informantene er endret.

Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 nr. 11 og art. 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse, som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes uttrykkelige samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a, jf. art. 9 nr. 2 bokstav a, jf. personopplysningsloven § 10, jf. § 9 (2).

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: Kajsa Amundsen
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

D) Information / Letter of approval

Forespørsel om deltakelse i forskningsprosjektet

"Effekten av bruk av smartklokke og aktivitetsapp på motivasjon».

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke effekten av bruken av et eHelse-verktøy, bestående av en smartklokke og en aktivitets-app, på motivasjon til å være fysisk aktiv. Videre ønsker vi å undersøke hvilken av de ulike komponentene for motivasjon som finnes i eHelse-verktøyet som motiverer deg mest.

I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

Fysisk aktivitet er en av nøkkelstrategiene for å motvirke livsstilsrelatert sykdom, og helsemyndighetene anbefaler derfor voksne å være fysisk aktive i minimum 150 minutter med moderat intensitet eller 75 minutter med høy intensitet per uke, eller en kombinasjon av de to. Imidlertid er det bare en liten del av befolkningen som imøtekommer disse anbefalingene for fysisk aktivitet. Bruk av smartklokker, aktivitetsmålere og helseapper har potensial å bidra til økt kunnskap om, og motivasjon til fysisk aktivitet, slikt at flere når tilstrekkelig aktivitetsnivå og helsegevinstene fysisk aktivitet gir.

Personlig Aktivitets-Intelligens (PAI) er en ny standard Cardiac Research Group (CERG) har utviklet for at alle kan se om de trener nok til å få eller beholde god helse. Flere av våre tidligere studier har koblet 100 PAI til et lengre liv og lavere sykdomsrisiko. Nå ønsker vi å finne ut om ei moderne treningsklokke og en nyutviklet app som regner ut PAI automatisk fra dine aktivitetsvaner motiverer tidligere inaktive menn og kvinner til å bli mer fysisk aktive. I tillegg til PAI-poeng måler den nye appen skritt, antall minutter fysisk aktivitet og treningsintensitet, og tilbyr muligheten å koble deg opp mot andre for gjensidig motivasjon og støtte.

Studiens formål er å undersøke effekten av bruken av et eHelse-verktøy, bestående av en smartklokke og en aktivitets-app, på motivasjon til å være fysisk aktiv. Videre ønsker vi å undersøke hvilken av de ulike komponentene for motivasjon som finnes i eHelse-verktøyet som motiverer deg mest.

Hvem er ansvarlig for forskningsprosjektet?

Institusjonene som er ansvarlige for forskningsprosjektet er NTNU ved Institutt for Sosiologi og Samfunnsvitenskap og Cardiac Exercise Research Group (CERG) ved Institutt for Sirkulasjon og Bildediagnostikk. Studien vil bli gjennomført som et samarbeid mellom instituttene, og er en masteroppgave ved studieprogrammet Master i Idrettsvitenskap hos NTNU.

Hvem kan delta?

Personer som er over 18 år, har liten tidligere erfaring med bruk av treningsklokker og helsesapper, og selv synes de har for lavt aktivitetsnivå i henhold til myndighetenes anbefalinger. Totalt søker vi 22 personer som møter disse inklusjonskriterier og ønsker å være med i prosjektet.

Du kan dessverre IKKE delta i prosjektet dersom du har fått treningsbegrensninger fra legen din.

Hva innebærer det for deg å delta?

Hvis du takker ja til å delta i studien så vil du tilfeldig bli tildelt plass enten i en treningsgruppe eller en kontrollgruppe. Er du i treningsgruppen vil du få teste en treningsklokke, få opplæring i aktivitetsappen, og få veiledning gjennom studieperioden på 3 uker. I tillegg vil du få en gjennomgang av hvor mye og hvilken type trening som er anbefalt for å få best mulig helseeffekt. Er du i kontrollgruppen blir du bedt om å følge helsemyndighetenes anbefaling om fysisk aktivitet. Alle deltakere vil bli bedt om å svare på et spørreskjema om motivasjon, aktivitetsnivå og flere andre faktorer både før og etter studieperioden.

De som svarer ja til å delta i undersøkelsen vil bli oppringt og innkalt til et oppstartsmøte ved St. Olavs Hospital i Trondheim. Dette møte vil ta rundt en halvtime, og det er her du vil bli trukket ut til din gruppe og få instruksjon om hva det innebærer. Før du kommer til undersøkelsen, vil vi sende deg et spørreskjema om dine aktivitetsvaner, din helse og livskvalitet, din motivasjon for fysisk aktivitet, og din tro til å være fysisk aktiv. Dette vil ta omtrent 15 minutter å fylle ut og skal tas med til oppstartsmøtet. Er du i treningsgruppen vil du også bli bedt om å rapportere din trening under studieperioden på 3 uker. Når studien er slutt vil du bli bedt om å fylle ut et ytterligere spørreskjema, og du kan bli bedt om å komme tilbake til et nytt møte.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykke tilbake uten å oppgi noen grunn. Alle opplysninger om deg vil da bli anonymisert. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Dersom du trekker deg fra prosjektet, kan du kreve å få slettet innsamlede opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige publikasjoner. Dersom du senere ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder.

Sensitivitet
Noen av spørsmålene i spørreskjemaet kan virke sensitive for noen, da du selv må vurdere deg selv og din fysiske tilstand. Vi ønsker derfor å informere om at hvis noen føler personlig ubehag, så anbefaler vi å ta kontakt med:
Mental Helses Hjelpetelefon på telefonnr: 116 123

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Informasjonen som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert.

Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste. Dersom du ikke ønsker at dataene du registrer i appen skal kunne knyttes til deg som person kan du benytte falskt navn og anonym epost. Vi i prosjektet vil ikke kunne følge med på din aktivitet som du måler gjennom appen og din aktivitetsklokke.

Prosjektleder har ansvar for den daglige driften av forskningsprosjektet og at opplysninger om deg blir behandlet på en sikker måte. Informasjon om deg vil bli slettet senest fem år etter prosjektslutt. Deltagerne vil ikke kunne identifiseres i publikasjonen av forskningsresultatene.

Godkjenning
Vi behandler opplysninger om deg basert på ditt samtykke. På oppdrag fra NTNU institutt for Sosiologi og Samfunnsvitenskap har NSD – Norsk senter for forskningsdata AS, vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med: NTNU institutt for sosiologi og samfunnsvitenskap ved Truls Torvik (mob 95142086, epost torviktruls@gmail.com). Veileder Ingar Mehus (epost ingar.mehus@ntnu.no) og biveileder Silvana Bucher Sandbakk (epost silvana.bucher@ntnu.no)

- Vårt personvernombud: Thomas Helgesen
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Silvana Bucher Sandbakk
Prosjektansvarlig
(Forsker/veileder)

Truls Torvik
Student

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet, og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i *prosjektet og at mine disse anonymiserte data kan benyttes i studien.*

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. *[1. april]*

(Signert av prosjektdeltaker, dato)