Is Heia Meg, a smartphone app, effective in helping users to make healthier lifestyle decisions about nutrition and physical activity?

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Abstract

Obesity is a common, costly, and life-threatening chronic disease characterized as abnormal or excessive fat buildup that causes a health risk. Overweight and obesity rates in adults and children continue to rise, whereas the frequency of overweight or obese children aged 5–19 years grew more than fourfold from 4% to 18% globally between 1975 and 2016. And in 2017 nearly 4 million individuals died as a result of being overweight or obese.

The present study investigated the usage of the application Heia Meg, and the effect of taking healthier lifestyle decisions regarding nutrition and physical activity. A prospective longitudinal study was conducted in collaboration with the Norwegian Directorate of Health. Participants were recruited through the application Heia Meg. All users downloading the app between October 4, 2021, and November 5, 2021, received a message containing an informed consent form and a link to the questionnaire. In the first (pre-intervention) questionnaire, 199 responses were included, while in the second one (post-intervention), there were 99 valid responses. Women outnumbered men in terms of participation, in both questionnaires, and age ranged from 18 years to 70 years and older. Men appear to have a higher Body Mass Index than woman, where both genders seem to be overweighted or grade I obese. Furthermore, when looking at the participants health score, men seem to have a higher health score than women.

Results: By analyzing the effect of the digital intervention on the Body Mass Index, a reduction has been observed between post and pre-intervention, while the health score was higher for the pre-intervention group than the post-intervention one. Furthermore, the Body Mass Index was able to account for a significantly amount of variance in the individual's health score for both groups (26.22% & 18.63%). A regression analysis was performed to assess the effect of independent variables on the health score. Gender, age, education, smoking, and BMI all had a statistically significant effect and accounted for significant amount of variance (44% & 35%).

Conclusion: From this study there is weak or no clear evidence to state that the app Heia Meg does lead to better nutrition and physical activity choices. This result can be attributed to the limitations and confounding factors described in the thesis, and further research – in other contexts – is needed to confirm, or not, this conclusion.

Keywords: lifestyle change, motivation, health, smartphone applications, Heia Meg

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1 Introduction

Consumers have benefited from the increasing availability of health information since the internet transformed access to information nearly two decades ago (Hasman, 2011). People may now access materials with a single touch of their keypads thanks to the development of smartphones. Smartphones, such as Android, iPhone, and Blackberry, give users access to a large number of health apps they can download (for free or not), many of which offer several features such as reference, tracking, and calculators, and cover a wide range of health-related issues. There are apps for counting calories and nutrition, calculating the Body Mass Index (BMI), monitoring diabetes, dealing with emergency circumstances, and improving workouts, for example. For the past few years, research on mobile health technology and consumer health informatics has been increasing in international literature (Hasman, 2011). According to research results, mobile phones can be useful tools for managing chronic conditions including hypertension, diabetes, and asthma (Hasman, 2011). In fact a report Sarcona et al. (2017) who looked at the differences in eating habits, physical activity, and health-related lifestyle choices among college students who used and didn`t use mobile health apps, found that users of mobile health apps had significantly higher eating behavior inventory scores or reported more positive eating behavior than nonusers. Furthermore, the use of mobile health apps was linked to improve lifestyle scores, although no statistical significance was found (Sarcona et al., 2017). In addition, a systematic study by Fry and Neff (2009) revealed that the use of periodic reminders in behavior modification interventions can be helpful. If reminders are given frequently and personal contact with a counselor is included, the effectiveness of the program will be improved. These insights can be utilized to improve periodic prompt interventions, which should result in increased effectiveness, positive behavior change, and better health (Fry & Neff, 2009). Text messaging, the capacity of smartphones to shoot photographs and video, and the rapid transfer of data have all been proven to have the potential to influence health outcomes (Fry & Neff, 2009; Hasman, 2011; Sarcona et al., 2017). While there are several publications regarding the use of mobile technology and health, there is still little research on the use or impact of health care apps on consumers. Therefore, this research thesis aims at contributing to filling this gap.

1.1 Determinants of health

The determinants of health are the element that influence people`s health throughout their lives, and health may be determined by where they live (forebygging.no, 2021). Individual life circumstances, social structures in the neighborhood and local community, the economics, culture, and political conditions in society are all determinants of health (forebygging.no, 2021). Systematic inequalities in health status that follow social and economic categories (particularly occupation, education, and income) are referred to as social inequalities in health (Helsedirektoratet, 2018). Because these health disparities are socially produced, they can and should be addressed. While socioeconomic health inequalities will be a gradient throughout the population, the relationship between socioeconomic status and health will be linear, where the statistics show that people with a higher socioeconomic status have better health, whereas those with a lower socioeconomic status have worse health (Helsedirektoratet, 2018).

Health is something that concerns everyone and is a wide topic that may be seen and described in variety of ways. “Health is not just the absence of disease and weakness, but also a state of complete physical, mental and social wellbeing” according to the World Health Organization (WHO) (Mæland, 2009, s.42). Fugeli & Ingstad (2009, s.41) examine three dimensions of health understandings, including positive and negative, subjective, and objective, holistic and reductionist perspectives. When viewed from a positive perspective, health is defined as the existence of numerous qualities such as energy, coping ability, and well-being, however when viewed from a negative perspective, health is defined as the absence of certain traits such as illness. Furthermore, Fugeli & Ingstad (2009, s.41) describes how one experiences health through the subjective health theory, which defines health as a personal experience determined by each individual`s experience, feelings, and values, as compared to objective health theories, which view health as something measurable. Health is grounded in the human being’s entire existence and position, whereas reductionist health theories are based on the idea of disease, where health is defined as the absence of faults in one or more elements of the body or mind (Fugeli & Ingstad, 2009, s.41-42). In addition, there is no definite answer to the question of what health is, but there are various perspectives on what health is and how it might be obtained (*Helsemodeller og forebyggende helsearbeid*, 2004). Such perceptions are referred to as health models. Health models can be utilized in research as they provide information on how groups of individuals think and could be used to highlight inequalities in thinking and acting (*Helsemodeller og forebyggende helsearbeid*, 2004). As for this study the health models are

used to investigate the different types of health thinking that are being used and have an impact on preventative health action. In regard to an examination of preventive health work four health models appear to be particularly relevant, as the biomedical health model, the public health model, as one`s ability to function or fulfill the roles imposed on one`s social position and, the political model (*Helsemodeller og forebyggende helsearbeid*, 2004). Illness is seen as a break from the usual, while health is seen as the norm. The focus is only on the body and bodily problems, and health has become an either-or proposition, yet the medical health paradigm is complex (Engel, 1977; *Helsemodeller og forebyggende helsearbeid*, 2004). The biomedical health model is often linked to a disease model that is referred to be reductionist, this because it aims to reduce diseases to problems in ever-smaller biological parts or to biological processes that are limited. Despite this, biomedicine`s greatest success has been reductionism. Control and duty, but also the right to health, have been linked to the expert-led health paradigm where the responsibility to health is regulated though laws regulating what foods can be sold to consumers, as well as measures related to harmful infectious diseases (Engel, 1977; *Helsemodeller og forebyggende helsearbeid*, 2004). The infection control act is an example of a law that refers to both the obligation and the right to health. Furthermore, expanded WHO the biomedical health model and established a holistic ideal model for health where health is seen as complete physical, mental, and social well-being, and not just as the absence of illness and blemish (*Helsemodeller og forebyggende helsearbeid*, 2004; Mæland, 2009, s.42). The concept of health presented by WHO (health is seen as complete physical, mental, and social well-being, and not just as the absence of illness and blemish) is referred to as positive because disease is not the opposite of health, on the other hand, is the biomedical approach referred to be negative because it focuses on disease and has been criticized for its limited scope (*Helsemodeller og forebyggende helsearbeid*, 2004). Another model named the public health model includes the "ordinary" people`s opinion of health, where being "ordinary" indicates that we relate to a different world of existence than the medical world of the expert and, after all the medically oriented reality of the WHO (*Helsemodeller og forebyggende helsearbeid*, 2004). Furthermore, have international studies shown that the ordinary people tend to perceive health as, firstly, the absence of disease, as the biomedical model does, and secondly as one`s capacity to cope with life events such as illness of shorter or longer duration, which seems to fit with the Nordenfelt`s health definition: "A person's health is constituted by his or her ability to realize vital goals" (Nordenfelt, 1995). And third, as one`s ability to function or fulfill the roles imposed on one`s social position (*Helsemodeller og forebyggende helsearbeid*, 2004). Although the public health model is really not true in medical terms, it is undeniably influenced by biomedicine. For

example, is stress viewed as unhealthy, and this way of thinking is most likely influenced by psychosomatic thinking in medicine, which claims that individuals get sick from stress and that coping stress is crucial for one`s health (*Helsemodeller og forebyggende helsearbeid*, 2004). The fourth health model is the political model or the empowerment model, where liberation and fundamental concepts are important. This model`s goal is to empower individuals where all professional expert and system that have influenced the population and patients in specific direction is removed (*Helsemodeller og forebyggende helsearbeid*, 2004). The motivation for investing in this health model was first and foremost, disagreement with biomedicine`s disease-focused approach and restricted, reductionist view of health. Instead of focusing on issues that can lead to health failure, forces within the preventative professional environment preferred to focus on positive elements that can enhance health (*Helsemodeller og forebyggende helsearbeid*, 2004). The term “empowerment” is utilized at both macro and micro levels. At macro level, empowerment refers to boosting a group`s collective power, while at micro level, empowerment refers to enhancing an individual`s control over himself and belief in himself. The primary idea being the empowerment model is that people should have control over their own life. As the expression goes "empowerment" refers to the distribution of power. People must be made aware of their own condition and how they may impact their surroundings, as well as acquire personal abilities that provide them with control over their own life, in order to come into position (*Helsemodeller og forebyggende helsearbeid*, 2004; Sørensen et al., 2002). Furthermore, people must nourish their own goals, needs, and participation in decision-making.

1.2 Overweight and Obesity

Overweight and obesity rates in adults and children continue to rise (*Obesity*, 2021). and according to the World Health Organization the frequency of overweight or obese children and youths aged 5-19 years grew more than fourfold from 4% to 18% globally between 1975 and 2016 (*Obesity*, 2021). Obese individuals outnumber underweight people worldwide, and overweight and obesity are associated to more fatalities globally than underweight (World Health Organization, 2020). We are also seeing a significant increase in overweight and obesity in the Norwegian population, which is mostly attributable to an energy intake/consumption imbalance (*Overvekt Og Fedme Hos Voksne - Helsedirektoratet, 2013*). Furthermore, according to the Norwegian Directorate of health, this increase is linked to increased inactivity, which can lead to variety of diseases over time, including increased mortality compared to normal weight, increased risk of heart attack, stroke, high blood pressure, type II-diabetes, several cancers,

musculoskeletal disorders, mental disorders, and so on. With growing levels of obesity, particularly abdominal obesity, the risk of these diseases rises (*Overvekt Og Fedme Hos Voksne - Helsedirektoratet, 2013*). Another study called "The Norwegian study": It`s never too late to start, exanimated the associations between long-term (11-22 years) dedication to physical activity recommendations and all-cause mortality and cardiovascular mortality (Moholdt et al., 2021). It's a population-based prospective study with repeated self-reported physical activity assessments (1984-86, 1995-97, and 2006-08) and follow-up until the end of 2013. All participants were women and men over the age of 20 years, with 32 811 people participating in the years of 1984-86, and 1995-97, 22 058 people participating in the years of 1984-86 and 2006-08, 31 948 people participating in the years of 1995-97 and 2006-09, and 19 349 people participating in all three examinations (Moholdt et al., 2021). The heart rates of all-cause mortality and cardiovascular disease mortality within each category of change in physical activity were calculated using a Cox proportional hazard model, compared to the reference category of individuals who reported maintaining the recommended level of physical activity over time. Moholdt et al. (2021) found that those who were physically inactive or had a level of physical activity below the norms had significantly increased mortality after 11 or 22years, compared with the participants who reported long-term dedication to physical activity recommendations. Individuals who resumed physical activity following the recommendations at the most recent examination after being inactive did not have significantly greater all-cause or cardiovascular disease mortality than those who reported long-term commitment, which is important for public health. Individuals who become inactive over time had nearly the same mortality as those who reported being inactive at all examinations (Moholdt et al., 2021). The conclusion of the finding stated that people should attempt to even up for their former inactivity or being below the level of recommendation of physical activity by implementing the recommended level of physical activity later in life. Moholdt et al. (2021) also found that people who earlier in life meet the recommendation of physical activity, and later in life found to be below the recommendation of physical activity did not confer any benefits later in life when becoming inactive. The findings of Moholdt, indicating the importance of being physical active and that it is never too late to change one's lifestyle when it comes to being physical active. Another study conducted in the United States, found that physical inactivity is the primary cause of increased mortality and morbidity in overweight (at least with a BMI up to 35), but that even if being overweight can lead to physical inactivity, the risk of weight-related disease can be significantly reduced in people through good physical shape (Sui et al., 2007). Increasing overweight and obesity has both health and economic consequences, such as the fact that

weight-related health problems account for 2-6 percent of total health costs when total societal costs associated with diseases, physical inactivity, obesity, and unhealthy diets are considered (WHO Consultation on Obesity & Organization, 2000).

Weight loss reduces risk of diabetes, improves blood pressure, lowers the need for blood pressure medications, improves blood fat and HDL cholesterol, and improves quality of life in those who are overweight or obese (Hauge & Tonstad, 2020; WHO Consultation on Obesity & Organization, 2000). A weight loss of 5-10% is usually sufficient to cause numerous beneficial consequences, such as improved lung function and breathlessness, reduced daytime somnolence, improved sleep quality and reduce frequency of sleep apnea (WHO Consultation on Obesity & Organization, 2000). Overweight people can commonly lose between 5-10% of their weight or more in short term, but sustained weight loss might be difficult for many. There are numerous different diets that can help losing weight, and it`s usually recommended to cut the daily calorie consumption by 500 to 1000 calories. To avoid regaining weight, these diets must be followed by long term dietary adjustments (Hauge & Tonstad, 2020). If increased physical activity is included in the plan, weight loss will be far more likely to be maintained. While 30 minutes of exercise per day is recommended for healthy adults, maintaining weight loss may require as much as 60-90 minutes on most days of the week (Hauge & Tonstad, 2020).

1.2.1 Overweight & BMI

Overweight and obesity is a condition in which the body stores too much energy in form of fat tissue (Gupta, 2014; Hauge & Tonstad, 2020). The difference between the organism's overall energy usage and its energy intake is the stored energy. Even in persons who gain weight, this balance is quite effectively maintained. A nine-kilogram weight gain between the ages of 25 and 55 (which is fairly unusual in Western industrialized countries) represents only 0.3 percent of total energy intake (Hauge & Tonstad, 2020). The body mass index, often known as BMI, can be used to determine the degree of obesity. It`s a fraction in which the numerator is the weight in kilograms and the denominator is height in meters to the second power (kg/m^2) A BMI of 18.5 to 25 kg/m^2 is considered normal weight (Hauge & Tonstad, 2020; Weir & Jan, 2021).

BMI	Definition
<18,5	Underweight

18,5 - 24,9	Normal Weight
25,0 - 29,9	Overweight
30,0 – 34,9	Obesity grade I
35,0 – 39,9	Obesity grade II
≥ 40	Obesity grade III

Table 1. BMI categories defined by WHO.

1.3 The «Heia Meg» application

The "Heia Meg" app was built by the Norwegian Directorate of Health in collaboration with the TRY company, with inspiration and background from a comparable web-based intervention from the United Kingdom (UK) called "One You," as well as an earlier app called "Slutta" (Angeltveit & Natvik, 2020). The project is based on the concept that motivation influences changing behaviour, and it is intended to be non-directly supporting. The Norwegian Directorate of Health has also developed an app called "Slutta" or "Quit" (in English). This app was made for people who wanted to quit smoking (unpublished document, delivered by the Norwegian directorate of Health). The "Quit" app received massive attention from Norwegian citizens and is currently a useful tool for people who aim to quit smoking. They continued to apply the self-efficacy and positive psychology approaches in the "Heia Meg" application as a result of the "Quit" application`s results (unpublished document, delivered by the Norwegian directorate of Health). The self-efficacy theory was developed by psychologist Albert Bandura and is defined as people`s conviction in their ability to regulate their own processes and events that affect their life (Bandura, 1991).

The following are some examples of self-efficacy in the app:

- Inspiring alternatives to harmful health outcomes.
- Support via push notifications.
- Use push alerts to avoid succumbing to temptation
- Use push alerts and follow-up to encourage positive behaviour.

The pursuit of well-being, a happy life, and happiness has been one of the humanities`s most enduring movements throughout history (Compton, 2005). Positive psychology is the most recent attempt to solve one of the most perplexing problems of our time "what is happiness?". Positive psychology is employed in Heia meg app as follows:

- How to deal with pressure and stress.
- You will receive push alerts informing you that you are able to do so.

The push alert arrives on a regular basis and a set time. Throughout the procedure, advice and follow-up are provided.

Figure 1. Screenshot from Heia Meg application.

So, after downloading the app, one must agree to the applications term of usage before being asked to choose between two of five themes to focus on. Users can choose between exercise, mental health, alcohol, sleep habits, and dietary intake, and after choosing theme, the application will send messages in the app on a regular basis, and if the user accept notification from the app, the messages will point up as a notification on the user's phone saying "You got a new message in Heia Meg application" whenever a new message is received in the app. The app`s messages include encouragement, facts regarding the chosen theme, various of challenges, and useful recommendations. The messages are all written in Norwegian and consist of a short text of 1-3 phrases, with no emojis or abbreviations. And at any time, the users can change the behavior one wants to focus on or start anew.

1.4 Motivation

To be motivated means to be driven to do action. Unmotivated people lack the motivation or inspiration to act, whereas motivated people are inspired or activated toward a goal (R. M. Ryan & Deci, 2000). Most everyone who works or plays with others is concerned with motivation, and practitioners of all types are faced with the perennial problem of encouraging more or less drive in those around them. Most motivation theories reflect these problems by treating motivation as a single phenomenon that ranges from a lack of motivation to a great deal of it. Even a cursory examination reveals that motivation is not a homogeneous phenomenon (R. M. Ryan & Deci, 2000). Human beings can either be proactive and engaged or passive and detached, depending on the social conditions in which they develop and function (R. Ryan & Deci, 2000). As a result, research led by self-determination theory has concentrated on the social–contextual variables that help or hinder natural self-motivation and healthy psychological development. Factors that boost vs inhibit intrinsic motivation, self-regulation, and well-being have been studied in detail. The findings have led to the hypothesis of three innate psychological needs: competence, autonomy, and relatedness, which, when met, contribute to increased self-motivation and mental health and, when unmet, to decreased motivation and well-being (R. Ryan & Deci, 2000). People have different levels of motivation and different motivation types. Researchers differentiate between several types of motivation in Self-Determination Theory based on the different reasons or goals that lead to an action (R. M. Ryan & Deci, 2000). The most basic contrast is between intrinsic motivation and extrinsic motivation, which relates to doing something because it is naturally fascinating or enjoyable. Over three decades of research has revealed that the quality of experience and performance can fluctuate dramatically depending on whether one is acting for intrinsic or extrinsic motivations (R. M. Ryan & Deci, 2000). For educators, intrinsic drive has emerged as a significant phenomenon—a natural source of learning and accomplishment that can be actively stimulated or impeded by parental and teacher practices. Because intrinsic motivation leads to high-quality learning and creativity, it's critical to understand the variables and forces that encourage or discourage it (R. M. Ryan & Deci, 2000). Extrinsic motivation encompasses a wide range of motivational styles. Extrinsic motivation has traditionally been described as a pale and impoverished form of motivation in contrast to intrinsic drive in the classic literature. According to self-determination theory, there are various sorts of extrinsic motivation, some of

which are impoverished forms of motivation and others of which are active, agentic states (R. M. Ryan & Deci, 2000).

According to the Norwegian encyclopedia motivation is a collective term for the elements that initiate and control humans' action (Teigen, 2020). The motivation that initiates is often referred to as the energy component of motivation (what drives us forward and determines effort and endurance), while the motivation that control our actions is associated with the motivation`s direction (what goals we set, and what choices we make) (Teigen, 2020). On the other hand, Bandura states that motivation is a broad term that refers to a set of regulatory processes that have both directional and activating effects (Bandura, 1991). At a generic level, it refers to the different types of events that moves on to action, while the level of motivation is commonly measured as the choice of courses of action, intensity, and persistence of effort. Another way of seeing motivation, is that motivation refers to the series of events that begins with motives or anticipated incentives and goals and ends with end-states (Deckers, 2018). Motives are satisfied, incentives are obtained, and objectives are met. To better understand how motivation operates, scientists have studied a person's internal dispositions and external circumstances. Deckers (Deckers, 2018) looked at what biological and psychological factors contribute to motivation, and what causes motivation, and why do we place a higher value on certain incentives and objectives than others.

Bandura utilizes social cognitive theory to clarify the determinants and intervening mechanics that control goal selection, activation, and persistence (Bandura, 1991). Late social cognitive theory distinguishes between three main sources of motivation, the first of which is biological in nature and includes biological conditions arising from cellular deficits as well as aversive events that activate consummate and persistent behavior (Bandura, 1991). Rather than being driven solely by biological urges, human action is substantially initiated and governed by foresighted and generative cognitive mechanisms. The second category of motivators is based on social reward. That is, bodily pleasurable experiences are related with expressions of others` attention and acceptance during growth, whereas painful ones are associated with rejection or mistrust (Bandura, 1991). Social emotions become predictors of primary rewarding and punitive effect as a result of these experiences, and therefore become incentives. The predictive value of social reactions as incentives, rather than the reaction itself, determines their effectiveness as incentives. As a result, the praise or rejection of people with the authority to reward or punish functions as a stronger motivator than equivalent emotions from people who

have little influence over one`s life (Bandura, 1991). The third most important source of motivation is cognitive. People encourage themselves and guide their activities in anticipation by exerting thoughtfulness, which is a cognitively created incentive (Bandura, 1991). They forecast the expected outcomes of potential actions, create goals for themselves, and devise strategies for achieving valued futures. Cognitive activity is at the foundation of self-motivation and deliberate behavior. Early experiences cannot be the source of current motivation or action, but they can be turned into current motivators and regulators of behavior through cognitive representation in the present (Bandura, 1991).

On the other hand, Decker (2018) invest the internal and external sources of motivation, where the internal sources can be divided into the biological variables and physiological variables that determine motivation. The Biological factors are physical and psychological aspects of the body and brain that influence behavior (Deckers, 2018). While the Psychological factors is referred to as the mind`s qualities, such as motives, and are explored in an indirect manner using measurable indicators like one's body language. Furthermore, the external motivation is seen as the natural worlds source of inspiration. Environmental variables are those aspects of incentives and goals that have the power to attract or repel people (Deckers, 2018). Positive traits entice us to pursue the reward, whilst negative characteristics drive us. In general, incentives and goals with higher levels of attraction or repulsion are more motivating than those with lower levels of attraction or repulsion. As a result, if the value of an incentive can be identified, its motivational power may also be determined (Deckers, 2018)

1.5 M-health

Mobile health (mHealth) is a relatively new field with a lot of potential to make a good impact while also reaching a huge part of the population in a cost-effective way. mHealth is a branch of eHealth that uses technology to improve people`s health (WHO Global Observatory for eHealth & World Health Organization, 2011). mHealth is described as a public and medical health practice supported by mobile devices such as personal digital assistants, patient monitoring devices, mobile phones, and other devices that incorporate the use and capitalization of a mobile phone, as well as core messaging and voice tools. More advanced applications and features are also being used in mHealth, such as Bluetooth technology, general packet radio service (GPRS), global positioning service (GPS), and third and fourth generation mobile telephony (3G and 4G systems) (WHO Global Observatory for eHealth & World Health

Organization, 2011). Previous studies in the area show that multiple apps supporting good health behavior can be found in the Appstore categories “health and fitness,” with the number of apps accounting for 2.9% in Google Play and 8.8% in Appstore (Antezana et al., 2020). In 2014, their use increased by 89 percent and 174 percent in the two app stores, respectively. Technologies that can record a user`s behavior are growing in popularity, and they provide cost-effective insight into the user`s everyday activities. Despite the potential for apps to impact health behavior, there is limited evidence of their foundation in health theory (Antezana et al., 2020). According to Antezana et al. (2020) apps aimed to influence health behaviors had low levels of theory of behavior change techniques, and that enhanced implementation of behavior change techniques could lead to higher user engagement and better interventions. Apinaniz et al. (2019) conduced a randomized controlled trial to examine if a mobile app could help overweight and obese adults live a healthier lifestyle. The use of the app “AKTIDIET” for lifestyle improvements in obese and overweight persons is not advised, according to this study, but additional evidence is needed. Flores Mateo et al. (2015) conduced a meta-analysis to evaluate the effectiveness of a mobile app with other methods for losing weight and increasing physical activity. There were significant differences in body weight changes by utilizing a mobile app compared to the control group, but no significant difference in physical activity changes by the intervention group compared to the control group in their analysis, which included 12 research. As a result, Flores Mateo et al. (Flores Mateo et al., 2015) stated that using a mobile app for weight loss may be beneficial and that more high-quality studies are needed on this topic. Overweight and obese people were included in the studies by Apinaniz et al. (2019) and Flores Mateo et al. (2015) also included physical activity, and Apinaniz et al. (2019) found no significant differences in weight loss. However, Flores Mateo et al. (2015) discovered significant variations in weight reduction but not in physical activity, indicating that more research is needed on this area. Covid-19 (Coronavirus illness 2019) is a disease caused by the SARS-CoV-2 virus, which was found in Wuhan, China, in December 2019 (CDC, 2020). It is very contagious and has spread rapidly over the world and is most commonly associated with respiratory symptoms that resemble a cold, the flu, or pneumonia, and has the potential to infect more than just one`s lungs and respiratory system. The condition may also affect other sections of one`s body (CDC, 2020).When looking at factors linked to covid-19 deaths, Williamson et al. (2020) and the centers for disease control and prevention investigated factors linked to Covid-19 death and discovered that comorbidities such as diabetes, cardiovascular illness, obesity, previous cancer or recent other cancer, autoimmune disorders, and neurological diseases were all linked to a higher risk of severe illness or dying from Covid-19. Overweight

and obesity was defined using BMI, and a BMI of 25 or higher is defined as overweight, and obesity is defined with a BMI of 30 or higher, and severe obesity is defined with a BMI of 40 or higher, where a higher BMI, the chance of severe covid-19 sickness rises dramatically (CDC, 2022). Another retrospective cohort study by Simonnet et al. (2020) investigated the link between clinical parameters, such as BMI, and the need for invasive mechanical ventilation (IMV) in 124 consecutive Covid-19 patients admitted to intensive care in a single French facility and found that obesity (BMI > 30) and severe obesity (BMI > 35) were found to be present in 47.6% and 28.2% of patients, respectively. In total, 85 patients (68.6%) out of 124 patients required IMV. The number of patients who required IMV grew with BMI categories (P = 0.01), with the highest proportion in patients with BMI > 35, (85.7%). The need for IMV was strongly linked with gender male (P = 0.05) and BMI (P = 0.05) in multivariate logistic regression, regardless of age, diabetes, or hypertension. Simonnet et al. (2020) concluded that obesity was shown to be frequent among Covid-19 patients hospitalized to intensive care unit. The severity of the disease worsened as the BMI increased, and obesity is a risk factor for the severity of Covid-19, necessitating greater attention to preventive measures in those who are susceptible (Simonnet et al., 2020). Another prospective, community-based, cohort study who took place in England, found among 6 910 695 eligible persons with a mean BMI of (26 * 78 kg/m2 [SD 5 * 59]), was 13 503 (20%) of them brought to hospital, while 1601 (0.2%) was sent to an ICU, and 5479 (0.8%) out of 6 910 695 died with a positive Covid-19test (Gao et al., 2021). Gao et al. (2021) discovered a linear rise in the risk of severe Covid-19 resulting to hospitalization and mortality at a BMI of more than 23 kg/m2, as well as a linear increase in admission to an ICU over the whole BMI scale, which is not linked to increased risks of related diseases. People under the age of 40 and of black ethnicity are at higher risk when their BMI rises (Gao et al., 2021).

2 Theoretical perspectives

Theories and models of health behavior can be used for a variety of purposes, including attempting to understand health behavior and its determinants, changing health behavior, realizing scientific advancements, and putting knowledge into reality (de Vries, 2017). But what exactly is a theory? A theory is a collection of interconnected concept, definitions, and assertions that give a systematic view of events or situations by identifying relationships among variables in order to explain and predict them (Glanz et al., 2008). Theories are abstract by definition; they don`t have a specific content or topic area. They have a shape and limits, but nothing definite inside, like an empty coffee cup. Only when they are filled with practical topics, aims, and challenges do they come alive in public health and health behavior (Glanz et al., 2008). As a result, theories and models describe behavior and provide methods for changing it. Because this thesis focuses on individual behavior modification, theoretical models from health psychology were used to create the experiment approach. The majority of social-cognitive theories assume that the desire to change is the best predictor of actual change, although people rarely act in accordance with their intentions (Schwarzer & Luszczynska, 2008). Sometimes unexpected obstacles might arise, or people can fall into temptations. People's belief in their own ability to produce designated levels of performance that exert influence over events that affect their behavior is defined by the self-efficacy model implemented in the application Heia Meg, which means that the perceived belief in mastery is defined by people`s belief in their own abilities to produce designated levels of performance that exert influence over events that affect their behavior self-efficacy deserves a citation here (Bandura, 1991). People's feelings, thoughts, motivation, and behavior are all influenced by their belief in mastery. This belief is formed by four distinct processes: cognitive, motivational, emotional, and selection. However, before users of this software can experience a sort of mastery belief, they must first download and install it. As a result, I`ve chosen that this thesis 'theoretical foundation' will be built on the concepts of the Health Belief Model, The self-efficacy theory, and the I-Change model. Testing multiple theories and identifying alternative pathways will be necessary for progress in health psychology (de Vries, 2017).

When one or more constructions form theory A` are combined with another theory B`, this is referred to as combining. Integrating these constructs necessitates thorough testing (de Vries, 2017). Combining theories, on the other hand, necessitates a simple additive model. An additive approach has several drawbacks, including the fact that it does not critically reflect on the added value of new constructs and may result in wheel reinventions (de Vries, 2017).

2.1 The Health Belief model

The Health Belief model (HBM) was first created in the 1950s by a social psychologist in the US public health service to explain why so many people fail to participate in disease prevention and detection programs (Glanz et al., 2008). HBM has been one of the most commonly used conceptual frameworks in health behavior research since its foundation in 1950, "both to explain change and maintenance of health-related behaviors and as a guiding framework for health behavior interventions" (Glanz et al., 2008; Rosenstock, 1974). Furthermore, the HBM encompasses ideas like as susceptibility, seriousness, advantages and berries to behavior, cues to action, and most recently self-efficacy, which predict why people would take action to avoid, screen for, or control medical conditions (Glanz et al., 2008)

> "*If individuals regard themselves as susceptible to a condition, believe that condition would have potentially serious consequences, believe that a course of action available to them would be beneficial in reducing either their susceptibility to or severity of the condition, and believe the anticipated benefits of taking action outweigh the barriers to (or costs of) action, they are likely to take action that they believe will reduce their risks*" (Glanz et al., 2008).

The perceived susceptibility relates to people`s perceptions about their chances of contracting an illness or condition. For example, a woman must believe there is a chance she will get breast cancer before she considers getting a mammography (ediblepsych, 2020; Glanz et al., 2008; Mark & Paul, 2005). While perceived severity relates to the feelings about the seriousness of developing a disease or of leaving it untreated includes evaluations of both medical and clinical implications (for example, disability, death, and pain) as well as possible social consequences (such as effects of the conditions on work, family life, and social relations) (ediblepsych, 2020; Glanz et al., 2008; Mark & Paul, 2005). Perceived threat is a term that refers to the combination of susceptibility and severity. And the perceived benefits are how a person feels personal susceptibility to a severe health condition, the individual`s beliefs about the perceived advantage of the many potential activities for reducing the illness threat will determine whether this perception leads to behavior change (ediblepsych, 2020; Glanz et al., 2008). Other non-health views, such as the financial savings associated with quitting smoking cues to action or satisfying a family member by getting a mammogram, may also affect behavioral decisions.

Individuals with ideal beliefs in susceptibility and severity are unlikely to adopt any advised health intervention unless they also believe the action has the ability to reduce the threat. Furthermore, the perceived barriers are the potential negative consequences of a health action perceived barriers could operate as a barrier to engaging in recommended behaviors. “It could help me, but it could be expensive, have undesirable side effects, be uncomfortable, inconvenient, or time consuming,” individuals assess the action´s predicted benefits against perceived barriers in a form of unconscious cost-benefits analysis (ediblepsych, 2020; Glanz et al., 2008). As a result, “the energy or force to act is provided by the combined levels of susceptibility and severity, and the perception of advantages (minus barriers) provides a preferred path of action” (Glanz et al., 2008). While cues to action is the concept of inputs that can trigger behaviors and was included in some of the HBM formulations earlier (Glanz et al., 2008). Hochbaum for example, believed that other elements may only increase readiness to act (perceived susceptibility and perceived benefits), particularly indications to act, such as physical occurrences, or environmental events, as media coverage (Hochbaum, 1958). Neither have action cues been thoroughly investigated. Self-efficacy is defined as “the conviction that one can successfully execute the behavior required to produce the outcomes” (Bandura, 1991; Glanz et al., 2008; Marks, 2002). Bandura (1991) contrasted self-efficacy predictions from outcome expectations, which are a person`s predictions that a particular conduct will result in specific results. The HBM idea of perceived benefits is similar to outcome expectancies, but they are not the same.

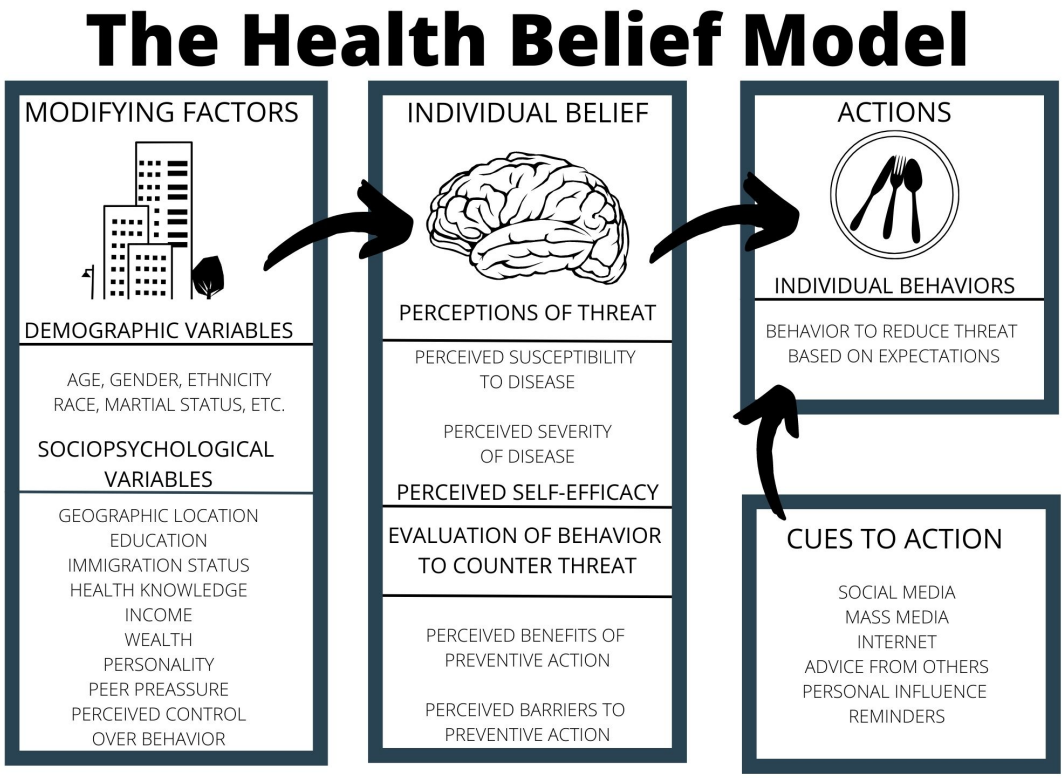

Figure 2. The Health Belief Model

2.2 Self-efficacy theory

Albert Bandura, a psychologist, is the founder of the self-efficacy theory (Bandura, 1991). When faced with tasks and challenges that affect one`s ability to act and experience control in a situation, self-efficacy is having faith in one`s own strengths. Something important to our self-perception, according to Bandura. Because the theory has already been implemented in practice, it seems reasonable to include it in the theoretical perspective. Self-efficacy theory as illustrated in Figure 3 shows four main sources of influence can shape people`s perspective of their own self-efficacy: (Lopez-Garrido, 2020)

(I) Mastery experiences (performance outcomes) - To bring forth the mastery experience, one must learn from new obstacle experiences in order to achieve, and one of the best ways to do so is to practice. Trough messages who have been added to the application “Heia Meg” which sends remainders about little challenges like “Try something new, what about a walk before bedtime? Remember to bring a headlamp”, “Select the stairs instead of the elevator”, and “Go for a 20-minute walk today”. This type of messages entails positive thoughts, which might help you believe in your ability to complete the challenge.

(II) Vicarious experiences (Social Role Models) - The second most important source of self-efficacy, deal with what we see other people do or accomplish. When you have positive role models in your life, you are more likely to carry some of the few positive beliefs about yourself with you. Family, friends, teachers, coaches, employers, and other can all serve as a role models. You feel like having a coach in your pocket when you read some of the application messages, which say things like “You don`t like hills, but they really have something beautiful to give. Hills give you a higher heart rate and a healthier heart. So, envision a goal line at the top while looking down and just go for it.”

(III) Social persuasion - Receiving vocal positive feedback while performing a tough activity is the third step in gaining self-efficacy, and it can persuade a person to believe that they have the skills and capacity to succeed. Verbal persuasion is effective for people of all ages, but it has the greatest impact the earlier it is used, increasing the likelihood that it will promote self-efficacy. The daily messages in the Heia Meg app are written in a verbally positive tone, with phrases like “Here`s a useful tidbit: Remember that something is better than nothing. As a result, the finest session is the one you finish:)”, and “Hooray! You`ve been at it for a week now. Many people find it difficult to begin started, so give yourself a pat on the back and keep going. Cheers!”.

(IV) Emotional and Physiological factors - They can have an impact on how someone feels about their own abilities in a certain situation. Even if you suffer from anxiety or depression, it is possible to develop self-confidence, but maintaining a good level of well-being will be more challenging. Individuals can increase their sense of self-efficacy by learning how to deal with anxiety and boost their mood in difficult situations. The app`s messages take into consideration the fact that not every day is the same and include motivational phrases like “Good company helps when motivation fades. Perhaps you know someone who wants to get in better shape as well? It is acceptable to ask about scheduling an activity together. If neither of you has been vaccinated against Covid-19, keep your distance.” And “Alternatively, here`s a tip for lazy days: Before you turn, go for a 5-minute walk. The first obstacle is always the most difficult, and you could change your mind and continue”.

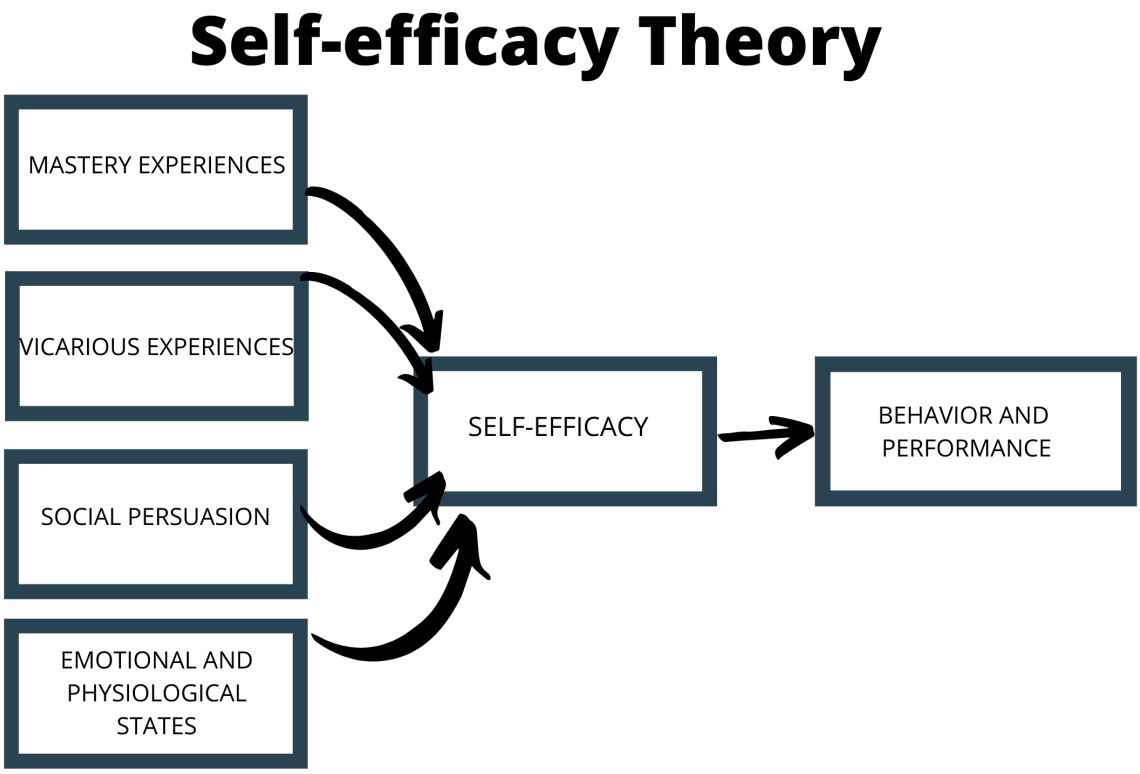

Figure 3. Self-efficacy Theory

2.3 The I-Change Model

The I-change model was created by Hein de Vries where he developed the integrated model to explain motivations and behavior change (*I-Change Model*, 2017). The I-Change model integrates aspects from various other theories, including the theory of planned behavior, the transtheoretical model for health behavior change, the social cognitive theory, the goal-setting theory, and health belief model, to create a motivation and behavior change model (Lungu et al., 2021). The I-Change model states that a person`s motivation or purpose to behave in a certain way determines both hidden (not observable) and open behavior (visible and observable) (*I-Change Model*, 2017; Lungu et al., 2021). Behavior is determined by a person`s motivation or intention. Motivation, in turn, is influenced by attitudes, social influences and self-efficacy. The perceived cognitive and emotional benefits and drawbacks of a person`s activity is defined as attitudes. Social modeling (The perception that others have this conduct), social norms (the rules that people have regarding this behavior), and social support obtained from others when executing the behavior are all examples of social influences on a person. Self-efficacy constructs a person`s impression of his capacity to accomplish a given type of behavior, and new research suggest that multiple varieties of self-efficacy exist, including stress-, social-

, routine-, and skills self-efficacy. The I-Change model as illustrated in Figure 4, assumes that two variables, information factors and preceding factors, influence communication outcomes (motivation, awareness, action, and behavior). The information factor: The importance of the source, channel, message, and messenger`s personal factors in determining the results of communication has been established in wide range of fields, including, but not limited to, health, marketing, education, and risk communication (Lungu et al., 2021). The preceding factors are predisposing factors for communication recipients and are divided into four categories: biological factors (e.g., gender or sex, ethnicity), psychological factors (e.g., personality, depression, and anxiety), behavioral factors (e.g., lifestyle and compliance with advice), and environmental factors (e.g., the availability of public health policies or lack of resources at community level). One's ability to prepare and execute detailed plans to achieve the intended behavior, will improve the likelihood of intentions being turned into actions, while barriers will reduce these chances (*I-Change Model*, 2017). Attitudes, social pressures, and self-efficacy expectations all play a role in determining a person`s motivation, where the advantages and disadvantages of an action are reflected in a person`s attitude.

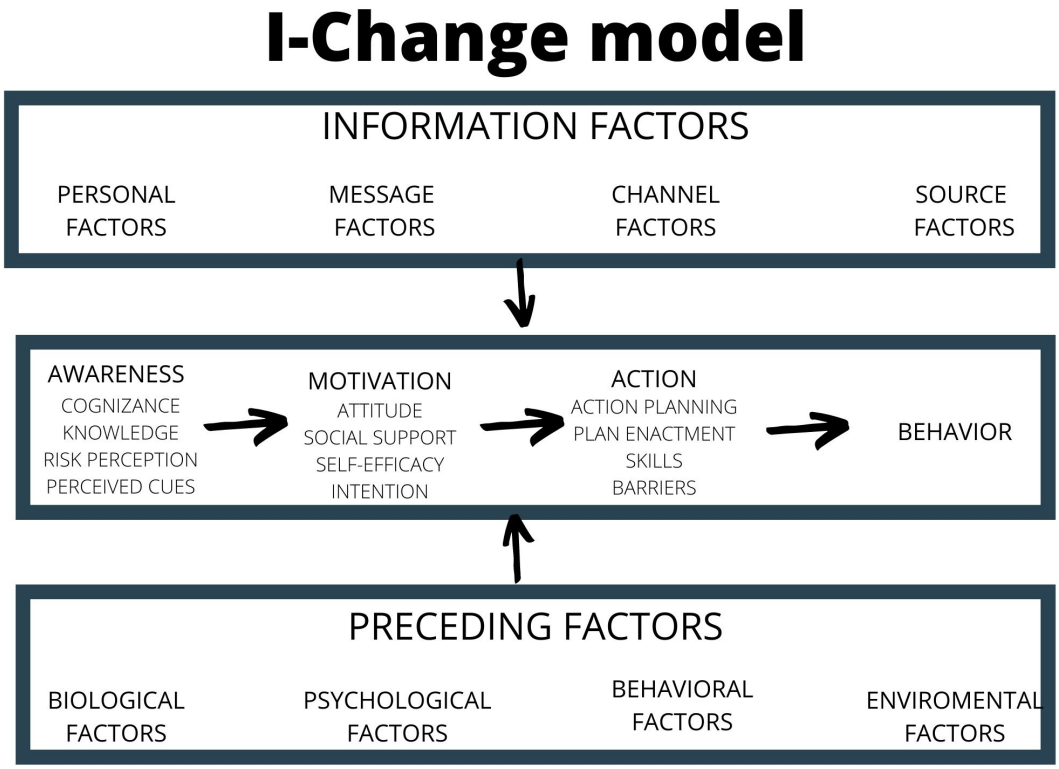

Figure 4. I-Change Model

3 Research question

After reading the National Institute of Public Health`s (NIPH) national public health survey, which presents a report of results on diet, self-reported weight, and weight development in the Norwegian population from 2020 (Abel, 2020). The report shows that over two-thirds of people wish to reduce weight or have tried to maintain their weight, and that many people have room for improvement when it comes to nutrition, as well as a big proportion of the population being overweight or obese. According to the findings of the public health survey on body weight and development, men`s average weight, height, and BMI were 86.6kg, 180.7cm, and 26.5 BMI (Abel, 2020). The percentage of men who were overweight or obese (BMI of 25 and up) was 59%, while the percentage of men who were underweight (BMI of less than 18.5) was 0.8%. On the other hand, the average weight, height, and BMI for women were 71.6kg, 167.3cm, and 25.6 BMI. The number of women who were overweight or obese (BMI of 25 and up) was 47%, while the proportion of women who were underweight (BMI of less than 18.5) was 2.7%. Overall, 16% of women and men had a BMI of 30 and up, which indicates obesity (Abel, 2020). The average person consumes two servings of fruits and vegetables each day, including juice, and according to the survey only 2.3% reported that they consume at least five servings each day. Furthermore, the report states that 43% of the participants eat fish 2-3 times each week, whereas 7% rarely or never eat fish for dinner. 30% said they ate sweets frequently (at least three times per week), while 10% report eating snacks, and 11% report eating sweet pastries at least three times per week (Abel, 2020). A large percentage of people report using soft fat or a combination of soft and hard fat types or none at all for bread, and 61% reported using soft fat, oil, or non-fat for frying. Further, when looking at sugary soft drinks, juices, and soda, 13% reported drinking sugary soft drinks three times a week or more, with the proportion being highest among younger men and reducing as education increased. Dietary changes were also mentioned, with 5.4% reported following a low-carb diet, 3.8% reported following a calorie-reduced diet, and 3.3% reported they fasted on a regular basis (Abel, 2020).

Although the public health survey indicates that Norway`s population has a need and desire to change their lifestyle regarding nutrition and weight loss, it is important to note that this survey was conducted on a sample of the Norwegian population, with approx. An equal number of participants were invited from each county, with a response rate of 38% and 8852 people aged 18-29years from all over Norway participating (Abel, 2020). So, how can one assist the population in losing weight and changing dietary habits, when the result of this report states

that two-thirds wish to reduce their weight. Is there a way of using an app that delivers useful information and guidance for making healthier dietary choices, as well as encouraging messages to do more exercise?

In general, all statistical hypotheses are present in all statistical tests. (Kwak & Park, 2019). A statistical hypothesis is a prediction regarding a population parameter. It`s possible that this assumption is correct, and to assess the validity of this hypothesis, a researcher could perform statistical research. The null hypothesis and the alternative hypothesis are two hypothesis that are commonly used in all data sets, whereas the distribution of the population is assumed to be normal (Kwak & Park, 2019). As a result, here are the null hypothesis (H0) and alternative hypothesis (Ha):

Problem statement:

Is Heia Meg, a smartphone app, effective in helping users to make healthier lifestyle decisions about nutrition and physical activity?

Ha: The app leads to better nutrition and physical activity choices

H0: The app does not lead to better nutrition and physical activity choices

4 Methods

4.1 Procedure

To begin with, an emailed proposal sketch was sent to the Norwegian Directorate of Health, who responded by scheduling a digital meeting, where further information was given and obtaining early feedback on the project. Furthermore, the proposal sketch was submitted to the University of Stavanger where the project needed acceptance and finding a competent supervisor who was assigned to this project. The procedure then required writing a more detailed project outline and developing a questionnaire to be submitted with an application to the Norwegian Center for Research Data (NSD) and the Regional Ethics Committee (REK). NSD did respond after some days, however, they could not respond to the project before REK. REK responded after three months, stating that the project did not require their approval implementation, and the contact with NSD was regained to get a consent and permission to begin the research project from the first of October. To start up the project, the supervisor of Norwegian Directorate of Health was to be contacted to hear when it would be possible to publish the internet link that pointed people to the questionnaire via the app Heia Meg. This inquiry was only available to people who have downloaded the Heia Meg app after the internet link was activated in the app. To raise awareness for this project, posters were posted on social media sites like Facebook, Instagram, and Snapchat, as well as a web-based employment page like workplace, and a campaign run for Heia Meg app was ongoing when it was possible to join the project, and a poster was tacked up at a nearby fitness center, where the poster included full information about the study and how to participate. The posters were designed in Norwegian because the application and questionnaire were both prepared in Norwegian in order to accommodate a wider range of Norwegian speakers. Below is a photo of the poster that was shared on social media as well as printed and displayed at the local gym.

Figure 5. Enrollment poster

4.2 Participants

Participants for this study were recruited through the smartphone app “Heia Meg”. It`s worth noting that the sample was made up of participants who downloaded the app on their own. Everyone who downloaded the app between October 4, 2021, and November 5, 2021, received a message through the app the day after they downloaded and started using the app, which said the following. “Vil du hjelpe oss å gjøre appen bedre? Hvis du svarer på noen enkle spørsmål, kan vi finne ut om appen er god motivasjonshjelp” (in English “Would you like to assists us in improving the app? We can figure out if the app is a good motivator if you answer a few simple questions.” The link to the survey was included in this message.

The questionnaire could only begin after participants had read and signed an informed consent form, which stated that they were over the age of 18, that they would be asked to participate

again in about a month, and that their data would be stored but de-identified until the assignment was submitted. Participants were also required to supply their e-mail address as form of identification, as the e-mail address was used to send out the following survey. Everyone who completed the first questionnaire through the app received an e-mail from Nettskjema approximately 20-40days after completing it, with the following text: “Hei jeg sender ut nytt spørreskjema da du har deltatt på min spørreundersøkelse i forbindelse med en masteroppgave ved bruk av appen Heia Meg. Jeg håper at du vil ta deg 3-5minutter til å gjennomføre skjema 2 til min oppgave” (in English: “Hi, I am sending out a new questionnaire as you have participated in my survey in relation with a master`s thesis through the app Heia Meg. I`m hoping you`ll spend 3-5minutes completing survey number 2 for my project.” An online link was included, which directed participants to the questionnaire.

4.3 Materials

A questionnaire was created for this project based on a prior study I took part in through the National Institute of Public Health (FHI) called “Sosiale forhold og helse: En tvillingstudie,” English: “Social circumstances and health: A twin study,” which was headed by Jennifer Harris. Changes and modifications were made to the form in order for it to fit this study. Twelve health-related items were included in the questionnaire prepared for this thesis.

These twelve health-related questions were all defined in the same way, so each one could be rated on a scale of one to four, with one being the worst and four being the best. These twelve questions would be gathered and evaluated as a health-score later on. The score is made by the sum of the participants responses, with a minimum of 12 points (scoring 1 – the lowest level – on all 12 items) and a maximum of 48 points (scoring 4 – the maximum value – on all 12 items), which meaning that the point value for the overall health-score is the answer given in the questionnaire. It`s also worth noting that this study took place during the Covid-19 pandemic, which may have influenced people`s health and lifestyle patterns, including physical activity, eating, and drinking habits, as well as their mental health. Covid-19 has resulted in lockdowns, with schools, gym, and offices shuttered, and as a result, people have been more at home, still sitting and barley out of the door. As a result, I thought it was vital to include a question about covid-19 and whether it had an impact on the people joining this study, this question was only in the first questionnaire, however, in the second questionnaire, all participants got the opportunity to come with feedback on how to make the application better.

Figure 6. Screenshot from Heia Meg application.

Questionnaire in English:

1. What are you using the app for? (Choose the same as those you choose in the app).

- Better sleeping habits
- Drink less alcohol
- Get in better shape
- Eat healthier
- Get mentally stronger

2. Gender:

- Male
- Woman
- I prefer not to answer

3. Age:

- Under 18 years

- 18 – 29 years
- 30 – 39 years
- 40 – 49 years
- 50 – 59 years
- 60 – 69 years
- 70years or older.

4. Weight in kilograms:

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5. Height in centimeters:

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6. Education Level:

- Primary school
- High school / certificate of apprenticeship
- University less than 4 years
- University, 4 years or more.

7. Do you currently smoke?

Yes / No

General health questions:

To what extent does the statement suit you? with the following answer options:

«4 - Strongly agree», «3 - Somewhat agree», "2 - Somewhat disagree", "1 - Strongly disagree"

- 8. Health is important to me.
- 9. I am satisfied with my own perceived health.
- 10. I am happy with my own body weight.
- 11. I am happy with my own body shape.
- 12. I am physical active according to the recommendations (150min per week / 30min per day).
- 13. when I am physically active, the intensity is such that you sweat and / or become out of breath.
- 14. Sleep is important for me and is prioritized.

- 15. I take good care of my mental health.
- 16. I eat fruit and vegetables according to the recommendations (5 a day).
- 17. Fast food / takeaway is reserved for the weekends.
- 18. Sweets / chips / ice cream is reserved for the weekend.
- 19. Alcohol is reserved for weekends or special occasions.

«Strongly agree», «Somewhat agree», "Somewhat disagree", "Strongly disagree"

For the first questionnaire:

20. Covid-19 question:

Covid-19 had a positive impact on your lifestyle?

«Strongly agree», «Somewhat agree», "Somewhat disagree", "Strongly disagree"

For the second questionnaire:

20. Improvement of the application:

In order for this app to give you a benefit, do you see any potential for improvement / shortcomings with the Heia Meg app?

4.4 Design

Statistics can aid in the collection of data and the interpretation of all figures in the face of uncertainty (Bjørndal & Hafoss, 2004, s.19). This is important for both the distribution process (also known as knowledge production or research) and professional evaluation in the work with patients and clients. The researcher must have a fundamental understanding of statistics since knowing statistics makes it easier to plan, gather, organize, analyze, and interpret quantitative data. One usually begins a research study with something found interesting and have made an observation from which built a hypothesis for forecasting a future event (Bjørndal & Hafoss, 2004, s.19). Based on the hypotheses or assumptions presented, one can establish what exaptation's one has for further inquiry – for example, conclude from the general to the specific, and if the predictions hold, one has confirmed the hypothesis. In this case, the curiosity is to see if the mobile app can motivate users to make healthier lifestyle choices regarding nutrition and physical activity. Based on past observations when using the application, its structure, and how it functions, assumed of the app having potential to change others lifestyle in terms of physical activity and nutrition. And in order to check the assumption, this study used a prospective longitudinal strategy, which is a type of research in which one largely utilize the observation method and do not become involved with the subjects as a researcher (Miller,

2016). It`s also worth noting that the same sample consisted of users who downloaded the app on their own, thus the result may not be indicative of the general public. It may be claimed, however, that the sample is typical of the intended market. The way one follows the participants in a longitudinal study is also unusual, because one typically uses a specific schedule that is dependent on the respondents, and as a result, data collection may take years, depending on the technique used. In this research project, all data was gathered within one and a half month. A prospective longitudinal study has its benefits and weaknesses, just like any other research method, where a prospective longitudinal approach has benefits such as the study method`s effectiveness in learning more about causality, assuring clear focus and validity, and its flexibility (Miller, 2016). The study methods are known to be more powerful than cross-sectional studies when it comes to excluding time variants and unobserved peculiar differences, as well as being able to observe certain events in a temporal order, and the study method is effective when it comes to exploring development trends. In terms of the flaws, it`s important to point out that the study technique takes a long time and can be costly when compared to cross-sectional studies; the study method usually necessitates large sample sizes; there`s a risk that data collection isn`t 100 percent reliable; and many participants drop out or stop participating for a variety of reasons (Miller, 2016).

When people downloaded the app, created a profile, and decided the theme they wanted to focus on, they would then receive a text message within the app the day after downloading it, as illustrated in figure 6. The text message included a link that would take them directly to the questionnaire via Nettskjema when clicking on it. After approximately 30 days, all participants who completed the first questionnaire received an email with a link to a second questionnaire, which was viewed as a result of using the app for 30 days. All data was collected and stored at the Nettskjema platform, and then the responses were exported to a Microsoft Excel file, where it was cleaned and further imported into IBM SPSS for finding descriptive statistics and a normality test to see which analysis this project could proceed with. Furthermore, all data was cleaned up again and more thoroughly before being analyzed using chronsback alpha, T-test and regression.

4.5 Ethical considerations

Big data benefits should not be at the expense of data privacy rights, nor should it be utilized for other purposes than those for which it was created (Bustreo & Tanner, 2020). Bustreo &

Tanner (2020) recognized that there are a variety of ethical concerns around the collection, sharing, repurposing, and misuse of big data, and that biased and unrepresentative data can contribute to widening the gap between those who profit and those who are left behind. The project was subsequently submitted to REK and NSD for clearance to proceed with the research project after gaining appropriate approvals from the University of Stavanger`s standards The applications to REK and NSD were both submitted the same week early in June 2021, but due to a longer application process at REK, NSD put the application on hold pending a response from REK, as proof of REK permission was to be included in the NSD application. Following the requisite approval of the project sketch by the stakeholders, the application process at REK is time-consuming, as they have seven deadlines a year where researchers can apply for approval for a medicine or health research project, where REK go over the applications that have been received after deadline, which makes the process long ang demanding, as it took three months to receive a response to the application with following number: 284804. The response to REK Application 284804 said that the research project did not require REK permission and that the project could proceed with an approval for NSD because of the research study did not intend to collect personal sensitive data. When REK first responded, the contact with NSD was reestablished in order to resume the application process. The communication was reestablished at the end of August 2021, and on October 1, 2021, the application at NSD 385157 was approved for start-up. The majority of the ethical considerations for this study project revolve around the collection of personal data and how to responsibly organize, implement, and complete this research study in accordance with statutory requirements and established ethical standards. The most central law in medical and health research is the Health Research Act, the Health Register Act and regulations on population-based health examinations, and the Privacy Ordinance and Personal Data Act which provide the overall framework (Folkehelseinstitutet, 2019). Like for this research project, which is a consent-based research study, the duty to provide information is fulfilled through the information provided with consent, as in this case via Nettskjema. Furthermore, an identification number was required since the experiment compared the subjects` baseline to their own post-test, and all personal information was to be anonymized for data processing. As a result of the participants using their e-mail when responding the questionnaire, their answers was not anonymous; nevertheless, the data was safeguarded, anonymized, and will be stored until the thesis is submitted, after which it will be deleted.

5 Results

This research project had a total of 365 people responding the questionnaire, however there were some people who did not manage the criteria and were excluded. In the first questionnaire five people were excluded because of their age (under the age of 18 years), nine people got excluded because they declined to provide informed consent, and twenty people got excluded because they had answered the questionnaire two times or more. For the second questionnaire two people got excluded because of their age (under the age of 18 years), and thirty-one people got excluded because they had answered the questionnaire two times or more. In total there was 67 people excluded for this research study, and 298 people were included. In the first questionnaire there was 66.78 % (N = 199) included responses, and in the second questionnaire there was 33.22 % (N = 99) included responses.

All statistically analyses were conducted using IBM SPSS Statistics version 26.

	Frequency	Percent	Cumulative percent
Gender			
Men	40	20.1	20.1
Woman	159	79.9	100.0
Prefer not to answer	0	0	
Total	199	100.0	
Age Group			
18-29 years	43	21.6	21.6
30-39 years	32	16.1	37.7
40-49 years	54	27.1	64.8
50-59 years	36	18.1	82.9
60-69 years	26	13.1	96.0
70 years or older	8	4.0	100.0
Total	199	100.0	
Education			
Primary school	40	16.1	16.1
High school / certificate of apprenticeship	54	27.1	43.2

University – less than 4 years	50	25.1	68.3
University – more than 4 years	63	31.7	100.0
Total	199	100.0	
Reason for lifestyle change			
Better sleeping habits	44		
Drink less alcohol	17		
Get in better shape	110		
Make better nutrition choices	114		
Mental health	81		

Table 2. Descriptive statistics – first questionnaire

As it can be observed from Table 2, women outnumbered men in terms of participation. Participants ranged in age from 18 to over 70 years old, with the majority falling into the 40-49 years age group, followed by the age group of 18-29 years. It`s also worth noting that there were persons above the age of 70 who wanted to change their lifestyle habits. The participant`s educational level was high, with the majority having completed four years or more at a university or college. There were also a large number of those who had completed high school or had an apprenticeship diploma. Furthermore, as showed in the table, most of the participants wanted to change their lifestyle habits when it comes to making better nutrition choices and get in better shape, followed by mental health, better sleeping habits, and drinking less alcohol.

Gender	Frequency	Mean	Std. Deviation
Male	40	31.22	17.85
Female	159	29.33	12.31
Prefer not to answer	0	0	
Total	199	29.71	13.58
BMI Groups			
<18.5 Underweight	0		
18.5 – 24.9 Normal weight	66	22.75	1.60
25.0 – 29.9 Overweight	61	27.56	1.53
30.0 – 34.9 Obesity grade I	48	32.24	1.28
35.0 – 39.9 Obesity grade II	12	36.45	2.53
≥ 40 Obesity grade III	10	43.34	3.35

Table 3. Description of the mean BMI for male and females and a description of the different BMI groups, when first downloading the app.

As Table 3 shows, when looking at BMI and gender, men appear to have higher BMI and a bigger dispersion from the mean than the women. As earlier shown in Table 1, a BMI value between 25 and 29.9 indicates overweight, while a BMI over 30 indicates obesity of grade I. The average BMI for the women (29.33) falls under the category of overweight, while the value for the men (31.22) falls under the category of obesity of grade I. Overweight and obesity is now associated with more fatalities globally than underweight and is mostly attributed to an energy intake / consumption imbalance, and with a growing level of obesity, the risk of diseases rises, especially type II diabetes, cardiovascular diseases, different types of cancers, and musculoskeletal disorders.

As seen earlier, in the questionnaire used for this study, and under the category of general health questions, there were twelve items regarding satisfaction against their own body, weight, and figure, and how good they take care of their health when it comes to activity and some claims regarding their eating habits and alcohol habits. All of the twelve general health claims were spelled in such a way that the answers were all having the same meaning. This allowed for the creation of the health score where each of the twelve general health items. The health score represents the sum of the individuals' responses that were converted to a 1-4 number from "Strongly disagree", "Somewhat disagree", "Somewhat agree", "Strongly agree". The health score ranges from 12 to 48, with 12 being the lowest and 48 being the highest.

	Frequency	Mean	Std. Deviation
Gender			
Male	40	36.90	6.56
Female	159	33.11	7.69
Prefer not to answer	0	0	
Total	199	33.87	7.62
Age Group			
18 - 29 years	43	33.77	8.61
30 - 39 years	32	36.25	7.60
40 - 49 years	54	32.96	7.65

50 - 59 years	36	33.56	6.71
60 - 69 years	26	32.77	6.40
70 years or more	8	36.00	9.07
Total	199	33.87	7.62
Education			
Primary school	32	31.25	6.05
High school / certificate of apprenticeship	54	32.07	7.67
University – less than 4 years	50	34.08	7.10
University – more than 4 years	63	36.57	7.93
Total	199	33.87	7.62
Smoking			
Yes	18	31.56	4.93
No	181	34.10	7.80
Total	199	33.87	7.62
Reason for lifestyle change			
Better sleeping habits	44	33.55	8.37
Drink less alcohol	17	35.53	7.33
Get in better shape	110	32.80	7.85
Make better nutrition choices	114	33.72	7.09
Mental health	81	34.22	7.64
BMI			
<18.5 Underweight	0		
18.5 – 24.9 Normal weight	66	38.18	7.60
25.0 – 29.9 Overweight	61	34.30	7.02
30.0 – 34.9 Obesity grade I	48	30.67	5.04
35.0 – 39.9 Obesity grade II	12	26.67	4.92
≥ 40 Obesity grade III	12	28.00	7.03

Table 4. Descriptive statistics of health score – first questionnaire

Table 4 shows the health score by gender, education, smoking, reason for lifestyle change and BMI for the first questionnaire. Men appear to have a greater health score than women, as seen in the table, while women have a higher standard deviation from the mean than men. People

between the age of 30 and 39 have the highest health score, followed by those aged 70 and more. People aged 60-69 appear to have the lowest health score, as well as the lowest standard deviation from the mean, compared to the other age groups. The health score increased with education, thus persons with higher education had better health scores than those with lower or no education. People who smoked scored lower on the health score than those who did not. Furthermore, when looking at the health score for the group of persons who wanted to make lifestyle changes, those who wanted to become in better shape had the lowest health score compared to those who wanted to drink less alcohol or improve their mental health. When comparing BMI and health score, persons with the lowest BMI had the best health score, while those with the highest BMI had the lowest health score.

	Frequency	Percent	Cumulative percent
Gender			
Male	23	23.2	23.2
Female	76	76.8	100.0
Prefer not to answer	0	0	
Total	99	100.0	
Age Group			
18-29 years	21	21.2	21.2
30-39 years	17	17.2	38.4
40-49 years	22	22.2	60.6
50-59 years	17	17.2	77.8
60-69 years	17	17.2	94.9
70 years or more	5	5.1	100.0
Total	99	100.0	
Education			
Primary school	8	8.1	8.1
High school / certificate of apprenticeship	28	28.3	36.4
University – less than 4 years	24	24.2	60.6
University – more than 4 years	39	39.4	100.0
Total	99	100.0	
Reason for lifestyle change			

Better sleeping habits	25
Drink less alcohol	10
Get in better shape	54
Make better nutrition choices	47
Mental health	40

Table 5. Descriptive statistics – second questionnaire

Table 5 displays a summary of the information gathered after the participants had used the app for one month. Gender, age group, education, and the cause for lifestyle modifications are all included in the table. Women made up the majority of those who responded the second time, with 76.8%. In terms of age categories, the 40-49 years old had the most participants, followed by the 18-29 years old group. The 30-39 years, 50-59 years, and 60-69 years all had the same number of participants. The application was still being used by persons aged 70 and older. Most people taking part in this research study appear to have higher education of more than four years at a university or fewer than four years at a university, based on their educational backgrounds. Many people had graduated from high school or had earned an apprenticeship diploma. They could also choose two out of five subjects to focus on in the application for lifestyle modifications. Most of the participants wished to get in better condition, followed by better nutrition habits, mental health, better sleeping habits, and drink less alcohol.

	Frequency	Mean	Std. Deviation
Gender			
Male	23	28.62	5.25
Female	76	28.52	5.98
Prefer not to answer	0	0	
Total	99	28.54	5.79
BMI Groups			
<18.5 Underweight	0		
18.5 - 24.9 Normal weight	35	23.24	1.45
25.0 - 29.9 Overweight	29	27.22	1.68
30.0 – 34.9 Obesity grade I	23	32.19	1.28
35.0 – 39.9 Obesity grade II	5	36.7	1.38
≥ 40 Obesity grade III	7	42.7	1.67

Table 6. Descriptive statistics of BMI – second questionnaire.

Table 6 shows the mean BMI for men and women after using the app for one month. Men in this group appear to have a little higher BMI than women, although women had a higher standard deviation from the mean than men. Both men and women are defined as overweighted as shown earlier in Table 1 with a BMI between 25.0 and 29.9 states overweight. Many of the participants appear to be in the normal weight BMI group, but the majority of them are seen in the overweight and obese I BMI group.

	Frequency	Mean	Std. Deviation
Gender			
Male	23	35.09	7.37
Female	76	32.25	7.90
Prefer not to answer	0	0	
Total	99	32.91	7.84
Age Group			
18-29 years	21	30.71	8.69
30-39 years	17	32.65	7.57
40-49 years	22	33.41	8.99
50-59 years	17	33.35	7.57
60-69 years	17	32.29	4.81
70 years or more	5	41.40	5.77
Total	99	32.91	7.84
Education			
Primary school	8	32.25	6.56
High school / certificate of apprenticeship	28	31.07	8.13
University – less than 4 years	24	32.00	7.00
University – more than 4 years	39	34.92	8.16
Total	99	32.91	7.84
Smoking			
Yes	8	26.25	8.48
No	91	33.49	7.55
Total	99	32.91	7.84

Reason for lifestyle change			
Better sleeping habits	25	32.52	9.47
Drink less alcohol	10	33.60	6.90
Get in better shape	54	31.44	7.86
Make better nutrition choices	47	34.02	7.09
Mental health	40	32.63	8.38
BMI			
<18.5 Underweight	0		
18.5 - 24.9 Normal weight	35	35.91	7.15
25.0 - 29.9 Overweight	29	31.24	7.06
30.0 – 34.9 Obesity grade I	23	32.87	7.96
35.0 – 39.9 Obesity grade II	5	37.20	5.02
≥ 40 Obesity grade III	7	21.86	2.85

Table 7. Descriptive statistics of health score – second questionnaire

Table 7 shows the participants` health scores after a month of using the application. Men had a higher health score than women, but women had a larger standard deviation from the mean. Even though the those above the age of 70 had a better health score than those under the age of 70, it`s worth noting that there were only five people over the age of 70. Furthermore, people between the ages of 40 to 49 had the second-best health score, while those between the ages of 18 and 29 had the lowest health score. People with more than four years of university education had a better health score than those with less education. Furthermore, smokers appear to have lower health score than non-smokers. And when it came to the purpose for a lifestyle change, individuals who wanted to get in better shape had lower health score than those who wanted to improve their nutrition or sleep habits. And when it comes to BMI, no one was underweighted, and those with obesity grade II appeared to have a better health score than the others, followed by those in the normal weight category.

5.1 Normality test

Given that various statistical approaches assume that the population data distribution is normal, it is critical to evaluate and test whether the data meet the normality criteria to evaluate and test whether the data meet the normality criteria in data analysis (Kwak & Park, 2019). Despite the

fact that analytical methods vary depending on whether or not normalcy is reached, conflicting results may be obtained on the analysis method chosen (Kwak & Park, 2019). Many clinical research publications present and interpret their findings without first assessing or testing for normalcy. When the number of samples is greater than 30, the central limit theorem states that the sample mean distribution satisfies the normal distribution. However, in many clinical trials, the number of samples is typically less than 30 due to cost and time constraints during data collection (Kwak & Park, 2019). A proper statistical analysis method is necessary in this case to establish whether or not the normalcy is satisfied by running a normality test. The normalcy curve can be explained mathematically, with formulas expressing the curve`s shape and function of its average and population spread (Bjørndal & Hafoss, 2004). We know the percentage of total observations between the average and standard deviation regardless of the height and curve of normalcy. In a normally distributed dataset, for example 68 percent of the observations are found between x-1 and x+1sd (Bjørndal & Hafoss, 2004). When knowing the average of the normal distribution, it`s possible to take advantage of it because, it is possible to use the standard deviation as a unit of measurement to discover any observation in the dataset. Further a normality test was performed to see whether the data was normally distributed and whether the analysis could proceed with parametric or non-parametric tests.

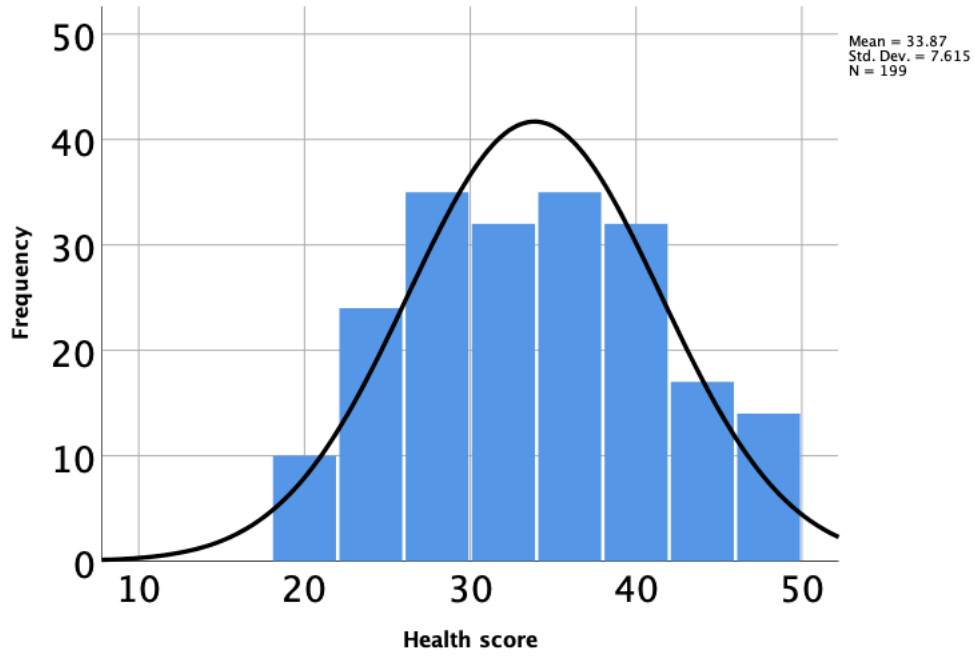

Figure 6. shows the first responding of health score. The histogram shows the number of participants each health score group, where the number of participants shown in the Y axe, and

health score shown in the X axe. This histogram indicates a normally distributed figure of the health score, and parametric tests can be done.

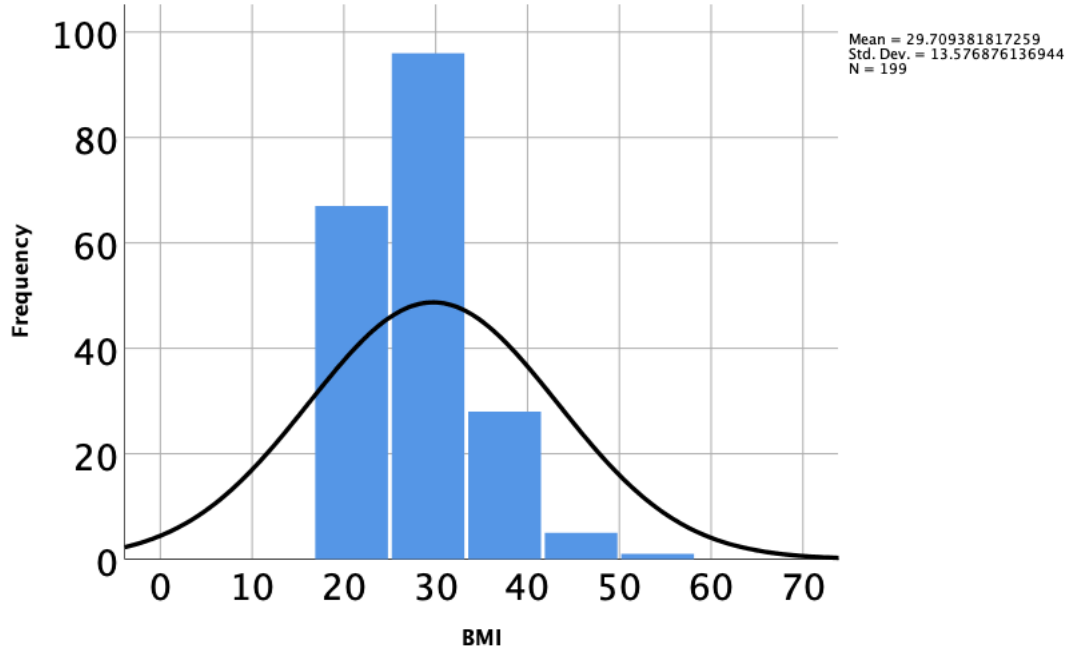

Figure 7. shows the second responding of health score. The histogram shows the number of participants in each health score group, where the number of participants shown in the Y axe, and health score shown in the X axe. This histogram indicates normally distribution of the BMI, and parametric tests can be done.

5.2 Data Analysis

Further on, the data went thru a clean-up, where only those who responded first, and second time was kept for further analysis. Since 12 questions were used to create the health score by summing single responses, the reliability of such set of questions as a valid scale had to be tested. To do so, a reliability analysis was conducted by using Cronbach`s Alpha. Lee Cronbach established the alpha coefficient in 1951, to provide a measure of a test`s or scale`s internal consistency which is expressed as a number between 0 and 1 (Tavakol & Dennick, 2011). Internal consistency refers to the extent to which all of the items in a test measure the same notion or construct and is thus linked to the test`s inter-relatedness (Tavakol & Dennick, 2011). Furthermore, reliability estimates demonstrate how much measurement error there is in a test. Put simply, this internal representation of reliability is the correlation of test with itself. The fraction of a test score attributable to errors will decrease as the estimate of reliability rises. It`s

worth noting that a test`s dependability reflects the influence of measurement error on a group cohort`s score rather than on an individual score.

5.2.1 Cronbach`s Alpha test

The Cronbach`s Alpha test is a measure of reliability and internal consistency and is used to determine the reliability of multiple-question Likert scale surveys, as in this matter the creation by 12 questions for making the health score (*Cronbach's Alpha*, 2022). It has become more common to calculate the Alpha score in medical research because it is easier to use than other tests like (test-retest reliability estimate) since it only requires one test (Tavakol & Dennick, 2011). Despite its extensive use of Alpha in the research, the meaning, proper usage, and interpretation of alpha aren`t really understood. The value of alpha is increased when the items in a test are correlated with one another. A high coefficient alpha, on the other hand, does not automatically imply a high level of internal consistency. This is because the number of questions has an impact on the alpha. The value of alpha is reduced if the numbers of questions are low and as a result, more similar items testing the same concept should be added to the test to boost alpha. "It is also important to note that alpha is a property of scores on a test from a specific sample of testes" (Tavakol & Dennick, 2011). As a result, researchers should always evaluate alpha each time the test / questionnaire is conducted. As in this matter, the alpha for the collection of the questions gathered as a health score was high = .92. Due of the large number of questions or, on the other hand, because of its great internal consistency.

Cronbach`s Alpha	Cronbach`s Alpha based on standardized items	N of items
.904	.912	12

Table 8. Cronbach`s Alpha test – Health score questions

As Table 8 shows, the Cronbach´s Alpha test indicates an excellent internal consistency of the health score with a value ≥0.9, and on a general basis, a score of more than 0.7 is usually accepted.

5.2.2 Paired sample T-test

The observations in a paired sample t-test are the differences between two sets of values, and each assumption refers to these differences rather than the original data values (*Paired Sample T-Test*, 2022). Like many other statistical tests, the paired sample t-test contains two hypotheses: The null hypothesis and the alternative hypothesis (*Paired Sample T-Test*, 2022). The null hypothesis affirms that the true mean difference between the two samples is zero (*Paired Sample T-Test*, 2022). All apparent differences in this model are accounted by random variation. The alternative hypothesis, on the other hand, assumes that the true mean difference between the paired sample is different than zero (*Paired Sample T-Test*, 2022) And because it is a test based on the normal distribution, the paired sample t-test requires numeric and continuous sample data. As in this case, this study is using discrete data converted to Likert-type scale to dissemble a continuous scale.

A Paired sample t-test was conducted to explore differences between the BMI of those who responded first and second time (Before and after using the application). A P-value of .05 was utilized. Descriptive statistics are available in Table 11 below.

BMI	Mean	N	Std. Deviation	Std. Error Mean
First responding	29.05	74	5.45	.634
Second responding	28.77	74	5.38	.626

Table 9. Paired Sample T-test Sample statistics – BMI
N = number, Std = standard

Table 9 describes the descriptive statistics of a T-test of the BMI from first and second responding, where the table states that the first responding (before using the app) had a higher BMI, than the second responding (After using the app).

				95% confidence interval of the difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
BMI	.284	1.32	.154	-.023	.590	1.84	73	.070

Table 10. Paired sample T-test – Paired differences – BMI
Std = standard, t = t-value, df = degrees of freedom, sig. (2-tailed) = P-value

Table 10 shows the paired sample T-test of the BMI before and after using the application. There were not significant differences between the group before and after using the application for BMI (t=1.84, p = .070).

Health Score	Mean	N	Std. Deviation	Std. Error Mean
First responding	34.65	74	7.11	.826
Second responding	33.85	74	6.96	.809

Table 11. Paired Sample T-test Sample statistics - Health score
N = number, Std = standard

Table 11 shows the paired sample t-test descriptive statistics of health score, where the table states that the first responding (before using the app) had a higher health score, than the second responding (After using the app).

				95% confidence interval of the difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed
Health Score	.797	5.82	.676	-.551	2.145	1.179	73	.242

Table 12. Paired sample T-test – Paired differences – Health Score
Std = standard, t = t-value, df = degrees of freedom, sig. (2-tailed) = P-value

Table 12 shows the paired sample T-test of the health score before and after using the application. There were no significant differences between the group before and after using the application (t=1.179 p = .242).

5.2.3 Regression

The most common reason for performing a regression analysis is that we have a sample data on a response variable and want to run a statistical analysis to explain its behavior. The hypothesis is that the variable`s behavior can be explained by a model which is typically in the

form of algebraic equation that includes additional variables that describe experimental conditions parameters that indicate how these conditions affect the response variable (Freund et al., 2006). And, probably most critically, how confident are we in each of these variables? Those factors are referred to as variables in regression analysis. The dependent variable which in this case is the health score and is the key factor to figure out or predict. Then there are independent variables, which are the variables one believes have an impact on the dependent variable such as gender, age, education, smoking and BMI. A linear regression was conducted to check which variables who had an impact on the health score and BMI.

5.2.3.1 Regression first responding health score and BMI

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.517[a]	.267	.257	6.13

Table 13. Model Summary – Regression First responding dependent variable health score.
a: Predictors: BMI

Table 13 shows that the predictors of BMI explain for 26.7% of the variances in an individual`s health score.

Model 1	Sum of Squares	df	Mean Square	F	Sig.
Regression	984.65	1	984.65	26.22	.000[b]
Residual	2704.21	72	37.56		
Total	3688.87	73			

Table 14. ANOVA - Regression First responding dependent variable health score.
Predictors: BMI

Table 14 demonstrates that the regression is significantly better than 0, indicating that the independent variable of BMI is able to account for a significant amount of variance in the individual's health score. The overall regression model is significant, F (1, 72) = 26.22, P< .000, R^2 = .267.

Model 1	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
Constant	54.23	3.89		13.94	.000
BMI	-.674	.132	-.517	-5.12	.000

Table 15. Coefficients [a] - Regression First responding dependent variable health score.

Table 15 indicates the statistically significant unique variance a predictor accounts for, where BMI was found to be statistically significant P = > .05.

5.2.3.2 Regression second responding health score and BMI

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.453[a]	.206	.194	6.25

Table 16. Model Summary – Regression First responding dependent variable health score. a: Predictors: BMI

Table 16 shows that the predictors of BMI explain for 20.6% of the variances in an individual`s health score.

Model 1	Sum of Squares	df	Mean Square	F	Sig.
Regression	726.97	1	726.97	18.63	.000[b]
Residual	2810.39	72	39.03		
Total	3537.37	73			

Table 17. ANOVA - Regression First responding dependent variable health score. Predictors: BMI

Table 17 demonstrates that the regression is significantly better than 0, indicating that the independent variable of BMI is able to account for a significant amount of variance in the individual's health score. The overall regression model is significant, F (1, 72) = 18.63, P< .000, R^2 = .206.

Model 1	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
Constant	54.23	3.89		13.94	.000
BMI	-.674	.132	-.517	-5.12	.000

Table 18. Coefficients[a] - Regression First responding dependent variable health score.

Table 18 indicates the statistically significant unique variance a predictor accounts for, where BMI was found to be statistically significant P = > .05.

5.2.3.3 Regression first responding health score with all variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.663[a]	.44	.398	5.52

Table 19. Model Summary – Regression First responding dependent variable health score.

a: Predictors: (Constant), Gender, Age, Education, Smoking and BMI

Table 19 shows that the predictors of gender, age, education, smoking, and BMI explain for 44% of the variance in an individual`s health score when taken together.

Model 1	Sum of Squares	df	Mean Square	F	Sig.
Regression	1620.46	5	324.09	10.66	.000[b]
Residual	2068.40	68	30.42		
Total	3688.87	73			

Table 20. ANOVA - Regression First responding dependent variable health score.

Table 20 demonstrates that the regression is significantly better than 0, indicating that the independent variables of gender, age, education, smoking, and BMI are able to account for a

significant amount of variance in the individual's health score. The overall regression model is significant, F (5, 68) = 10.66, P< .000, R^2 = .44.

Model 1	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
Constant	40.58	7.12		5.70	.000
Gender	-4	1.61	-.233	-2.49	.015
Age	-.222	.432	-.047	-.514	.609
Education	1.47	.642	.220	2.28	.026
Smoking	9.93	3.51	.277	2.83	.006
BMI	-.742	.124	-.569	-5.96	.000

Table 21. Coefficients[a] - Regression First responding dependent variable health score.

Table 21 indicates the statistically significant unique variance a predictor accounts for, and as seen, age is not statistically significant P < .05. Gender, Education, smoking, and BMI is statistically significant P > .05.

5.2.3.4 Regression second responding health score with all variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.587[a]	.35	.297	5.837

Table 22. Model Summary – Regression second responding dependent variable health score.
a: Predictors: (Constant) Gender, Age, Education, Smoking and BMI

Table 22 shows that the predictors of gender, age, education, smoking, and BMI explain for 35% of the variance in an individual`s health score when taken together.

Model 1	Sum of Squares	df	Mean Square	F	Sig.
Regression	1220.28	5	244.06	7.16	.000[b]

Residual	2317.09	68	34.08
Total	3537.37	73	

Table 23. Regression second responding ANOVA[a]

a: Dependent Variable – Health Score

b: Predictors (Constant), BMI, Gender, Age, Education, Smoking

Table 23 demonstrates that the regression is significantly better than 0, indicating that the independent variables of gender, age, education, smoking, and BMI are able to account for a significant amount of variance in the individual's health score. The regression model is significant, F (5, 68) = 7.16, P< .000, R^2 = .35.

	Unstandardized Coefficients	Unstandardized Coefficients	Standardized Coefficients		
Model 1	B	Std. Error	Beta	t	Sig.
Constant	32.56	7.61		4.28	.000
Gender	-1.96	1.70	-.117	-1.16	.251
Age	.669	.458	.146	1.46	.149
Education	.228	.679	.035	.336	.738
Smoking	11.02	3.68	.314	3.00	.004
BMI	-.706	.132	-.546	-5.34	.000

Table 24. Regression second responding Coefficients[a]

a: Dependent variable – Health Score

Table 24 indicates the statistically significant unique variance a predictor accounts for, and as seen, gender, age and education are not statistically significant P > .05. Smoking and BMI is statistically significant P < .05.

6 Discussion

6.1 Participants

Looking at the participants for this study, it began with approximately 200 individuals, where approx. 100 completing both surveys. Women represented most of the responding's with 79.9% on the first questionnaire and 76.8% on the second questionnaire, which could be interesting to investigate further. Is it because women are more interested in improving their health, do women have stronger belief in health-related apps, or is it because of the app`s design that women find it more appealing than men? Finding the answer to this question represents a further research opportunity. Another interesting observation was the high percentage of participants aged 40 to 69 years, having 58.3 percent responding the first questionnaire and 56.6% responding the second time, as well as the involvement of people over 70 years or older (4% & 5.1%). When the questionnaire was sent through the app "Heia Meg", there was an unspoken expectation that the app would be used by the younger generation. It`s possible that youths already have health-related apps and have downloaded Heia Meg or use other apps, however for the older participants, it might feel safer to try an app developed and sponsored by the Norwegian Directorate of Health. In terms of generalizability, the high average age makes it difficult to generalize findings to the general population in Norway.

In addition, I'd like to highlight the participants' high level of education, which was demonstrated by 56 percent of the first responders and 63,6 percent of the second responders. Where the participants had less than four years of university education (25.1 percent and 24.2 percent, respectively) or more than four years (31.7 percent and 39.4 percent).

It would be interesting to investigate whether people with higher education are more concerned with their own health than those with lower education or is it that people with higher education tend to respond surveys often than those with lower education? Studies like Furnée et al. and Nummela et al. Whereas Furnée et al. conducted a meta-analysis to determine the marginal impact of education on self-reported health, while Nummela et al. looked at the relationship between self-reported health and three variables of social economic position (disposable household income, self-reported education and adequacy of income), and three categories of communities (rural areas, highly or sparsely papillated areas, and urban areas) among men and woman in southern Finland (Furnée et al., 2008; Nummela et al., 2007). Nummela et al (2007) found in all three community types, there were a positive association between indicators of social economic status and self-reported health. Furthermore, after accounting for other

variables, adequacy of income had the largest positive correlation with self-reported health in urban regions among all age groups, indicating that while actual income is a strong predictor of health, adequacy of income is even greater (Nummela et al., 2007). While Furnée et al. (2008) discovered that a year of education had a quality adjusted life years weight of 0.036. The cost-benefit ratio of investments in education on health is strongly positive, according to preliminary calculations, but a more integrated approach to education and health should be pursued. This is also tied to health literacy, which is defined of The National Library of Medicine bibliography as individual`s ability to receive, process, and comprehend fundamental health information and services needed to make considered health decisions, and assumes that people with proper health literacy may make better decisions about their health and well-being (Parker, 2000) Furthermore, environmental demands and available resources, for example, have an impact on health literacy, emphasizing the necessity of developing health literacy throughout the school and community (Haugen et al., 2022). Individually, it has been suggested that rather than transferring theoretical and practical knowledge, health literacy efforts in schools should focus on teaching meta-cognitive abilities like critical thinking, self-awareness, and citizenship. Furthermore, health literacy education should emphasize the social determinants of health as well as the social power of dynamics that contribute to health disparities (Haugen et al., 2022) The majority of the participants wanted to change their lifestyle regarding making better nutrition choices and becoming in better shape. Further, when looking into the BMI, men had a higher mean BMI than women (31.2 vs. 28.6 / 29.3 vs. 28.5). While men who responded for the first time appeared to be mainly in obesity group I, women were mainly in the overweight group. However, by looking at the BMI in the second questionnaire, men had a higher decrease in BMI than women, and both sexes were now in the overweight group. Despite the fact that both sexes ended up in the overweight or obesity group, there were also many participants who were within the BMI group of normal weight (66 & 35 people), and it is also important to note that none of the participants were underweight, but there were as many as ten and seven people who were severely overweight and ended up in the obesity group III. For the general health questions, a score was calculated using the twelve questions, which was then referred to as the health score. Men had a greater health score than women (36.9 vs. 35.09 / 33.1 vs. 32.25), however both women and men looked to have decreased health ratings between the first and second questionnaires, according to the descriptive statistics. I`m curious if the participants who had the best health scores did not continue in the study regards of the changes, or if those who participated felt better about themselves, when answering the first survey than the second one. Also, this study was conducted during the covid-19 pandemic, and society was closed and

reopened numerous times, and could it therefore be that the society was more open when the study began (04.10.2021), than when the last questionnaire was sent out (25.11.2021), or did the participants change their own habits regarding the pandemic and its lookdowns? During the Covid-19 pandemic, a study by Flanagan et al. (2021) looked at changes in physical activity, nutrition, sleeping patterns, and mental health, with the result showing that eating behavior changed significantly. Cooking at home increased from 4.49 to 5.18 times per week ($P < 0.001$), while eating out declined from 1.98 to 1.08 times per week ($P < 0.001$). Participants` quick eating judgments improved from 0.04 to 0.81 ($P < 0.001$), indicating a healthy diet. Furthermore, did participants indicate beneficial changes such as skipping breakfast less frequently, eating four or more restaurant meals less frequently, consuming fewer fried foods, and ingesting fruits more frequently (Flanagan et al., 2021). On the other hand, did the study`s participants report any unfavorable dietary changes, such as an increase in sweets and sugary drinks consumption. While 25.8% of the participants said they ate more healthy snacks, 43.5% said they ate more harmful snacks, with 20.7% saying they ate healthier, and 35.6% saying they ate unhealthier. When compared to individuals who ate healthier, those who changed their diet to bad habits had an increased sedentary lifestyle, less physical activity, did not go to bed and/or did not sleep until later in the evening, and reported almost a doubling in anxiety (Flanagan et al., 2021). While for the participants who reported that they ate healthier, the physical activity increased. In this group, the largest proportion of participants who worked from home were as a result of the pandemic. Then again physical activity increased for those who reported eating healthier, and the pandemic was responsible for the greatest number of participants working from home in this study (Flanagan et al., 2021). Something else noticed, was the large changes in health score in the age group of 30 to 39 years and for the age group over 70 years or more, where the age group of 30-39 years had the highest health score when first participating, but one of the lowest reported health scores at the end of the participation. But for the age group of 70 years or more, they had a high health score when they joined the study with 36 and increased this health score further at the end to 41.40. It is possible that the age group of 30-39 years has more variation in everyday life as a result of the establishment phase and starting a family, which can have a serious influence on their perceived health as well as diet and exercise habits, whereas the age group of 70 years and up has more stability in their lives, which influence their perceived health, as well as eating and activity habits, also, the age group of 70 years and up accounted for 5% of the responses, so it must be taken into account when interpreting the results. Furthermore, when it came to education and health score, those who joined the study with the lowest completed education also had the lowest health score, while those with the

highest education had the highest health score. In the last questionnaire regarding education and health score, those who had completed high school or received an apprentice chip diploma, had the lowest health score, while those with the highest education of four years or more had the highest health score. It`s worth noting that there were twice as many participants at the start, and that a major proportion of participants in each education group dropped out. It`s unknown whether these were participants with the best or worst health scores, or if it was the participants with the most considerable numbers who dropped out. A small percentage of smokers were found, and smokers had lower health scores than non-smokers. Tobacco use has long been recognized as a risk factor for a variety of life-threatening diseases (Abdollahifard et al., 2013). It is one of the top ten habits that contribute to the global burden of diseases (Abdollahifard et al., 2013; Glanz et al., 2008). Tobacco use is a considerable risk factor for heart attacks, strokes, chronic bronchitis, mouth, throat, voice box, and pancreatic cancers, as well as a significant cause in miscarriages among pregnant smokers, and a tobacco-related disease will kill half of all long-term smokers (Abdollahifard et al., 2013). Chronic diseases and impairments were exacerbated by social determinants of health. The socioeconomic status of people has generated remarkable health-related inequities among individuals with different income levels, as it does in most developing countries. As a result, chronic diseases and behavioral risk factors are more common among those with lesser income and education (Mahdaviazad et al., 2022). Furthermore, changes in health behavior are our best hope for lowering the global burden of preventable disease and death (Glanz et al., 2008). In the United States alone, tobacco use, sedentary lifestyles, poor diets, and alcohol consumption responsible for about one million fatalities per year (Glanz et al., 2008). Although the incidence of smoking in the United States has decreased by half since the first Surgeon General's Report on Smoking and Health was published in 1964, tobacco use continues to kill over 400,000 people prematurely each year (Glanz et al., 2008). The World Health Organization has warned that the tobacco pandemic could kill one billion people worldwide by the end of the century (Glanz et al., 2008). Despite all knowledge in which tobacco causes, there are still people using it, which rises the curiosity of whom are those who smoke, which educational status do they have, are they informed on health literacy, and have they tried to quit? As the study (Mahdaviazad et al., 2022) found, there was higher prevalence of smoking among those with primary education, physical jobs, and low income as the most socioeconomic factors related to tobacco usage, and tobacco control initiatives should focus on vulnerable groups of cigarette users (Mahdaviazad et al., 2022) Furthermore, socioeconomic factors, as well as the reduction of health-related inequities and inequality, should be prioritized (Mahdaviazad et al., 2022). When it came to the topic for

lifestyle change, those who wanted to get in better shape had the lowest health score, while those who wanted to make better nutrition choices had lower health score when joining this study than those who responded the second time. BMI and the health score showed that the participants who joined this study and had a low BMI seemed to have a higher health score than those with high BMI, while for those who also answered questionnaire no. 2, showed that those with obesity grade III had the highest health score, while the BMI group of overweight had the lowest health score.

6.2 Paired sample T-test

To explore the differences between BMI and health score before and after the participants starting to use the application, a paired sample T-test was conducted. When it comes to the BMI, the descriptive statistics in table 9, showed that the first responding had a higher BMI than the second responding, and as further shown in table 10 there wasn't statistically significant differences between the first and second group when it comes to the BMI (P=.070), and the t-value was quite small (t=1.84). However, it is important to mention that there was a difference and change in the BMI value for the better, even though it didn't meet the criteria of significancy level. Furthermore, a paired sample t-test was conducted with the health score, before and after using the app. When looking at table 12 with the descriptive statistics of the health score, the first responding's had a greater health score than the second responding's, and the difference didn't meet the criteria of statistically significant level (p=.242). None of the paired sample's t-test was shown to be statistically significant (P>.05). However, both groups (BMI and health score) stated that there has been changes within the groups, BMI for a better change, but on the other hand, health score for the worse. There may be different reasons for the test not getting statistically significant like the number of participants, where the number of participants was reduced after cleaning the data where only those who also responded to the second questionnaire was kept. The length of this study is also worth mentioning, since it only lasts for a month, however, you may change a lot of lifestyle habits in a month. On the other hand, this research study took place during the Covid-19 pandemic, which may impact the participants motivation, lifestyle habits and mood and therefore also impacted on how participants were capable of doing changes.

6.3 Regression Test

For this regression analysis the BMI and health score was chosen as dependent variables and gender, age, education, smoking and BMI / health score as independent variables. First, a linear regression test was conducted of the first and second responding of health score as the dependent variable and BMI as the independent variable. Where the first responding shown in table 13 stated that BMI could explain for 26.7% of the variance in the individual`s health score. However, the second responding shown in table 16 stated that BMI could explain for 20.6% of the variance in one's health score. Furthermore, looking at the first responding in table 14, which indicates that the independent variable of BMI can account for a significant amount of variance in an individual health score, and the overall regression model is significant, F (1, 72) = 26.22, P = < .000, R^2 = .267. On the other hand, when looking at the second responding in table 17, it stated that the independent variable of BMI can account for a significant variance in the individual`s health score, and the overall regression model is statistically significant, F (1, 72) = 18.63, P < .000, R^2 = .206. Both ANOVA test shown in table 15 and 18 indicates that BMI was found to be statistically significant P = > .05. Furthermore, a linear regression test was conducted of the first and second responding of health score as the dependent variable and gender, age, education, smoking and BMI as independent variables, were table 19 states that the independent variables (gender, age, education, smoking and BMI) could explain for 44% of the variance in the individual's health score. On the other hand, when looking at the linear regression result from the second responding of health score, table 22 states that the independent variables could explain for 35% of the variance in the individual`s health score. Both ANOVA test shown in table 20 and table 23 of the regression analysis came back significantly better than 0 (P>.05). Furthermore, when looking at the different independent variables in table 21 and 24, table 21 states that gender, education, smoking, and BMI was statistically significant (P>.05) while age didn´t meet the criteria of statistically significant (P<.05). However, table 26 shows that smoking and BMI was statistically significant (P>.05), while gender, age, and education did not meet the criteria of statistically significant (P<.05). As both regression tests show, there is regression between the dependent variables (Health score) and the independent variables (Gender, age, education, smoking, and BMI), and even though as seen in tables 21 and 24, different variables account for the unique variance of the regression. However, BMI and smoking were both independent variables that accounted for variance in both of the regression analysis

6.4 Theoretical perspective

The true point of this project was to contribute to the ongoing research of digital health interventions by using mobile apps. As seen from the results, the app seems to be commonly used, with over 200 individuals joining this research study by a message through the app, and about 50% of the individuals completed both questionnaires (before and after using the app). This might indicate that the app was beneficial to the study participants. Were the reminders effective, and the words pleasant, encouraging, and perhaps even motivating? This also raises the question of whether or not this app was well-designed for its target group. However, the participants who answered both questionnaires, got the opportunity to make a statement of any changes good or bad they would suggest for the application. Some of these feedbacks was more constructive like: "Should have been more specific tips", "I only get push alerts from Heia Meg, not alerts with a visible note, that's what I need to get motivated from the application", "Make it more clear, what extreme progression you get when first starting a lifestyle change as physical activity, as well as how these progression values for everyday life", "cheering on other, like friends and family. Its motivating to motivate other as well", "some advice is to basic, almost feels like the advice is adapted for people with poor functioning. There should be different levels of advice" and "There should be assessments in the app to log the progress". On the other hand, there was also some people who gave the app great feedback: "So far I think the app has been good and helpful", "It`s great, simple and straightforward". However, after interpreting the results, the paired sample T-test of both health score and BMI where not statistically significant, which indicates that the application does not have an impact on the BMI and health scores, but somehow it seems to be some changes, which leads to the thoughts of the study not having enough participants, was it too short study, or was it participants not being motivated, not finding the application interesting and helpful as the thought of it, or did the covid-19 pandemic influence changes.

When a program or intervention is inspired by a theory of health behavior, it is more likely to benefit individuals and communities (Glanz et al., 2008). Never have individuals working in health education and behavior change faced so many demands or had so many options from which to select. Theories also help to establish the aim of change and the strategies for achieving it. Individuals' subjective hypotheses and expectations, on the other hand, are emphasized in cognitive theories, which believe that conduct is a function of the subjective value of a result and the subjective probability, or anticipation, that a particular event will occur (Glanz et al.,

2008). Despite the flaws of theories, we aim to maintain their strengths while eliminating their flaws. The self-efficacy theories clear definition of the four main sources of influence can shape people`s perspective of their own self-efficacy, for example, is a strong point. However, refinement of these sources may be needed as different factors within these sources may exist. Furthermore, the health believe model focuses on the individual attitudes about health problems, which predict individual health-related actions, while the I-change theory assumes that two variables, information factors and preceding factors, influence their communication outcomes. Interventions that adopt a theoretical foundation to increase health behavior change are more effective than those that do not, while interventions that incorporate numerous theories and concepts have higher effects (Glanz & Bishop, 2010; Naslund et al., 2017). Digital technologies, such as mobile phones, computers, and smart phone applications, might provide additional opportunity for people to change their lifestyle habits. As the digital world expands and changes, a mobile application may be able to be used as a therapeutic device for lifestyle modifications (Naslund et al., 2017). When considering how a digital intervention might contribute to the health belief model, it can raise awareness of risks or advantages, provide cues or reminders for engaging in healthy behaviors, and provide encouragement or training to help people gain confidence. When looking at the self-efficacy theory and how digital interventions can help, it can support the effort to increase self-efficacy through mastery and vicarious experiences, as well as social persuasion and emotional and physiological factors with sending prompts and challenges for engaging in healthy behaviors, as well as the opportunity to follow other friends / family or someone seen as a role model. Furthermore, when considering how a digital intervention might contribute to the health belief model, it can raise awareness of risks or advantages, provide cues or reminders for engaging in healthy behaviors, and provide encouragement or training to help people gain confidence. When looking at the self-efficacy theory and how digital interventions can help, it can support the effort to increase self-efficacy through mastery and vicarious experiences, as well as social persuasion and emotional and physiological factors with sending prompts and challenges for engaging in healthy behaviors, as well as the opportunity to follow other friends / family or someone seen as a role model.

The health score was made up by the twelve health-related questions, which was all defined in the same way, so each one could be rated on a scale of one to four, with one being the worst and four being the best. The score is made by the sum of the participants responses, with a minimum of 12 points (scoring 1 – the lowest level – on all 12 items) and a maximum of 48 points (scoring 4 – the maximum value – on all 12 items), which meaning that the point value

for the overall health-score is the answer given in the questionnaire. Despite the fact that the health score is not a validated tool for investigating people's health and lifestyles, it is a useful contribution in terms of a quantitative measure of all of these habits and satisfactions with one's lifestyle. This measure is not perfect, but it will show in the participants' overall health score if they report bad habits and satisfaction, and if the applications assisted them in achieving motivation and better habits, the health score will change for the better when the participants improve their habits and satisfaction. The health score has the potential to be a useful tool, and other researchers may use it in the future.

6.5 Bias & limitations

Through good study design and data analysis, chance and confounding can be assessed and/or minimized. Only the most rigorously done experiments, on the other hand, can totally rule out bias as a possible reason for an association. Unlike random error, which is caused by sampling variability and reduces as the sample size grows, bias is unaffected by sample size or statistical significance. Estimates of association can be higher or lower than the genuine association due to bias. In this study, I chose a prospective longitudinal design, but alternative designs, such as pre and posttest, might be used. When it came to recruiting participants, it became clear that the survey contained flaws that affected the data`s validity and reliability. Several participants changed their goal of behavior during the first and second questionnaire, which impacted the number of participants who could be used in a paired t-test for comparison. In several cases, individuals completed the questionnaire multiple of times, with different responding on age, education, and which theme they wanted to focus on. Therefore, it could be useful to remind participants of which behavior they picked. As stated, the sample size for the paired sample t-test was small after trimming the data. The questionnaire was not sent out until the next day after the app was downloaded, but the recruitment of participants potentially brought with those who really was using the app, as it required them to read the message and then click at the link which took them to the questionnaire. The recruiting received more women than men, which made me wonder if the application is more appealing to woman than men, and if women are more interested in changing one’s lifestyle than men, or if woman have a stronger belief in lifestyle changes with the use of technology. There were also more individuals with a high level of education than those with low level of education, but despite these difficulties, there was some useful information to be retrieved from the data.

Furthermore, when it comes to the research study's limitations, it's worth highlighting its insufficient research design in terms of not having a control group for determining the cause and impact of Heia Meg application. On the other side, did the study have limitations because it was a master's thesis, with time constraints, access to sponsors, the number of participants who could participate, and the fact that it was conducted during a pandemic? There are also certain limits, such as voluntary participation and therefore a limited number of participants, which may jeopardize the study's external validity, as volunteer participants are likely to have different perspectives on the topic than the general public. The questionnaire should be validated, although it was based on a previous FHI study. The first questionnaire had a much higher number of participants than the second, showing that the Heia Meg app did not catch everyone, potentially influencing the outcome.

7 Conclusions

This research project attempted to use the theoretical theories of the health belief model, Self-efficacy theory and the I-change model to further invest the lifestyle application “Heia Meg” which is developed by the Norwegian directorate of health. Even though there were some challenges in regards of which research design and how to create the questionnaire as well as this study being conducted during a pandemic, there was gathered valuable information, leading to a noteworthy conclusion.

With these findings it seems reasonable to dismiss the H_a and accept the H_0 as the conclusion is: The app does not lead to better nutrition and physical activity choices. This result can be attributed to the limitations and confounding factors described above, and further research – in other contexts – is needed to confirm, or not, this conclusion.

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