Lifestyle intervention program for individuals with cardiometabolic risk factors in Iceland

Based on the Diabetes Prevention Program

Íris Björk Ásgeirsdóttir

Thesis for the degree of Master of Public Health Sciences

University of Iceland
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HÁSKÓLI ÍSLANDS

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Lífsstílsinngrip fyrir einstaklinga með áhættuþætti efnaskiptasjúkdóma á Íslandi

Byggt á The Diabetes Prevention Program

Íris Björk Ásgeirsdóttir

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Abstract

The prevalence of noncommunicable diseases have been rising in the world and account for 70% of all deaths globally. Unhealthy lifestyle and lack of physical activity are believed to increase the likelihood of cardiometabolic risk factors, individuals are therefore at higher risk of developing lifestyle related diseases. Studies have shown that lifestyle intervention programs with emphasis on increased physical activity and dietary changes can reduce weight and cardiometabolic risk factors. The Diabetes Prevention Program (DPP), a known and well investigated intervention program designed for individuals with impaired glucose tolerance has shown promising results. This study evaluated the effects of a lifestyle intervention program based on the Diabetes Prevention Program on weight, body composition, physical activity, quality of life, and dietary habits among participants.

This was a prospective, non-randomized 6-month intervention study conducted at Heilsuborg clinic in Iceland. A total of 81 participants entered the study of which 49 completed (mean age 48 years) the intervention program. The research period was from June 2018 to March 2019 and data was collected at the beginning and at the end of the program through online questionnaire and measurement at the clinic. The measurements were compared before and after intervention using paired *T*-test and McNemar´s Chi-square test. Logistic regression was used to calculate odds ratios with 95% confidence intervals to evaluate the effects of different lifestyle factors on weight loss.

Results show that mean weight loss among participants (N=49) after completing the program was 1.97 kg (p=0.001). Mean BMI decreased by 0.55 kg/m^2 (p=0.030) and mean fat percentage decreased by 0.8% (p=0.007) but change in muscle mass was not significant. Self-reported quality of life improved by 23% (p<0.001) and those who underwent the cardiorespiratory fitness test improved their distance covered by 0.12 km (p=0.002). Participants reported an increase in exercise frequency after the intervention as exercise performed 1-4 times per week increased from 39% to 72% (p=0.005). Exercise intensity increased as well as vigorous physical activity increased from 8% to 40% after the intervention (p<0.001). Fruit consumption increased as those who reported to consume fruit 1-2 times per week or more increased from 46% to 65% after the intervention (p=0.020). Changes in consumption of vegetables, whole grain, and fish did not change significantly after the intervention. Those who consumed fruits 1-2 times per week at baseline were more likely to lose weight during the intervention compared to those who consumed fruits never or rarely (OR = 5.92; 95%CI: 1.29 – 34.62).

This study suggests that intervention program based on DPP for individuals with cardiometabolic risk factors can reduce weight, BMI, fat percentage and increase quality of life, fitness, exercise intensity, exercise frequency, and fruit consumption among participants. Moreover, higher fruit consumption at baseline was associated with weight loss.

Ágrip

Tíðni lífsstílstengdra sjúkdóma hefur farið vaxandi í heiminum og eru þeir nú taldir valda um 70% dauðsfalla um heim allan. Óheilbrigt líferni er talið auka líkur á áhættuþáttum efnaskiptasjúkdóma, einstaklingar eru þá í meiri hættu á að þróa með sér lífsstílstengda sjúkdóma. Rannsóknir hafa sýnt að lífsstílsinngrip þar sem áhersla er lögð á aukna hreyfingu og bætt mataræði getur lækkað líkamsþyngd og dregið úr öðrum áhættuþáttum efnaskiptasjúkdóma. The Diabetes Prevention Program (DPP) er vel rannsakað lífsstílsinngrip frá Bandaríkjunum sem er hannað fyrir einstaklinga með skert sykurþol og sýnt hefur fram á góðan árangur m.t.t. bætts lífsstíls og minni áhættu á að þróa með sér sykursýki af tegund 2. Í þessari rannsókn var notast við íhlutun þar sem árangur lífsstílsnámskeiðs sem byggist á DPP var kannaður. Tilgangurinn var að rannsaka hvort námsskeið með það að markmiði að breyta lífsstíl þátttakenda sýni jákvæðar breytingar á þyngd, líkamssamsetningu, hreyfingu, mataræði og lífsgæði þeirra.

Um er að ræða sex mánaða lífsstílsinngrip sem haldið var í Heilsuborg. Þátttakendur rannsóknarinnar voru 81 einstaklingar en 49 þátttakendur (meðalaldur 48 ár) kláruðu námskeiðið. Rannsóknartímabilið var frá júní 2018 til mars 2019, og var gögnum safnað í upphafi og lok námskeiðs með rafrænum spurningalista og mælingum frá Heilsuborg. Mælingar voru bornar saman fyrir og eftir námskeið með pöruðu *T*-prófi og McNemar prófi. Lógistísk aðhvarfsgreining var notuð til þess að kanna mögulega áhrifaþætti þyngdartaps.

Niðurstöður rannsóknarinnar sýndu að meðal þyngdartap þátttakenda (N = 49) eftir námskeiðið var 1,97 kg (p=0,001). Meðal líkamsþyngdarstuðull minnkaði um 0,55 kg/m^2 (p=0,030) og meðal fituprósenta minnkaði um 0,8% (p=0,007) en breytingar á vöðvamassa voru ekki marktækar. Sjálfsmetin lífsgæði jukust um 23% (p <0,001) og þeir þátttakendur sem tóku þolpróf bættu meðal vegalengd sína um um 0,12 km (p=0,002). Æfingatíðni jókst eftir inngripið, hlutfall þeirra sem æfðu 1-4 sinnum í viku jókst úr 45% í 72% (p=0,005). Æfingarákefð jókst einnig, en erfið æfingarákefð jókst úr 8% í 40% (p<0,001). Ávaxtaneyslan jókst eftir að hafa tekið þátt í námskeiðinu, 46% sögðust borða ávexti 1-2 sinnum í viku eða oftar í byrjun samanborið við 65% eftir námskeið (p=0,020). Ekki varð marktæk aukning í neyslu á grænmeti, heilkornavörum og fiski eftir þátttöku á námskeiðinu. Þeir sem neyttu ávaxta 1-2 sinnum í viku í upphafi námskeiðs voru líklegri til þyngdartaps samanborið við þá sem neyttu ávaxta sjaldan eða aldrei (OR = 5,92; 95%CI: 1,29 – 34,62).

Þessi íhlutunarrannsókn bendir til þess að lífsstílsinngrip fyrir einstaklinga með áhættuþætti efnaskiptasjúkdóma geti dregið úr þyngd, líkamsþyngdarstuðli, fituprósentu og aukið lífsgæði, æfingartíðni, æfingarákefð, líkamshreysti og ávaxtaneyslu þátttakenda. Aukin neysla á ávöxtum við upphaf námskeiðs jók líkur á þyngdartapi á námskeiðinu.

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Declaration of Contribution

The master's student, Íris Björk Ásgeirsdóttir, assisted in applying for ethical and research permits, introduced and gathered participants for the study, assisted in combining the datasets needed, ran the statistical analysis and wrote this thesis. This was done with good guidance of her supervisor and master's thesis committee.

1 Introduction

The prevalence of noncommunicable diseases (NCDs) is rising in the world and affect all ages, groups, regions and countries. NCDs are the result of genetic, physiological, environmental, and behavioural factors and now account for 41 million deaths every year, or 70% of all global deaths. These deaths are mainly caused by cardiovascular diseases, cancers, chronic respiratory diseases and diabetes (1).

Cardiometabolic risk factors, such as excess weight, high waist circumference, high blood pressure, elevated triglycerides, low high-density lipoprotein cholesterol and elevated fasting glucose are closely related to diabetes and cardiovascular disease (2,3). These factors increase the risk of developing type 2 diabetes, hypertension, overweight/obese, and dyslipidaemia (4) and thereby the risk of developing cardiovascular disease (CVD) later in life. Individuals with cardiometabolic risk factors do not have a diagnosis of a chronic disease and therefore differ from metabolic syndrome (5). Unhealthy diet, lack of physical activity, tobacco use, and alcohol consumption increase the likelihood of cardiometabolic risk factors (1).

Risk factors for cardiometabolic diseases often cluster together, commonly for overweight or obesity, diabetes, hyperlipidemia, and hypertension (6). A research that was conducted on the impact of cardiometabolic risk factor clusters on health-related quality of life (HRQL) showed that individuals with common cardiometabolic risk factor cluster show lower HRQL score than those without cardiometabolic risk factors (7).

Studies have shown that lifestyle interventions with emphasis on increasing physical activity and dietary changes can reduce weight and cardiometabolic risk factors (4,8). There are many different forms of lifestyle intervention programs. The prevalence of type 2 diabetes is rising in the world (9) and many evidence based intervention programs therefore focus on how effective different lifestyle programs are regarding preventing the development of type 2 diabetes.

2 Cardiometabolic risk factors

2.1 Overweight and obesity

Excess energy that a person does not need from food and drink is stored in the body as adipose tissue and can result in excess weight. Fundamental cause of overweight and obesity is an imbalance between calorie intake and calorie expenditure (10). Excess body fat is associated with numbers of chronic diseases including diabetes, cardiovascular disease and cancer (10). Being overweight or obese can therefore reduce life expectancy (10,11). Body mass index (BMI) is often used to evaluate whether a person is overweight or obese. BMI is easy to calculate, a person´s weight (in kg) is divided by the square of a person's height (in meters). The World Health Organization (10) classifies being overweight as having BMI between 25 and 30 and obesity is classified as having BMI equal or greater than 30. Obesity is categorized into obese class 1, 2 and 3. Obese class 1 has BMI between 30 and 34.99, obese class 2 between 35 and 39.9 and obese class 3 has BMI over 40.

The prevalence of overweight and obesity is rising in the world, since 1975 obesity has nearly tripled (10). A large analysis, with 19.2 million participants, studied trends in BMI in 200 countries from 1975 to 2014. Results showed that age-standardised mean BMI increased globally from 21.7 kg/m^2 to 24.2 kg/m^2 among men and from 22.1 kg/m^2 to 24.4 kg/m^2 among women (12). According to OECD (13) the prevalence of overweight and obese population in Iceland has also been on the rice and is now 58%, or the highest prevalence of the Scandinavian countries. A study that The Directorate of Health (14) in Iceland conducted in 2017 showed that number of individuals at normal weight has decreased from 2007. In 2007 normal weight individuals were 39% of the Icelandic population, they were 36% in 2012 and 34% in 2017. At the same time those classified as being overweight, with BMI between 25 to 30, has decreased. In 2007 overweight individuals were 40% of the Icelandic population, they were 41% in 2012 but 39% in 2017. However, proportion of those who are obese has increased, from 20% in 2007 to 27% in 2017 (14).

The effects of overweight and obesity on health is well investigated. High BMI is a risk factor for diseases like cardiovascular disease, diabetes, musculoskeletal disorders and certain types of cancers. The overall risk increases with higher BMI (10). A meta-analysis of 239 prospective studies investigated overweight and obesity and all-cause mortality. Being overweight or obese was associated with an higher all-cause mortality (15). Cardiometabolic multimorbidity also increased with higher BMI, risk of mortality was twice as high compared to healthy weight individuals, it was almost five times higher for individuals with obesity class 1 and 15 times higher for those with obesity classes 2 and 3 (16).

Although BMI is the most widely used measurement to evaluate overweight and obese individuals its accuracy of detecting excess body adiposity is often criticised. A study on the subject showed that BMI didn't discriminate between body fat and lean mass with both men and women (17). There is evidence that BMI cut-off values need to be reconsidered. A study on BMI and all-cause mortality showed both strong and positive association between mortality and the upper limits in the normal BMI category (above 24 kg/m^2), suggesting that BMI spectrum might need further investigation (15). A study on normal weight obesity (NWO), metabolic syndrome and insulin resistance in young

adults showed that individuals with BMI within normal range but with high percentage of body fat was associated with metabolic syndrome (18). An Icelandic study on NWO adolescents showed similar results, NWO adolescents were more likely to have one or more risk factors for metabolic syndrome compared to adolescents with normal fat percentage (19).

Epidemiologists have been studying the dilemma of how to measure excess adiposity and if different measurements show stronger associations with health outcomes (20). There are different possible ways to evaluate adiposity, each varying in ease of use and complexity. In a systematic review on different measures of adipose tissue showed that precise measures like dual-energy x-ray may provide more specific and better associations with diseases compared to simpler measurements like BMI or waist circumference. However, the difference between simpler and precise measurements is not always that significant (20).

One way to evaluate excess adipose tissue in a fairly simple way is by evaluating body composition (21). Body composition can be measured with different technologies, the bioelectrical impedance (BIA) is one of them. BIA measures the impedance of the body with small electric current, it can estimate fat free mass (FFM) and fat mass (FM) through measurement of total body water (21). The BIA has been affective for determining obesity, a specific equation has been developed. However, in massively obese individuals the technique overestimates lean mass and underestimates fat mass (22). BIA technology can vary in accuracy, the multifrequency bioimpedance analysis (MFBIA), where the whole body is measured, is considered to be more accurate than foot-foot measurement (23).

There are many factors that need to be considered regarding measurements on weight and excess adiposity in a public health setting. Precise measurements often need expensive equipment and specially trained staff. Although precise measurements might be most useful in a study setting to determine disease risk it might not be as feasible in a public health setting where simplicity and cost-effectiveness matters. BMI and waist circumference is well known in medical, scientific and public health settings, it is easy in use and therefore many investigators choose those measurements in translation to public health messages (20).

2.2 Waist circumference

Waist circumference is used to measure abdominal obesity and to predict cardiovascular disease (CVD) risk (24), mainly because increased visceral adipose tissue is associated with many metabolic abnormalities that increases the risk of type 2 diabetes and CVDs (24). Men who have waist circumference 102 cm or higher and women who have 88 cm or higher are at greater risk of cardiometabolic disease (25).

Studies in recent years indicate that waist circumference measurement is more accurate at describing fat distribution than body mass index (BMI) (26). A study that was done on Icelandic children with obesity indicated that waist circumference was better to predict cardiometabolic deviations than BMI and might therefore better at evaluating disease risk (27). Combining these two measurements might however improve the overall risk evaluation (24).

It is important to be aware of the fact that many things can affect waist circumference which needs to be taken under consideration regarding cut-off points (24). There is a difference in body fat distribution between the sexes, men have greater total lean mass and bone mineral mass compared to women. Women have in general higher fat mass and greater adipose tissue than men, men have less limb fat, greater arm muscle and larger bones but greater central fat distribution. This gender difference is related to different sex hormone levels (28).

Age effects fat distribution, waist circumference increases with age according to WHO (2008) expert consultation on waist circumference. A Finnish study on waist circumference in adults showed that waist circumference over a 15-year period increased on average by 2,7 cm in men and 4,3 cm in women (29).

Cut-off points are often based on studies on European population that do not take in consideration other ethnic variations (30). A study of Asians adults showed that body fat is higher in Asians at lower BMI (31). Body fat distribution can vary between different ethnic groups and therefore can affect risk assessment (30). Studies are not conclusive among other ethnic groups and further investigation is needed regarding cut-off points (24).

2.3 Cardiovascular disease and risk factors

Cardiovascular disease (CVD) are a group of disorders that affect blood vessels and the heart and is the leading cause of death globally. It is estimated that in 2016 nearly 17.9 million individuals died from cardiovascular disease where 85% were because of heart attack and stroke (32). Worldwide, stroke has a huge disease burden as 10.3 million new strokes occurs yearly and causes 113 million disability-adjusted life years (DALYs) (33).

Risk factors for CVDs are elevated blood pressure, blood glucose or blood lipids and/or if an individual is overweight or obese. These risk factors indicate an increased likelihood of heart attack, stroke, heart failure and other complications (34).

The World Health Organization (34) states that most CVDs could be prevented with lifestyle alterations where the focus is on healthy diet, weight management, physical activity and no alcohol consumption nor tobacco use (34).

CVD risk factors often cluster together and affect one another. A study on BMI and its effect on hypertension and cardiovascular health indicated that increased BMI lead to an increase in blood pressure and the association was both positive and linear from BMI of 18.5 to 30.0 (35). Another study on the subject, where effects of obesity severity on hypertension, diabetes, dyslipidaemia and metabolic syndrome were investigated showed that an increase of obesity class resulted in an increased risk for those diseases mentioned (36).

A study on hypertension and cardiovascular disease mortality and all-cause mortality was conducted in Iceland from 1967-1996. The research showed that those with treated hypertension had lower CVD mortality compared to those with untreated or uncontrolled hypertension. Systolic blood pressure was the best predictor of CVD mortality and all-cause mortality in women with treated hypertension (37). Risk factors for stroke can be both non-modifiable and potentially modifiable. Hypertension is the most important modifiable risk factor for stroke and is responsible for 65% of lost

disability-adjusted life years (DALYs) in stroke incidence in low- and middle-income countries and 60% in high income countries (38). The Global Burden of Disease (GBD) 2013 study stated that modifiable risk factors caused more than 90% of all strokes, 75% of these incidence could be reduced by controlling behavioural and metabolic risk factors (33).

CVDs can be costly for societies; they can cause disability. DALYs are estimated to increase from a loss of 85 million DALYs in 1990 to 150 million in 2020, becoming the leading cause of loss productivity (39). Since most risk factors for CVDs are preventable with lifestyle adjustments (34) it is an important factor in public health prevention. Good guidelines in clinical practise are important for health promotion and improving patient outcomes. European Guidelines on cardiovascular disease prevention in clinical practice has defined characteristics of people who stay healthy. To stay healthy council experts recommend no tobacco use, exercise of at least 30 minutes five times a week, healthy eating habits, not being overweight, having blood pressure below 140/90 mmHg, having blood cholesterol below 5 mmol/L, having normal glucose metabolism and avoid excessive stress (40).

A research on stroke prevention and strategies with a global focus reflected that effective tobacco control, adequate nutrition and development of healthy cities (where environment encourages healthy living) are crucial for primordial prevention. For primary prevention of stroke polypill strategies, mobile technology, salt reduction and other dietary interventions were affective. For secondary prevention a collaboration between different health-care sectors, government policies and campaigns were successful (41).

2.4 Diabetes and impaired glucose tolerance

Diabetes is a disease where the pancreas cannot produce enough of the hormone insulin or the body cannot use the insulin it produces. Insulin is a crucial hormone that regulates blood sugar levels in the blood. If an individual has raised blood sugar (e. hyperglycaemia) over extended period that is not treated it can lead to damage on many of the body's systems like the nerves and blood vessels. Diabetes can also cause blindness, kidney failure, heart attacks, stroke or lower limb amputation (9).

There are two types of diabetes, type 1 and type 2. Type 1 is known as insulin dependent, where an individual does not produce enough insulin and requires daily administration of the hormone. Type 2 diabetes is much more common disease that happens when the body cannot use the insulin it produces. Type 2 diabetes is largely caused by excess body weight and physical inactivity. A person is considered to have diabetes when fasting blood glucose is higher or equal than 7 mmol/L. When a person has impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG), they are at high risk of developing type 2 diabetes. It is when blood glucose is elevated and above normal values but not high enough to classify as having diabetes (9). IFG is classified as having fasting glucose that ranges from 5.6-6.9 mmol/L and IGT cut off points ranges from 7.8-11.0 mmol/L (42). Having values lower than that is classified as normal values. Gestational diabetes happens during pregnancy and is similar to IGT and IFG, the glucose values are elevated and above normal values but not high enough to classify as having diabetes. Women who have gestational diabetes have an increased risk of complications during pregnancy and delivery, their children are at risk as well of developing diabetes later in life (9).

The prevalence of type 2 diabetes has been rising rapidly in the world, especially in middle- and low-income countries (9). The World Health Organization (9) estimated in 2014 that around 422 million individuals worldwide suffered from diabetes, a number that is likely to more than double over the next 20 years. The prevalence of type 2 diabetes has also been on the rising in Iceland. A study on diabetes type 2 prevalence in Iceland between 1967 to 2002 showed that in the 30-year period type 2 diabetes prevalence increased by 48% among males and 53% among women (43). In another Icelandic study on type 2 diabetes and BMI and its development over a 40-year period (1967-2007) showed that mean BMI had increased by two units among men and women. In the same time period type 2 diabetes prevalence doubled among men and increased by 50% among women. This study showed a dose-response relation between higher BMI and prevalence of type 2 diabetes (44). According to Kramer et al (45), obesity is one of the biggest modifiable risk factor in type 2 diabetes prevention.

Type 2 diabetes has been strongly related to excess fat within the liver and pancreas, therefore weight gaining can increase the risk of type 2 diabetes (46). Individuals with type 2 diabetes often have disease-related morbidity and reduced longevity. The disease is becoming more common among young obese people and more number of life-years are therefore lost through the disease (47). When an individual is diagnosed with type 2 diabetes it doesn't necessarily need to be a permanent one. There is a possibility of remission of type 2 diabetes if the individual changes his lifestyle and loses weight within 6 years after diagnosis (48).

It is estimated that over 84 million Americans have impaired glucose tolerance (IGT), that is 1 out of 3 adults. Big proportion of that number don't know that they have IGT and without any change in lifestyle individuals have a high risk of developing type 2 diabetes within 5 years (49). In Iceland there is no record for IGT prevalence but since BMI and type 2 diabetes incidence is rising in Iceland (14,50) one can assume that IGT prevalence is rising as well.

Studies have shown that lifestyle interventions with emphasis on increased physical activity and dietary changes can reduce weight and cardiometabolic risk factors such as impaired glucose tolerance. Intervention programs can delay or prevent the onset of type 2 diabetes among individuals with impaired glucose tolerance or at high risk of developing the type 2 diabetes (4,8,51,52).

3 Nutritional guidelines

3.1 Healthy diet and public health

Healthy diet throughout life can help prevent malnutrition and noncommunicable diseases like diabetes, heart disease, stroke and cancer. Today, unhealthy diet and low physical activity have become the leading global risk to health. Production of processed foods, urbanization and lifestyle changes have resulted in changes in dietary patterns and have led to an increased consumption of foods high in energy, fats, sugar and salt/sodium (1,53).

The Directory of Health in Iceland (54) publishes recommendations on diet and nutrition. In its latest update the focus is on healthy dietary patterns rather than focusing on a specific nutrient, eating diverse foods in modest amount, eating regularly and enjoying food intake (55). Studies have shown that adherence to healthy dietary patterns rather than consumption of special nutrient or food is associated with lower risk of stroke and better cardiovascular health (56–58). The Icelandic recommendations are set up to be simple and easy to understand. The recommendations have emphasised on the consumption of fruits and vegetables, whole grain, fish, healthy fats and less salt and sugar. Icelanders are also advised to use vitamin D supplements over the darkest months of the year, when direct sunlight is low (54).

The recommendations advice that fruit and vegetable consumption should reach at least five portions each day or 500 g in total, where at least half should be vegetables. According to the Directory of Health in Iceland only 16% consumed vegetables two times each day or more, fruit consumption was the same or 16% ate fruits or berries two times a day or more (14).

Whole grain is recommended to be consumed at least twice a day, it is important for digestion and is a rich source of vitamin B, vitamin E, magnesium and fibre (Embætti landlæknis, 2017). Diets that consists of low fruit, vegetable and whole grain but are high in sodium and sweet-sugar beverages have been associated with an increased risk of stroke (38). A series of systematic reviews of data from 185 prospective studies and 58 clinical trials suggests that those who consumed high fibre diet had 15-30% decrease in all-cause and cardiovascular mortality, heart disease, stroke incidence and mortality, type 2 diabetes and colorectal cancer compared to those who consumed low fibre diet. Those who consumed high fibre diet had lower body weight, systolic blood pressure and total cholesterol compared to those of low fibre diet. Risk reduction was apparent when consuming fibre between 25 g and 29 g per day (59)

The World Health Organization guideline on sodium intake (60) recommends salt intake for adults less than 2 g/day to prevent NCDs (60). Reducing salt intake in a diet has been linked to a lower systolic blood pressure, which is crucial in stroke prevention (61). Therefore, sodium restricted diet can be beneficial to stroke prevention which is the leading cause of mortality worldwide (1,60,62) .

The Directory of Health in Iceland (2017) recommends that fish should be a part of a weekly diet two to three times a week, where fatty fish should be consumed at least one times per week. Fatty fish is rich of vitamin D and omega 3 fatty acids which is mainly found in seafood. Studies have shown that regular consumption of fatty fish can lower the risk of cardiovascular disease (63–65). According

to the Directory of Health in Iceland 49% of Icelanders reached the recommended fish consumption 2-3 times per week (14).

In the study for this thesis dietary habits were evaluated with food frequency questionnaire (FFQ). The focus was to evaluate fruit and vegetable consumption, whole grain and fish consumption.

3.2 Food Frequency Questionnaire (FFQ)

Information on persons diet can be useful in public health and in disease risk prevention (66). Food Frequency Questionnaires (FFQ) are used to measure dietary habits in epidemiologic studies among individuals. Respondents are asked how often and how much food they consumed over a certain time period. FFQs can be self-registered or collected through an interview. This method makes it possible to research dietary patterns over a long period in a simple and a cost-effective way without being time consuming. The questionnaires can be adjusted to each research group (67). FFQs main disadvantage is that the evaluation of food frequency relies on participants memory of their diet. Therefore it is important to use FFQs that have been tested and validated (68). The FFQ for this thesis has been validated to minimize the risk of measurement errors (69).

4 Physical activity

The World Health Organization publishes recommendations for physical activity. They have advised 18-64-years old to exercise for at least 150 minutes of moderate-intensity aerobic exercise per week or do at least 75 minutes of vigorous-intensity aerobic exercise per week. Each exercise must last for at least 10 minutes and muscle strengthening activities should be performed 2 days a week or more (70). The recommendation on physical activity from the Directory of Health in Iceland (71) advice adult individuals to exercise at least 30 minutes per day of moderate intensity where each exercise lasts longer than 10-15 minutes.

The development of a modern society encourages physical inactivity (72,73) and todays data on physical inactivity shows that 23% of adults and 81% of adolescents do not meet the recommended physical activity according to WHO. Estimated global cost of physical inactivity is estimated to be 54 billion INT$ a year in direct health care (73). According to data from Eurostat almost half of European population over 18 years didn't participate in any sport but third spent at least two and half hours per week doing physical activities in their leisure time in 2014. The highest proportion of those who exercised at least two and half hours per week was in the Nordic countries, with Finland (54%), Denmark (53%) and Sweden (53%) at the top (74). A research that was conducted on the prevalence of physical activity in European adults showed that 61% attained the physical recommendation of ≥30 minutes of at least moderate physical activity ≥ 5 times a week. However, 40% of the European population weren't active enough to be beneficial to their health (75). According to the Directory of Health in Iceland 10% of individuals exercised every day and 16% exercised 5-6 times per week for 30 minutes in 2017 (76).

The benefits of physical activity and exercise on health has been well established. Physical activity lowers the risk of diseases like cardiovascular disease, hypertension, diabetes and certain types of cancers (70,77,78). Research has shown that physical activity is protective against premature mortality as well as cause-specific mortality (79). Regular physical activity is one of the key factors in health and wellbeing, research has suggested that physical activity and exercise has beneficial effects on several mental-health outcomes and physical activity has been associated with better quality of life (80).

Studies have shown that individuals who stay physically active are less likely to develop IGT, individuals who train regularly have greater glucose tolerance and lower insulin response when compared to sedentary individuals (81,82). Regular physical activity has benefits on insulin sensitivity even beyond 72 hours of last exercise (83).

Since the literature on the benefits of physical activity is clear it is important to be aware of the time individuals spend sitting down. Sitting for long periods of time can compromise metabolic health, it can increase the risk of cardiometabolic risk factors even if an individual meets the recommended physical activity. If a person sits most of the day it can affect one's health. Therefore, focusing on minimizing the leisure time as well as increasing physical activity can be beneficial to health (84). A research on sitting time and all-cause mortality risk showed that the association between sitting and all-cause mortality was apparent, prolonged sitting is a risk factor independent of physical activity (85). It is therefore important to encourage physical activity and minimize time sitting as much as

possible. Changing the way an individual travel between places can matter. A country that is economically developed often has lower physical activity, even as high as 70%, due to changes in transportation, increased technology and urbanization (73). A study that was conducted on commuting showed a decrease in BMI by 0.30 if individuals switched from car commuting to active or public transportation. Among those individuals that switched from active or public transportation to car commuting there was an increase in BMI by 0.32 (86).

The need to increase physical activity is clear, it can be complex because of challenges in a modern society. However, changing the way we travel between places and decreasing the time spent sitting might be a good way to start.

4.1 Physical activity evaluation and cardiorespiratory fitness

Objective and subjective methods are currently used to measure physical activity (87). Physical activity questionnaires (PAQs) are convenient in a large-scale study because of their low cost and they are easy to implement. Usually PAQs evaluate physical activity the last 7 days during a "typical week" either administered by interview or self-administered. PAQs have acceptable reliability (88) but they are prone to measurement error such as overreporting, misreporting or lack of recall of the event (89).

Another way to evaluate physical activity is by measuring physical fitness. Physical fitness is usually expressed as cardiorespiratory fitness and is measured by different exercise tolerance tests (90). VO_2max is the maximum ability to use oxygen and determines ones cardiorespiratory fitness (91). Research has shown that an individual with higher VO_2max has a decreased risk of heart failure incident (92) and mortality (93).

Many different tests have been developed to measure VO_2max in group setting where it is not possible to directly measure oxygen consumption. These tests are usually from submaximal exercise setting where VO_2max is predicted based on the relationship between heart rate and oxygen uptake (94). One of these tests is known as the 12-minute walk/run test or Cooper test.

Cooper test is a 12-minute field or treadmill performance to estimate maximal oxygen uptake. The test is easy to adapt to a large group setting and needs minimum equipment. The test measures distance covered and from that estimates the VO_2max with the following formula (95):

$$VO_2\text{max}\ (\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}) = (22.351 \times \text{distance covered in kilometers}) - 11.288$$

In a study on Cooper test validity to estimate VO_2max showed that there was a significant correlation with distance covered in the Cooper test and VO_2max, the equation is thought to be a valid method to evaluate cardiorespiratory fitness (96).

5 Lifestyle intervention programs

Protecting and promoting health is one of the key factors in human welfare and people rate health as one of their highest priorities in most countries (97). The prevalence for NCDs are rising worldwide, especially in low-income and middle-income countries with more than three quarters of NCD deaths globally (1).

Socioeconomic status (SES) can determine individuals likelihood of being exposed to environmental and other risk factors for health (98). Individuals with lower SES and other ethnic minority groups have a greater risk of diabetes compared to white adults (99,100). Since diabetes incidence are rising in the world (9) many intervention program focus on diabetes incidence as an outcome. Studies have shown that lifestyle intervention programs that focus on increased physical activity and dietary changes have been affective regarding weight loss and cardiometabolic risk factors (4,8).

Since access to health promotion and prevention is important for health there needs to be a good health financing system if the service is to be available for all members of society (97). The Diabetes Prevention Program (DPP) is a well investigated, cost-effective lifestyle intervention program that has been successful in type 2 diabetes prevention (101).

5.1 The Diabetes Prevention Program

The Diabetes Prevention Program (DPP) is a well-known lifestyle change program that was developed to decrease the risk of developing type 2 diabetes among individuals with impaired glucose tolerance (101). The program is recognized as a lifestyle change program by the Centres for Disease Control and Prevention (CDC) in America (102).

The DPP program runs for 1 year. First 6 months participants will meet specially trained lifestyle coaches about once a week, or total of 16-sessions, where each session lasts for about an hour. In these sessions' participants are educated on nutrition, exercise and behavioural self-management. The first eight sessions focus on fundamental knowledge on modifying energy intake and increasing energy output. Participants are helped to self-monitor their diet and physical activity. The latter eight sessions focus on the psychological, social and motivation challenges participants might face in maintaining the healthy lifestyle behaviour. The focus in the program is on weight loss and increased physical activity as an outcome. Weight goals for the participants is to lose 7% of initial body weight and to reach a minimum of 150 minutes of exercise per week. The second 6 months is a follow up program where participants will meet the lifestyle coaches once or twice a month. The follow up involves meeting the coaches face-to-face once every 2 months and be contacted by phone between visits (103).

The DPP initial study was a 27-center randomized clinical trial to evaluate whether a lifestyle intervention program or pharmacological therapy of metformin would prevent or delay the onset of type 2 diabetes among individuals with impaired glucose tolerance (IGT) (104). The study included 3234 overweight participants which had IGT of ≥7.8 to <11.1 mmol/l and fasting plasma glucose (FPG) between 5.3 and 6.9 mmol/l. Participants were volunteers and were randomized into three treatment groups, (1) intensive lifestyle intervention (*n*=1079), (2) standard advice and metformin drug (*n*=1073) (3) and standard advice and placebo (*n*=1082). Participants of the intensive lifestyle group were assigned a weight loss goal of 7% of initial body weight and moderate-intensity physical activity of 150 minutes per week. Participants were to achieve their weight loss through dietary changes by reducing calorie intake and fat consumption in the first 6 months of the program. The results showed that both metformin and the lifestyle intervention groups decreased the incidence of type 2 diabetes compared

to the placebo group. The lifestyle intervention decreased the type 2 diabetes incidence by 58% and the metformin group by 31% three years after the intervention took place (101).

A 10 year follow up study on the DPP program showed that diabetes incidence since last researched was reduced by 34% in the lifestyle group and 18% in the metformin group when compared to the placebo group (105). In a long-term effect study, 10 years after the DPP program, on cardiovascular risk factors showed that those in the metformin group that continued to take the drug improved their risk factors for cardiovascular diseases like high cholesterol or blood pressure. However, those from the lifestyle intervention group achieved the same results but with lower rates of blood pressure and cholesterol lowering medications (106). In another study 10 years after the DPP program showed that the lifestyle intervention was cost-effective compared to the placebo group (107). A 15 year follow up on the program showed a 27% delay in diabetes development compared with the placebo group (108).

5.1.1 Nutritional guidelines in the DPP program

Weight loss is measured as an outcome in the DPP program, to achieve a 7% weight loss goal in the first 6 months of the program participants need to make some adjustments to their diet.

Calorie goal for each participant is calculated by estimating the calories needed every day to maintain participants initial weight and subtracting 500-1000 calories each day, depending on participants initial weight. This is to achieve a weight loss of 0.5-1 kg (1-2 pound) each week. Each participant is not to consume more than 25% of total calories per day from fat. Participants are encouraged to gradually achieve their dietary goals through better choices of meals and healthy snacks in-between meals and get booklet developed by the DPP to help with meal sizes, choices and food register (103).

Each participant in the program was assigned a case manager known as a lifestyle coach. Most of the lifestyle coaches in the trial were registered dietarians, commonly with a master´s degree in exercise physiology, behavioural psychology or health education. Participants tracked their meals and physical activity and reported to their lifestyle coach each week (103).

5.1.2 Exercise guidelines in the DPP program

Exercise minutes is measured as an outcome in the DPP program. The physical activity goal is to reach at least 150 minutes of moderate intensity each week. This goal was chosen to increase energy expenditure and is according to public health recommendations to physical activity. DPP participants had a weekly physical activity goal to help them reach 150 minutes. The program emphasised on brisk walking as the mean to achieve but participants were introduced to other activities with equivalent intensity. Participants can divide their exercise minutes to different days, but each exercise had to last at least 10 minutes. Strength training can be applied with the maximum of 75 minutes of the 150-minute activity goal. Participants were encouraged to other lifestyle activities like using the stairs, gardening and stretching but it would not be included in the 150-minute goal although it would be beneficial to their health (103).

5.1.3 Behavioural self-management

Participants in the DPP program were taught behavioural strategies to remain long-term changes in their diet and to maintain weight loss. These behavioural strategies included self-monitoring of weight, ways to monitor their intake and physical activity, problem solving skills, stress management and ways to stay motivated. By introducing participants with different strategies, they learned how to make healthier choices on their own and maintain lifestyle behaviours long-term. These skills were taught gradually in the first weeks of the program and positive behaviour was recognized and reinforced by their lifestyle coach (103).

5.1.4 The DPP program nationwide

Although the DPP program has been successful and cost-effective there is no model available for nationwide dissemination. Translating interventions successfully can be challenging since lifestyles are affected by cultural and social factors (109). Still, other countries have attempted to adapt the DPP program. The Finnish DPP program was successfully adapted with equivalent results as the American one (110) while the Chinese Da Qing DPP study showed 40% reduction of diabetes incidence with the lifestyle group (111). There has also been modified shorter translational studies of the DPP program, like the Sidney Diabetes Prevention Program, where participants attended fewer sessions but still showed a 30% risk reduction in diabetes incidence (112). Fully digital DPP programs have been recognized by the CDC which can be a cost-effective way in diabetes prevention nationwide (113).

In a systematic review on effectiveness of program modification strategies of the DPP program showed that the program is vigorous to different cultural adaptation and translational strategies. When the program is adapted to be cost saving it does not seem to reduce its effectiveness on diabetes outcome. However, maintenance phase after the first 6 months is important, they significantly reduce risk of developing type 2 diabetes (114).

5.2 Dropout and lifestyle interventions

Dropout rates in weight management interventions can be high. In a systematic review on the subject showed that dropout rates from weight loss interventions varied from 10-80%, depending on program type and setting (115). Mattfeldt -Berman et al (116) research attendance at intervention programs and pointed out that adherence to a program relates to long term success where participants are more likely to exercise regularly and use self-monitoring strategies. Other studies on the subject show similar results, adherence is the key to achieve long term weight loss (117).

However, keeping participants in the program is challenging. In a study on obesity intervention dropout showed that most participants dropout of the program after the first session, or about 80% of those who quit the program (118). A systematic review showed that three main variables affected adherence in weight loss interventions. Supervised attendance programs have lower dropout rates than unsupervised ones, interventions with social support have higher adherence compared to no

social support and programs with dietary intervention alone have lower dropout rates than exercise programs alone (117).

A study on lifestyle intervention and impacts of dropout rates showed that the non-completers of the program had slightly lower weight, BMI and waist circumference compared to the completers. The non-completers were likelier to have a full-time job and didn't have as many of obesity related diseases and were less depressed as those who completed the program (118). Another study showed that younger participants are more likely to quit than older participants (119). Expectations to weight loss at the beginning of the program can influence dropout, those with higher expectations regarding weight loss at the beginning of the program have higher dropout rates (119). Another research showed that if participants show little improvement to their BMI on the first two weeks of the intervention, the likelier they are of dropping out of the program (120).

There seem to be many different reasons for dropout at weight loss programs. Most studies investigate those who completed the program but not those who dropped out and therefore it can be challenging to pinpoint exactly the reason participant dropout. Awareness of these factors could help structure a program to avoid high drop-off rates.

5.3 Lifestyle intervention and modern medicine

In today's world digital innovations have an opportunity to support and promote individuals of all ages to make healthier choices in their lives (73). Growing technology and ownership of mobile phones all over the world (121) can be an interesting and cost-effective way to improve health, especially in low income countries where health service is limited and health gap in knowledge is present. Mobile health applications (apps) can be adapted to the individual resulting in an patient-centred messaging which encourages behavioural change (122).

There are growing numbers of mobile health apps on the market but very few of them are evidence based, creating a gap between research and the market (123). A study that was conducted on weight-loss mobile apps and behavioural strategies analysed the DPP program and identified strategies of the program. Then, 30 mobile health apps were analysed and seven technology-enhanced features that support the program were identified. Results showed that the features that should support the DPP program are a barcode scanner, physical activity tracking, online social network, meal reminder, tracking of stress or negative thoughts, a calendar and rewards for reaching a dietary goal (124). An app that includes most of these features should be beneficial to the DPP program, it might be a good way to reduce program cost so that it is available for all in need.

5.4 Lifestyle intervention and Quality of Life

The World Health Organization has defined Quality of Life as "an individual´s perception of their position in life in the context of the culture and value systems in which they live in and in relation to their goals, expectations, standards and concerns" (125).

There are many different things that can affect Quality of Life. The literature on Health Related Quality of Life (HRQoL) suggests that obese individuals show lower HRQoL compared to those who

are at normal weight (126–128). In a 10 year follow up research on HRQoL among severely obese individuals showed that HRQoL was associated with the magnitude of weight loss or weight gaining (129). Diabetes has also been associated with poor health-related quality of life (130) and individuals with diabetes related problems have reduced HRQoL when compared to those without diabetes related problems (131,132).

HRQoL has been studied in relation to prevention or intervention programs. A study that was conducted on HRQoL among subjects in the Diabetes Prevention Program showed an improvement in HRQoL among those who achieved weight loss and increased their physical activity after the intervention when compared to those without treatment (133). Staying physically active and eating healthy are major determinants of health, they decrease disease risk and weight gain (134). Therefore, promoting these factors has the potential of reducing weight and disease risk as well as improving quality of life.

Since HRQoL is often lower among obese individuals increased quality of life is one of the most important outcomes for themselves. The term Self-Efficacy (SE) has been used to describe an individual's perception of their ability to successfully perform a certain behaviour. If an individual believes he can perform the behaviour successfully he is more likely to engage in it (135). In relation to weight loss and intervention programs SE can therefore have great impact on weight loss and if an individual completes an intervention program or not. A study on self-efficacy and quality of life in a lifestyle intervention program has shown that if an individual's BMI decreased by one unit there was an increase in self-efficacy (136). SE is therefore an important factor in lifestyle intervention program outcomes.

6 Specific aims

The research that was conducted for this thesis is an intervention study for individuals with cardiometabolic risk factors at Heilsuborg clinic. The participants of the study attended educational classes based on the Diabetes Prevention Program (DPP), but participants were also guided through a health app in between classes where they could seek support. The aim of this study was to investigate whether a lifestyle intervention program adapted from the DPP program for adults with cardiometabolic risk factors can achieve clinically meaningful changes among participants.

Specifically, we aim to investigate whether the adapted DPP lifestyle intervention program can:

1. Achieve clinically meaningful changes (5-7%) in body weight and body composition (e. fat mass and muscle mass) among individuals with cardiometabolic risk factors.
2. Increase fruit, vegetable, fish and whole grain consumption among individuals with cardiometabolic risk factors.
3. Show improvement in the frequency and level of strain of physical activity individuals with cardiometabolic risk factors.
4. Increase quality of life among individuals with cardiometabolic risk factors.

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Article

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Effects of a lifestyle intervention program for individuals with cardiometabolic risk factors in Iceland

Based on The Diabetes Prevention Program

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Abstract

Objectives: This study evaluates the effects of a lifestyle intervention program based on the Diabetes Prevention Program (DPP) on weight, body composition, physical activity, quality of life, and dietary habits among participants.

Methods: This was a prospective, non-randomized 6-month intervention study conducted at Heilsuborg clinic in Iceland. A total of 81 participants entered the study of which 49 completed (mean age 48 years) the program. The research period was from June 2018 to March 2019 and data was collected at the beginning and at the end of the program through online questionnaire and measurement at the clinic. The measurements were compared before and after intervention using paired *T*-test and McNemar´s Chi-square test. Logistic regression was used to calculate odds ratios with 95% confidence intervals to evaluate the effects of different lifestyle factors on weight loss.

Results: Mean weight loss among participants (N=49) after completing the program was 1.97 kg ($p=0.001$). Mean BMI decreased by 0.55 kg/m^2 ($p=0.030$) and mean fat percentage decreased by 0.8% ($p=0.007$) but change in muscle mass was not significant. Self-reported quality of life improved by 23% ($p<0.001$) and those who underwent the cardiorespiratory fitness test improved their distance covered by 0.12 km ($p=0.002$). Participants reported an increase in exercise frequency after the intervention as exercise performed 1-4 times per week increased from 39% to 72% ($p=0.005$). Exercise intensity increased as well as vigorous physical activity increased from 8% to 40% after the intervention ($p<0.001$). Fruit consumption increased as those who reported to consume fruit 1-2 times per week or more increased from 46% to 65% after the intervention ($p=0.020$). Changes in consumption of vegetables, whole grain, and fish did not change significantly after the intervention. Those who consumed fruits 1-2 times per week at baseline were more likely to lose weight during the intervention compared to those who consumed fruits never or rarely (OR = 5.92; 95%CI: 1.29 – 34.62).

Conclusion: This study suggests that intervention program based on DPP for individuals with cardiometabolic risk factors can reduce weight, BMI, fat percentage and increase quality of life, fitness, exercise intensity, exercise frequency, and fruit consumption among participants. Moreover, higher fruit consumption at baseline was associated with weight loss.

Keywords: intervention study; cardiometabolic risk factors; The Diabetes Prevention Program; weight loss; body composition; body mass index; dietary habits; physical activity; quality of life

Introduction

Noncommunicable diseases (NCDs) account for 41 million deaths yearly, or 70% of all global deaths, the majority are because of cardiovascular disease, cancers, chronic respiratory disease, and diabetes. NCDs are rising in the world and they are influenced by genetic, environmental, and behavioral factors (1). Most NCDs can be prevented with lifestyle adjustments where emphasis is on healthy diet, physical activity, weight management and minimizing alcohol and tobacco use (1). Poverty and NCDs are closely related, individuals with lower socioeconomic status (SES) are more likely to get NDCs (2,3) and have higher premature mortality rates compared to those of higher social positions (1).

Diabetes prevalence has been rising rapidly worldwide, especially in middle- and low income countries, and is now the seventh leading cause of death globally (4). Majority of those with diabetes have type 2 diabetes which is largely the result of excess weight and lack of physical activity (4). Type 2 diabetes prevalence has been rising in Iceland like with the rest of the world. From 1967 to 2002 diabetes prevalence increased by 48% among men and 53% among women in Iceland (5). The disease is becoming more apparent in young people and therefore more life-years are lost due to the disease (6).

Cardiometabolic risk factors, such as excess weight, high waist circumference, high blood pressure, elevated triglycerides, low high-density lipoprotein cholesterol, and elevated fasting glucose, are closely related to diabetes and cardiovascular diseases (7,8). These factors increase the risk of developing type 2 diabetes, hypertension, overweight/obese, and dyslipidaemia (9) and thereby the risk of developing cardiovascular disease (CVD) later in life. Prediabetes increases the risk of developing type 2 diabetes (4) and it is estimated that 1 in 3 adults in America have prediabetes and many cases may be undiagnosed (10).

Studies have shown a strong relation between high BMI and type 2 diabetes (11–13). According to OECD the prevalence of overweight (BMI 25-29.9 kg/m^2) and obesity (BMI>30 kg/m^2) has been rising rapidly in Iceland and now accounts for 58% of the population which is the highest prevalence among the Nordic countries (14). The Directorate of Health in Iceland have performed comprehensive studies on the health and well-being of Icelanders since 2007 and have reported an increase in obesity (BMI>30 kg/m^2), from 20% of population in 2007 to 27% in 2017 (15). Weight management is one of the biggest modifiable factor in preventing type 2 diabetes (11), staying physically active and eating healthy can prevent weight gaining and improve quality of life (16,17). Obese individuals report lower health-related quality of life (HRQoL) compared to those of normal weight according to WHO definition (BMI 18.5-24.9 kg/m^2)(18–20). Self-efficacy is an important term in relation to quality of life, if an individual believes he can perform a certain behavior, like lose weight, he is more likely to engage in it (21,22). These factors can therefore matter in a lifestyle intervention program when the focus is on behavioral change that results among others in weight loss.

Previous studies have shown that lifestyle intervention programs with focus on increased physical activity and dietary changes can be effective in weight management and reduce cardiometabolic risk factors (9,23). The Diabetes Prevention Program (DPP) is a lifestyle change program that was developed in America to decrease the risk of developing type 2 diabetes among

individuals with impaired glucose tolerance. Studies have shown that participants in the DPP program reduce diabetes incidence by 58% compared to a placebo group (24). Diabetes reduction was still apparent among participants of the lifestyle intervention program 10 years later as diabetes incidence was 34% lower among participants compared to the placebo group (25). The DPP program has been tested and studied in Europe with equivalent results as shown in America (26).

Evidence-based lifestyle intervention program for individuals with cardiometabolic risk factors or for diabetes prevention has not been available in Iceland until Heilsuborg clinic implemented the program in 2017. The aim of this study was to evaluate whether a lifestyle intervention based on DPP for individuals with cardiometabolic risk factors can show clinically meaningful changes in weight, body composition, physical activity, quality life, and dietary habits.

Methods

Study design and participants

Participants of the study were adult individuals with cardiometabolic risk factors living in Reykjavík and nearby areas. The intervention program was advertised in a local newspaper and on social media, participants self-registered into the lifestyle intervention program and paid participation fee. All participants that registered in the program were invited by Heilsuborg clinic to participate in the study. The study was introduced to subjects attending the program in their second educational lecture. If they agreed to participate in the study, they were asked to sign an informed consent but were informed that they could withdraw their participation at any time. Data from three intervention groups was used for this research and data collection was ongoing from June 2018 to March 2019. The study was approved by the Bioethics Committee of Iceland (VSNb2018040012/03.01).

Lifestyle intervention program

The lifestyle intervention program was conducted at the private health and fitness clinic Heilsuborg. At the beginning of the program participants met a nurse for a 30-minute interview, participants then attended 10 educational group lectures where they were informed about suitable practice for dietary habits, physical activity, sleeping habits, and mental health. The group lectures were taught by Heilsuborg clinic where lifestyle coaches were clinically trained professionals with a university education. Majority of lifestyle coaches were nurses, nutritionists, psychologists, sport scientists, or physicians. Each group session was taught every other week for 90 minutes and included lectures, discussions, and class assignments. After 10 group sessions participants were interviewed again by a nurse for 30 minutes where the program was discussed and their measurements were made.

At the beginning of the program participants downloaded a health app, called Sidekick health (27), that encouraged them to make positive changes in their lifestyle while taking part in the program. Participants received educational videos through the app regarding each week's topic to prepare for the coming class. Participants were encouraged to register their food intake and physical activity as well as performing stress relieving exercises available in the app. Participants could also use the app

to contact their lifestyle coach or other participants in the program in between sessions if they needed extra guidance or support.

Participants were offered to take part in an exercise class along with the educational classes where they would exercise three times per week with a trainer from Heilsuborg clinic. Participation in the exercise class was optional.

Measurements

The lifestyle coaches were responsible for data collecting and measurements on weight, body composition, and cardiovascular fitness. Data was collected via online questionnaire using REDCap (28). Information gathered through the questionnaire regarded background characteristics, physical activity, dietary habits, mental health, disease history, and quality of life in the past month. The questionnaire was sent to three intervention groups within the first month of the program. In one case the questionnaire was sent out after two months while waiting for study permission from the Bioethics Committee. Information on dietary habits, physical activity, quality of life as well as background characteristics were used in this study.

Weight, BMI and body composition

Weight, BMI, and body composition (body fat and muscle mass) were analyzed using bioelectrical impedance (BIA) Tanita MC-7800U multi frequency segmental body composition analyzer. Analysis performed were made by clinic staff who were trained and followed a strict protocol. All participants were requested to avoid drinking and eating at least 1 hour before testing. Clinic staff would enter sex, height and age into the Tanita, allowing specific calculations for each participant. Impedance measures were obtained and registered at baseline and again after 6 months.

The Tanita also predicted energy need for each participant which were used for individually based guidance on energy intake.

Dietary habits and quality of life

Dietary habits were evaluated with a validated food frequency questionnaire that included 87 questions on frequency of intake of 76 food items (29). For this research, participants were asked to evaluate dietary habits in the last month. Data on whole grain, fish, vegetable and fruit consumption was used for this research. To evaluate whole grain consumption, the food items: whole wheat bread, rye bread, flatbread, porridge, chia and muesli were used. To evaluate participants fish consumption questions on intake of sushi and fish meals were used. Questions on intake of raw and cooked vegetables, fruit, berry's and dried fruit were used to evaluate vegetable and fruit consumption. Participants were asked how often they consumed these food items, for each food item there were six or seven possible answers. For whole grain, vegetables, and fruit the response categories were: never/rarely, 1-3 times per month, 1-2 times per week, 3-4 times per week, 5-6 times per week and daily. Due to limited number of participants, responses were recoded into two categories, never/rarely and 1-2 times per week or more. Never/rarely included answers from never/rarely and 1-3 times per

month. 1-2 times per week or more included answers from 1-2 times per week, 3-4 times per week, 5-6 times per week and daily. For fish consumption possible answers were: never/rarely, 1-3 times per month, 1 time per week, 2 times per week, 3-4 times per week, 5-6 times per week and daily. Responses were recoded into two categories, never/rarely and 1 time per week or more. Never/rarely included answers from never/rarely and 1-3 times per month and 1 time per week or more included answers from 1 time per week, 2 times per week, 3-4 times per week, 5-6 times per week and daily.

Participants' quality of life was also evaluated with the questionnaire, before and after lifestyle intervention. Participants were asked to evaluate their quality of life on the scale of 1-100. The question was: How would you describe your health today on the scale from 0-100? With 0 indicating the worst and 100 the best health.

Exercise

Exercise was evaluated with the questionnaire, data on exercise frequency and exercise intensity was used in this study. To evaluate exercise frequency participants were asked how often they would exercise, possible response categories were: daily, 5-6 times per week, 3-4 times per week, 1-2 times per week, rarely and never. Responses were recoded to never/rarely, 1-4 times per week and 5-7 times per week. To evaluate exercise intensity participants were asked how difficult their usual exercise was. Possible response categories were light, moderate, and vigorous.

Participants of the study were offered to participate in an exercise program, the exercise program was optional. For those who registered in the exercise program cardiorespiratory fitness was evaluated with a 12-minute walk/run test called Cooper test. The Cooper test was performed on a treadmill at the clinic with a sport scientist present. Participants would warm up on a treadmill for 10 minutes and then undergo the test. The treadmill was programmed to stop after 12 minutes, measures for total distance covered was obtained and registered. The Cooper test was conducted within the first two weeks of the program and then again after 6 months.

Statistical analysis

Data processing was based on both analytical and descriptive statistics. All analyses were performed in R version 3.5.2 (30). Effects of the lifestyle intervention program on body weight, body compositions, physical activity, quality of life, and dietary habits was evaluated by comparing means or frequency before and after intervention. Paired *T*-test was used for continuous variables and McNemar´s Chi-square test was used for categorical variables. Logistic regression was used to calculate odds ratios with 95% confidence intervals for quality of life, exercise frequency, exercise intensity, whole grain-, vegetable-, fish-, and fruit consumption to evaluate effects on weight loss (yes/no). Adjustments were made for weight at baseline and age. Since majority of participants were women, adjustment for sex was not needed.

Results

Out of 81 participants that started the program, a total of 49 (60%) individuals completed the program, 11 men and 38 women with mean age of 47.7 years. Baseline characteristics of all participants that started the program are shown in table 1, where characteristics of those who dropped out of the program and those who finished are compared. Education levels were similar among the two groups, more than half (63%) of the participants had a University degree, 86.7% were in a relationship, and 55.6% had household income of more than 900 thousand (ISK) monthly. Participants that completed the program had slightly lower weight, BMI, and fat percentage at baseline, but higher muscle mass compared to those who dropped out.

Participants who dropped out of the program had lower participation rate in the optional exercise classes available at the clinic, or 34% compared to 76% (p=0.001). However, participants who dropped out of the program reported to exercise more often at baseline, or 57% of the dropout group exercised 1-4 times a week compared to 37% among the completers (p=0.030). However, when we looked at different cut-off for exercise frequency (≤2 times per week and ≥3 times per week) the difference between groups was not statistically significant. Cooper test outcome at baseline was similar between the groups (p=0.249) showing mean overall distance covered in 12 minutes to be 1.11 km. Although not statistically significant, participants who dropped out of the program evaluated their quality of life (on the scale from 0-100) worse at baseline, or on average 35 points compared to 43 points among completers.

Baseline data on dietary habits were not statistically different between those who dropped out of the program and those who completed the program.

Comparison before and after lifestyle intervention program

Paired *T*-test was used to compare measurements in weight, BMI, fat percentage, muscle mass, quality of life and Cooper test before and after intervention among participants (N=49) that completed the program (table 2). Mean weight loss was 1.97 kg (p=0.001) and mean BMI decreased by 0.55 kg/m^2 (p=0.033). Fat percentage decreased by 0.75% (p=0.007) but changes in muscle mass were not significant. Self-reported quality of life was significantly higher after the intervention as the score on quality of life improved on average by 23% (p<0.001). Those participants who underwent Cooper test increased their mean distance covered by 0.12 km (p=0.002).

McNemar´s Chi-square test was used to compare the effect of lifestyle intervention on exercise intensity, exercise frequency, and consumption of vegetables, fruits, fish, and whole grain products (table 3). More participants reported to exercise 1-4 times per week as 39% reported this frequency of exercise at baseline compared to 72% reported this frequency at the end of the intervention (p=0.005). Exercise intensity increased after the intervention as frequency of those who evaluated their exercise intensity to be vigorous increased from 8% to 40% and light exercise intensity decreased from 45% to 8% (p<0.001). At baseline 46% of participants reported to consume fruits 1-2 times per week or more compared to 65% after the intervention (p=0.020). Increase in consumption of vegetables, whole grain products, and fish meals did not change significantly after the intervention.

Weight loss

The associations between baseline dietary habits, quality of life and physical activity reported at the end of intervention and weight loss during the intervention are shown in table 4.

Although not statistically significant, those who evaluated their quality of life to be high at baseline were 60% more likely to lose any weight compared to those who evaluated their quality of life to be low at baseline (95%CI: 0.32-9.44). Participants who consumed vegetables 1-2 times a week or more at baseline were twice as likely to lose weight in the program compared to participants who consumed vegetables less than 1 time a week (OR = 2.15; 95%CI: 0.41-11.27), the results are however not statistically significant. Those who consumed fish 1 time a week or more were as well almost twice as likely to lose weight compared to participants who consumed fish less than 1 time a week (OR = 1.98; 95%CI: 0.23-41.86), the results are not statistically significant. Participants who consumed whole grain products 1-2 times a week or more were 69% more likely to lose weight in the program compared to participants who consumed whole grain less than 1 time a week, the results are however not statistically significant (95%CI: 0.41-6.98). When fruit consumption was evaluated participants who consumed fruit 1-2 times a week or more were almost six times likelier to lose weight compared to those who consumed fruit less than 1 time a week (OR = 5.92; 95%CI: 1.29 – 34.62). Although not statistically significant, participants who exercised three times a week or more had greater chance of weight loss compared to those who exercised 2 times a week or less (OR = 1.20; 95%CI: 0.19 – 10.16). Exercise frequency seemed to be a better predictor of weight loss than exercise intensity, those who exercised at moderate or vigorous intensity at baseline were not as likely to lose weight in the program as those who exercised at light intensity (OR = 0.46; 95%CI: 0.07 – 1.67), results are however not statistically significant.

Lifestyle factors measured at the end of the program were not statistically associated with any weight loss during the intervention. However, risk estimates were similar as shown in table 4, except for fruit intake.

Discussion

Our findings suggest that lifestyle intervention program based on the DPP program can decrease weight, BMI, and fat percentage and increase fitness, exercise intensity, exercise frequency, quality of life, and fruit consumption among individuals with cardiometabolic risk factors.

Studies on interventions have shown increased physical activity and dietary changes to be effective in weight management and reduction of cardiometabolic risk factors (10,24). A systematic review on interventions found programs that focus on both diet and physical activity, social support, and behavioral change techniques to be important to achieve clinically meaningful changes in weight loss (31). In the present study all participants were educated on dietary habits and behavioral change techniques were applied. However, the exercise class was optional resulting in different attendance in physical activity and social support among participants. Interventions with exercise programs have shown significantly greater weight loss compared to dietary interventions alone (32). Overall, participants increased their exercise frequency and exercise intensity in this study. If weight loss in current study is investigated and compared to other studies, the mean weight loss is not as great.

Mean weight loss in present study was 2% of initial body weight compared to 4.5% to 5.5% after 6-months in other DPP based studies (33–36). Mean age among participants in these studies varied from 50-63 years, majority were women, and mean baseline weight varied from 87-101 kg (33–36). In present study majority of participants were women as well, mean baseline weight was 107 kg and mean age was 48 years. However, in current study number of participants of the program was different, or 49 compared to 88-1079 participants in other studies (33–36). Since weight loss varied greatly among participants of the program the participation rates could affect weight loss outcomes.

Studies have examined the association between weight loss and consumption of fruits and vegetables. A research with 24 years of follow-up showed that high fruit consumption was protective against weight gain and even showed a slight weight loss for each extra serving per day (37).This study also showed that, the benefits of weight change were greater with increased consumption of fruits when compared to vegetables (37). Other studies show mixed results on the subject, some found an association only between weight loss and high fruit consumption (38) but other with both high vegetable and fruit consumption (39). In the present study those who consumed fruit 1-2 times a week or more at baseline were almost six times more likely to lose weight in the program compared to those who ate less fruit at baseline (p=0.030). Consumption of other tested food items were not statistically significantly connected with weight loss, although it must be stated that we did not examine the association between all food items asked about in the FFQ and weight loss. Lifestyle factors measured at the end of the program were not statistically associated with any weight loss during the intervention. Although we did not find a statistically significant associations between high vegetable-, whole grain-, and fish consumption and weight loss, the estimates all pointed into the direction of being associated with weight loss. A larger sample size would have been more favorable in order to analyze this association further.

Quality of life improved greatly among participants of the program. Increased quality of life has been linked to self-efficacy; individuals believe that they can successfully perform a certain behavior (21,22). In an intervention program like this were the aim is to change the participants' behavior – to eat healthier and increase exercise – increased quality of life can therefore influence behavioral change. If an individual believes a certain behavior or project can be performed successfully, he is more likely to engage in it (16,17). Increased quality of life might therefore be beneficial for health outcomes and health behaviors for participants later in life.

Difference between study dropouts and completers

Initially 81 participants entered the program and the dropout rate was 40% where 49 participants completed the program. Weight loss programs are prone to high dropout rates so this number of dropout is not unusual for this type of intervention which can vary from 10-80%, depending on program implementation (40).

It was interesting to see that in present study the difference between the dropout group and those who completed the program was in the participation rate in the optional exercise classes held at the clinic. Participants who dropped out of the program had lower participation rate in the optional exercise class (p=0.001), or 34% compared to 76%. These findings are consistent with other studies

on DPP program attendance (41) where extra group support from other participants seems to matter. The support that participants get from one another at the exercise class seems to affect adherence in the program. Another interesting thing regarding exercise between the two groups was participants exercise frequency. Participants who dropped out of the program reported to exercise more often at baseline, or 57% of the dropout group exercised 1-4 times a week compared to 39% among the completers (p=0.030). This was interesting since baseline Cooper test results were similar between the two groups.

Although not statistically significant, those who ate more fruit and vegetables at baseline were likelier to complete the program. Those who evaluated their quality of life higher were as well more likely to complete the program compared to those who evaluated their quality of life to be lower. These results are consistent with other studies, where poorer quality of life affects adherence in weight management programs and weight loss (42). Studies have shown that obese individuals report lower health-related quality of life (HRQoL) compared to normal weight individuals (18–20), but the HRQoL increases as the individual loses weight (43). In the present study, those who evaluated their quality of life high at baseline were almost twice as likely to lose weight compared to those who evaluated their quality of life to be low. These findings are however not statistically significant.

This type of intervention has not been performed in Iceland before until Heilsuborg clinic implemented the program in 2017. It was interesting to see what kind of individuals chose to register in this intervention program. The intervention was advertised in local newspaper and on social media and should therefore be visible for broad spectrum of individuals. Based on data from Statistic Iceland, education level among participants was higher than average (44) as 62% of the participants had a university degree compared to 42% of the population in Iceland. Majority (87%) of the participants were in a relationship (married or cohabiting) and more than half of the participants in present study had household income above average (>900 thousand ISK) (45). The intervention program was held at a private health and fitness clinic which participants had to pay for, the lifestyle coaches of the program were clinically trained professionals, quality equipment was used, and measurements in the program were comprehensive, which resulted in a relatively costly program without the possibility of program subsidizing, making it less accessible for individuals with lower income. It would be feasible to be able to offer lower income groups to participate in a program like this, especially since lower social status is associated with increased disease risk compared to individuals of higher social positions (1–3). To be able to provide such a program there are two possible options, to subsidize the program or reduce its cost. There have been different implementations made to the DPP program to reduced cost and make the program accessible for minority groups as well. One way is to specially train lifestyle coaches to deliver the program instead of health care workers, these individuals don't necessarily need to have a background in healthcare services or education in the field. This makes staff expenses lower which reduces program cost (46). Studies have shown this to be an effective way to reduce cost but still reduce weight and diabetes incidence (41). Another way to reduce program cost is by making the program fully digital, that way staffing becomes cheaper as well. Fully digital modifications have been made to the DPP program

with positive outcomes (47). Further investigations on the Sidekick health app to possibly reduce cost and offer low-cost services in the program is therefore interesting.

The other possibility is to subsidize the intervention program. The YMCA in America has tried this with the DPP program, they used charitable donations to reduce cost and make the program accessible for individuals with low-income with good results (48). This would be similar to subsidizing of the unions in Iceland, or preferably the participation of the government. According to the International Classification of Diseases (ICD-10) obesity is classified as a disease (49), by recognizing obesity as a disease more access to care is possible when it comes to obesity treatments (50). Obesity is as well recognized as a disease in Iceland and treatment options that are subsidized by the Icelandic Health Insurance are; treatment at lifestyle receptions at health clinics, interviews by two obesity medical specialists, treatment at rehabilitations centers, and bariatric surgery (51). Interdisciplinary obesity treatments at rehabilitation centers are available in Iceland, these treatments are however for severely obese individuals with other obesity related symptoms or complications (52). The rehabilitation is in cooperation with the National University Hospital of Iceland which performs bariatric surgeries, so those who need to undergo bariatric surgeries need to go through the program at the rehabilitation centers first (52). These two treatments are both for severely obese individuals, early prevention or intervention is important as well. The lifestyle receptions at the health clinics are intended for early intervention. However clinical guidelines for adult, obese individuals have not been made. These clinical guidelines have been made for obese children, according to an action plan to decrease obesity prevalence in Iceland, clinical guidelines for adults have been on the agenda since 2013 (53). Without clinical guidelines for health care workers at lifestyle receptions, recommendations and treatment options for patients might be limited or ineffective. The need for early prevention or treatment is great in light of increasing prevalence of obesity in Iceland (13,15,54), access to care therefore needs to be both affordable and effective for all citizens.

Strengths and limitations

The strength of our study lies in the comprehensive information gathered on lifestyle among participants. Only a part of those information gathered was used for this research but will hopefully be analyzed in relation with weight loss in the nearest futures. Our data provides information that was used to study what was different between those who completed the program and those who did not, which is rarely done in other DPP studies. The measurements on weight, body composition, and endurance made in the program were performed with quality equipment by specially trained professionals. Based on the measurements it was possible to predict the energy need for each participant, which made feedback and guidance in the program more individually based. Those who registered in the exercise class underwent Cooper test to evaluate their fitness more precisely, which is a good addition to the self-evaluated fitness. Also, participants had access to highly educated lifestyle coaches, which ensures quality educational lectures. Participants were also able to exercise at the clinic with access to sport scientists who have experience in training overweight individuals, participants did not need to go elsewhere to exercise which makes access to quality exercise good.

Some limitations to this study should be noted. Firstly, participants of the study self-registered to the intervention program. An individual who self-registers to an intervention program is likelier to be ready for a lifestyle change compared to a person who would be referred to an intervention program by a physician or other health staff. There is no control group which limits the possibility of comparing different strategies in achieving meaningful weight loss. We had high number of missing values in our data (see supplement table 1 on missing data). The missing values were randomly spread making statistical analysis limiting, especially for the information gathered through the questionnaire. Due to practical issues, the questionnaire was sent out later to one of the program group to measure baseline well-being and lifestyle which might affect study outcome. The questionnaire was comprehensive and took quite a long time to answer (20-30 minutes) which may have resulted in more missing answers. The question on the frequency of physical activity was not precise enough in our questionnaire to evaluate exactly how many minutes per week participants engaged in physical activity. Since participants self-evaluated their dietary intake, exercise and quality of life there is always a possibility of response bias. The exercise class was optional and not all participants registered. The exercise class can affect outcomes in weight loss and quality of life. Lastly, sample size was rather small which makes statistical power low (55). Studies have shown that dropout rates in obesity related programs is high and only 49 participants completed the program in present study, which results in greater influence of outcomes per individual. Sample size would have had to be larger for meaningful analysis of the data.

Conclusions

Our study suggests that intervention program based on the DPP program for individuals with cardiometabolic risk factors can reduce weight, BMI, fat percentage and increase quality of life, fitness, exercise frequency, exercise intensity, and fruit consumption among participants. Muscle mass and consumption of vegetables, whole grain, and fish did not change significantly after the intervention. High fruit consumption at baseline was associated with weight loss at the end of the program. Although not statistically significant there is an indication that baseline characteristics of quality of life, exercise frequency, and consumption of vegetables, whole grain, and fish might affect weight loss. Further studies are needed to analyze the effect of such implementation, preferably with larger sample size to increase statistical power. Further investigation is also needed to demonstrate long term effects of the program in Iceland.

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Table 1: Baseline characteristics of participants that entered the intervention program.

	Overall (n=81)	Dropped out (n=32)	Finished (n=49)	p-value
Baseline kg				
Mean (SD)	107 (20.9)	108 (19.0)	107 (22.3)	0.386
Median [Min, Max]	105 [73.8, 153]	105 [77.2, 149]	105 [73.8, 153]	
Baseline BMI				
Mean (SD)	36.9 (6.15)	37.8 (6.64)	36.3 (5.79)	0.401
Median [Min, Max]	36.2 [26.7, 54.2]	35.7 [27.0, 54.2]	36.6 [26.7, 47.2]	
Baseline fat %				
Mean (SD)	41.3 (5.31)	42.9 (4.59)	40.3 (5.54)	0.662
Median [Min, Max]	41.9 [21.9, 50.6]	43.9 [32.8, 50.5]	40.8 [21.9, 50.6]	
Baseline Muscle mass				
Mean (SD)	59.3 (11.1)	58.0 (8.62)	60.1 (12.5)	0.537
Median [Min, Max]	56.4 [40.7, 91.0]	57.1 [45.4, 80.6]	56.2 [40.7, 91.0]	
Baseline exercise week before, n (%)				0.038
Never/rarely	33 (49.3%)	7 (30.4%)	26 (59.1%)	
1-4x a week	30 (44.7%)	13 (56.5%)	17 (38.6%)	
5-7x a week	4 (5.9%)	3 (13.0%)	1 (2.3%)	
Baseline exercise intensity, n (%)				0.377
Light	25 (41.7%)	7 (33.3%)	18 (46.2%)	
Moderate	30 (50.0%)	13 (61.9%)	17 (43.6%)	
Vigorous	5 (8.3%)	1 (4.8%)	4 (10.3%)	
Registered in an exercise class, n (%)				0.001
No	33 (40.7%)	21 (65.6%)	12 (24.5%)	
Yes	48 (59.3%)	11 (34.4%)	37 (75.5%)	
Baseline Cooper test*				0.249
Mean (SD)	1.11 (0.188)	1.13 (0.181)	1.11 (0.192)	
Median [Min, Max]	1.12 [0.730, 1.66]	1.13 [0.890, 1.48]	1.10 [0.730, 1.66]	
Baseline Quality of life**				0.392
High	17 (27.0%)	4 (18.2%)	13 (31.7%)	
Low	46 (73.0%)	18 (81.8%)	28 (68.3%)	
Sex, n (%)				0.103
Male	13 (16.0%)	2 (6.2%)	11 (22.4%)	
Female	68 (84.0%)	30 (93.8%)	38 (77.6%)	
Age				0.478
Mean (SD)	47.9 (11.1)	48.2 (11.1)	47.7 (11.1)	
Median [Min, Max]	48.0 [21.0, 71.0]	49.5 [28.0, 70.0]	47.0 [21.0, 71.0]	
Education, n (%)				0.494
Primary	9 (13.4%)	4 (17.4%)	5 (11.4%)	
Secondary/Vocational	16 (23.9%)	3 (13.0%)	13 (29.5%)	
University	42 (62.7%)	16 (69.6%)	26 (59.1%)	
Relationship status, n (%)				0.959
Single	10 (14.3%)	4 (16.7%)	6 (13.0%)	
Married/cohabiting	60 (86.7%)	20 (83.3%)	40 (87.0%)	

Household income, n (%)* **				0.929
Below average	28 (44.4%)	10 (47.6%)	18 (42.9%)	
Above average	35 (55.6%)	11 (52.4%)	24 (57.1%)	
Smoker, n (%)	12 (14.8%)	4 (12.5%)	8 (16.3%)	1.00
Hypertensive, n (%)	20 (24.7%)	6 (18.8%)	14 (28.6%)	1.00
Vegetables, n (%)				0.197
Never/rarely	18 (26.0%)	9 (37.5%)	9 (20.0%)	
≥1-2 per week	51 (74.0%)	15 (62.5%)	36 (80.0%)	
Fruit, n (%)				0.132
Never/rarely	36 (52.2%)	16 (66.7%)	20 (44.4%)	
≥1-2 per week	33 (47.8%)	8 (33.3%)	25 (55.6%)	
Whole grain, n (%)				1.00
Never/rarely	28 (41.2%)	10 (41.7%)	18 (40.9%)	
≥1-2 per week	40 (58.8%)	14 (58.3%)	26 (59.1%)	
Fish, n (%)				1.00
Never/rarely	40 (77.0%)	13(76.5%)	27 (77.1%)	
≥1 per week	12 (23.0%)	4 (23.5%)	8 (22.9%)	

***** Cooper test is a 12-minute walk/run test to evaluate participants physical fitness.
** Quality of life below 50 classified as low quality of life, quality of life over 50 classified as high.
*** Household income below average classified as monthly income lower than 900 (ISK) per month and income above average classified as monthly income higher than 900 (ISK) per month.

Table 2: Comparison of weight, BMI, fat percentage, muscle mass, quality of life and Cooper test after intervention program among completers with paired *T*-test.

	N	Mean before intervention (SD)	Mean after intervention (SD)	Mean difference (95% confidence interval)	p-value
Weight	49	107 (22.3)	105 (22.0)	-1.97 (0,838-3,100)	0.001
BMI	49	36.3 (5.79)	35.8 (6.0)	-0,55 (0,045-1,047)	0.033
Fat %	49	40.3 (5.54)	39.6 (5.51)	-0,75 (0,208-1,298)	0.007
Muscle mass (kg)	49	60.1 (12.5)	59.7 (12.3)	0,39 (-0,727-0,865)	0.095
Quality of life	41	42.9 (20.8)	67.2 (19.2)	23.25 (16.858-29.641)	< 0.001
Cooper test	25	1.11 (0.19)	1.23 (0.18)	-0.117 (0.183-0.046)	0.002

Table 3: Comparison of exercise intensity, exercise per week, vegetable-, fruit-, whole grain- and fish consumption before and after lifestyle intervention with McNemar´s Chi-square test.

Variable	Category	Before intervention n (%)	After intervention n (%)	X^2 (*p-value*)
Vegetable, n (%)	Never/rarely	8 (17.8%)	4 (8.9%)	0.220
	≥1-2 per week	37 (82.2%)	41 (91.1%)	
Fruit, n (%)	Never/rarely	25 (54.4%)	16 (34.8%)	0.027
	≥1-2 per week	21 (45.6%)	30 (65.2%)	
Whole grain, n (%)	Never/rarely	19 (44.2%)	18 (41.9%)	1
	≥1-2 per week	24 (55.8%)	25 (58.1%)	
Fish, n (%)	Never/rarely	40 (77.0%)	40 (77.0%)	1
	≥1 per week	12 (23.0%)	12 (23.0%)	
Exercise intensity, n (%)	Light	18 (45.0%)	3 (7.5%)	< 0.001
	Moderate	19 (47.5%)	21 (52.5%)	
	Vigorous	3 (7.5%)	16 (40.0%)	
Exercise per week, n (%)	Never/rarely	27 (58.7%)	10 (21.7%)	0.005
	1-4x a week	18 (39.2%)	33(71.7%)	
	5-7x a week	1 (2.2%)	3 (6.5%)	

Table 4: Odds ratio for weight loss and baseline characteristics

Characteristics	Categories	Crude OR (95% CI)	Adjusted* OR (95% CI)
Quality of life	Low quality of life	1.0	1.0
	High quality of life	1.58 (0.36 - 8.32)	1.60 (0.32 – 9.44)
Vegetables	Never/rarely	1.0	1.0
	≥1-2 per week	2.4 (0.50 - 11.14)	2.15 (0.41-11.27)
Fish	Never/rarely	1.0	1.0
	≥1 per week	2.45 (0.34 - 50.02)	1.98 (0.23 – 41.86)
Whole grain	Never/rarely	1.0	1.0
	≥1-2 per week	2.12 (0.57 – 8.19)	1.69 (0.41 – 6.98)
Fruit	Never/rarely	1.0	1.0
	≥1-2 per week	4.29 (1.13 - 18.97)	5.92 (1.29 – 34.62)
Exercise per week	≤2x per week	1.0	1.0
	≥3x per week	1.15 (0.22 – 8.77)	1.20 (0.19 – 10.16)
Exercise intensity	Light	1.0	1.0
	Moderate/vigorous	0.46 (0.10 – 1.85)	0.37 (0.07 – 1.67)

* Adjusted for age and weight at baseline

Table 5: Baseline characteristics of participants with missing values.

	Overall (n=81)	Dropped out (n=32)	Finished (n=49)
Baseline kg			
Mean (SD)	107 (20.9)	108 (19.0)	107 (22.3)
Median [Min, Max]	105 [73.8, 153]	105 [77.2, 149]	105 [73.8, 153]
Baseline BMI			
Mean (SD)	36.9 (6.15)	37.8 (6.64)	36.3 (5.79)
Median [Min, Max]	36.2 [26.7, 54.2]	35.7 [27.0, 54.2]	36.6 [26.7, 47.2]
Missing	1 (1.2%)	0 (0%)	1 (2.0%)
Baseline fat %			
Mean (SD)	41.3 (5.31)	42.9 (4.59)	40.3 (5.54)
Median [Min, Max]	41.9 [21.9, 50.6]	43.9 [32.8, 50.5]	40.8 [21.9, 50.6]
Baseline Muscle mass			
Mean (SD)	59.3 (11.1)	58.0 (8.62)	60.1 (12.5)
Median [Min, Max]	56.4 [40.7, 91.0]	57.1 [45.4, 80.6]	56.2 [40.7, 91.0]
Baseline exercise week before, n (%)			
Never/rarely	33 (40.7%)	7 (21.9%)	26 (53.1%)
1-4x a week	30 (37.0%)	13 (40.6%)	17 (34.7%)
5-7x a week	4 (4.9%)	3 (9.4%)	1 (2.0%)
Missing	14 (17.3%)	9 (28.1%)	5 (10.2%)
Baseline excersie intensity, n (%)			
Light	25 (30.9%)	7 (21.9%)	18 (36.7%)
Moderate	30 (37.0%)	13 (40.6%)	17 (34.7%)
Vigourous	5 (6.2%)	1 (3.1%)	4 (8.2%)
Missing	21 (25.9%)	11 (34.4%)	10 (20.4%)
Registered in exercise class, n (%)			
No	33 (40.7%)	21 (65.6%)	12 (24.5%)
Yes	48 (59.3%)	11 (34.4%)	37 (75.5%)
Baseline Cooper test*			
Mean (SD)	1.11 (0.188)	1.13 (0.181)	1.11 (0.192)
Median [Min, Max]	1.12 [0.730, 1.66]	1.13 [0.890, 1.48]	1.10 [0.730, 1.66]
Missing	33 (40.7%)	21 (65.6%)	12 (24.5%)
Baseline Quality of life, n (%)**			
Low quality of life	46 (56.8%)	18 (56.2%)	28 (57.1%)
High quality of life	17 (21.0%)	4 (12.5%)	13 (26.5%)
Missing	18 (22.2%)	10 (31.2%)	8 (16.3%)
Sex, n (%)			
Male	13 (16.0%)	2 (6.2%)	11 (22.4%)
Female	68 (84.0%)	30 (93.8%)	38 (77.6%)
Age, n (%)			
Mean (SD)	47.9 (11.1)	48.2 (11.1)	47.7 (11.1)
Median [Min, Max]	48.0 [21.0, 71.0]	49.5 [28.0, 70.0]	47.0 [21.0, 71.0]

Education, n (%)			
Primary	9 (11.1%)	4 (12.5%)	5 (10.2%)
Secondary/Vocational	16 (19.8%)	3 (9.4%)	13 (26.5%)
University	42 (51.9%)	16 (50.0%)	26 (53.1%)
Other	3 (3.7%)	1 (3.1%)	2 (4.1%)
Missing	11 (13.6%)	8 (25.0%)	3 (6.1%)
Relationship status, n (%)			
Single	10 (12.3%)	4 (12.5%)	6 (12.2%)
Married/cohabiting	60 (74.1%)	20 (62.5%)	40 (81.6%)
Missing	11 (13.6%)	8 (25.0%)	3 (6.1%)
Income, n (%)* **			
Below average	28 (34.6%)	10 (31.2%)	18 (36.7%)
Above average	35 (43.2%)	11 (34.4%)	24 (49.0%)
Missing	18 (22.2%)	11 (34.4%)	7 (14.3%)
Smoking, n (%)			
Non-smoker	55 (67.9%)	19 (59.4%)	36 (73.5%)
Smoker	12 (14.8%)	4 (12.5%)	8 (16.3%)
Missing	14 (17.3%)	9 (28.1%)	5 (10.2%)
Hypertension, n (%)			
No	11 (13.6%)	3 (9.4%)	8 (16.3%)
Yes	20 (24.7%)	6 (18.8%)	14 (28.6%)
Missing	50 (61.7%)	23 (71.9%)	27 (55.1%)
Vegetables, n (%)			
Never/rarely	18 (22.2%)	9 (28.1%)	9 (18.4%)
≥1-2 per week	51 (63.0%)	15 (46.9%)	36 (73.5%)
Missing	12 (14.8%)	8 (25.0%)	4 (8.2%)
Fruit, n (%)			
Never/rarely	36 (44.4%)	16 (50.0%)	20 (40.8%)
≥1-2 per week	33 (40.7%)	8 (25.0%)	25 (51.0%)
Missing	12 (14.8%)	8 (25.0%)	4 (8.2%)
Whole grain, n (%)			
Never/rarely	28 (34.6%)	10 (31.2%)	18 (36.7%)
≥1-2 per week	40 (49.4%)	14 (43.8%)	26 (53.1%)
Missing	13 (16.0%)	8 (25.0%)	5 (10.2%)
Fish, n (%)			
Never/rarely	40 (49.4%)	13 (40.6%)	27 (55.1%)
≥1 per week	12 (14.8%)	4 (12.5%)	8 (16.3%)
Missing	29 (35.8%)	15 (46.9%)	14 (28.6%)

***** Cooper test is a 12-minute walk/run test to evaluate participants physical fitness.
** Quality of life below 50 classified as low quality of life, quality of life over 50 classified as high.
*** Household income below average classified as monthly income lower than 900 (ISK) per month and income above average classified as monthly income higher than 900 (ISK) per month.

Appendix 1: Lifestyle intervention curriculum

Fræðsluplan – Að stjórna eigin heilsu

Fyrir þá sem byrja í september 2018

Dags.	Kl.	Fyrirlesari	Umfjöllunarefni
13. september	16:30 - 18:00 18:15 - 19:45	Helga Margrét	Kynning / Að koma sér af stað
27. september	16:30 - 18:00 18:15 - 19:45	Kristín Rún	Nærumst vel
11. október	16:30 - 18:00 18:15 - 19:45	Kristín og Sólveig	Niðurstöður mælinga og smakk og hugmyndir að morgunmat og millibitum
25. október	16:30 - 18:00 18:15 - 19:45	Helga Margrét	Innkaup og umbúðalestur
8. nóvember	17:30 - 19:00	Marianna	Q&A Spurningar og svör
22. nóvember	17:30 - 19:00	Erla Gerður	Áhættuþættir heilsunnar og þyngdarstjórnun
6. desember	17.30 - 19:00	Marianna	Að standast freistingar á mannamótum og kveikjur
10. janúar	17:30 - 19:00	Erla Gerður	Svefn og svefnraskanir
24. janúar	17:30 - 19:00	Kristín Rún	Að vinna með hugsanir sínar og streita
7. febrúar	17:30 - 19:00	Helga Margrét	Bakslagsvarnir, upprifjun og Q&A

*Með fyrirvara um breytingar

Appendix 2: Approval from Bioethics Committee

VÍSINDASIÐANEFND
Borgartúni 21 - 4. hæð
105 Reykjavík,
Sími: 551 7100
netfang: vsn@vsn.is www.vsn.is

Háskóli Íslands,
Miðstöð í lýðheilsuvísindum
Jóhanna Eyrún Torfadóttir,
rannsóknarsérfræðingur
101 Reykjavík
jet@hi.is

Reykjavík 22. maí 2018
Tilv.: VSNb2018040012/03.01

Efni: 18-088-S1 - Lífsstílsnámskeið fyrir fullorðna einstaklinga með áhættuþætti efnaskiptasjúkdóma (A Lifestyle Change Program for Adults with Cardiometabolic Risk Factors)

Vísindasiðanefnd þakkar svarbréf þitt, dags. 15.05.2018 vegna áðursendra athugasemda við ofangreinda rannsóknaráætlun sbr. bréf nefndarinnar dags. 08.05.2018. Í bréfinu koma fram svör og skýringar til samræmis við athugasemdir Vísindasiðanefndar.

Fjallað var um umsókn þína, svarbréf þitt og önnur innsend gögn á fundi Vísindasiðanefndar 22.05.2018.

Rannsóknarlok eru 31.10.2019. Engar persónugreinanlegar heilbrigðisupplýsingar verða varðveittar að rannsókn lokinni.

Með vísan til laga nr. 44/2014, um vísindarannsóknir á heilbrigðissviði er rannsóknaráætlunin endanlega samþykkt af Vísindasiðanefnd með þeim almenna fyrirvara að lögbundið samþykki skráarhaldara skv. 2. mgr. 27. gr. laga nr. 44/2014 verður að liggja fyrir áður en aðgangur að heilbrigðisgögnum er veittur frá viðkomandi stofnun/skráarhaldara.

Vísindasiðanefnd vekur sérstaka athygli á að ábyrgðarmaður rannsóknarinnar ber ábyrgð á að sótt sé um viðeigandi leyfi fyrir rannsókninni hjá þeim stofnunum sem við á. Óheimilt er að hefja rannsóknina fyrr en þau liggja fyrir. Afrit leyfa/samstarfsyfirlýsinga þurfa að berast nefndinni. Áréttað er að allar fyrirhugaðar breytingar á þegar samþykktri rannsóknaráætlun þurfa að koma inn til nefndarinnar til umfjöllunar. Jafnframt ber ábyrgðarmanni að sækja um breytingar til þeirra stofnanna, sem veitt hafa leyfi vegna framkvæmdar rannsóknarinnar eða öflunar gagna, um framangreint, ef við á. Vísindasiðanefnd bendir rannsakendum vinsamlegast á að birta VSN tilvísunarnúmer rannsóknarinnar þar sem vitnað er í leyfi nefndarinnar í birtum greinum um rannsóknina. Minnt er á að tilkynna rannsóknarlok til nefndarinnar.

Með kveðju og ósk um gott rannsóknargengi, f.h. Vísindasiðanefndar,

Kristján Erlendsson, læknir, formaður

Appendix 3: Introduction letter

Viðauki 2

Lífsstílsnámskeið fyrir fullorðna einstaklinga með áhættuþætti efnaskiptasjúkdóma er rannsókn sem unnin er á vegum Háskóla Íslands, Heilsuborgar, SidekickHealth og Stanford háskóla. Rannsóknin miðar að því að kanna hvort að lífsstílsinngrip fyrir einstaklinga með áhættuþætti efnaskiptasjúkdóma geti hægt á eða komið í veg fyrir þróun sykursýki týpu tvö. Rannsóknin stendur til boða þeim sem skrá sig á lífsstílsnámskeið í Heilsuborg. Þátttakendur eru allir fullorðnir einstaklingar sem annaðhvort skrá sig sjálfir á námskeiðið eða er boðið af vinnuveitenda á það.

Leitast verður við að svara eftirfarandi spurningum:

- Er hægt að meta hvort einstaklingar með áhættuþætti efnaskiptasjúkdóma geti sýnt fram á mælanlegar breytingar á þyngd, líkamssamsetningu, gripstyrk, blóðþrýstingi og ummáli með lífsstílsfræðslu þar sem blandað er saman stafrænni tækni og vikulegum fundum með leiðbeinendum lífsstílsnámskeiðs?
- Verða breytingar á lífsstílsþáttum s.s neysluvenjum, hreyfingu, svefni og andlegri líðan meðal einstaklinga á lífsstílsnámskeiði þar sem blandað er saman stafrænni tækni og vikulegum fundum með leiðbeinendum lífsstílsnámskeiðs?
- Geta niðurstöður úr snjallúrum með skrefateljara gefið upplýsingar varðandi mælanlegar breytingar á áhættuþáttum efnaskiptasjúkdóma?

Væntingar rannsóknarinnar eru að meta árangur af lífsstílsþjálfun fyrir einstaklinga með áhættuþætti efnaskiptasjúkdóma sem hægt væri að nýta til forvarna og meðferðar til þess að auka heilsu og líðan fólks.

Hvað felur þátttaka í sér?

- **Svörun rafræns spurningalista.** Spurningar varðandi neysluvenjur, hreyfingu, andlega líðan og svefn
- **Mælingar á þyngd, líkamssamsetningu, gripstyrk, blóðþrýstingi og ummáli.** Mælingar verða framkvæmdar á meðan á námskeiðinu stendur. Allar mælingar verða framkvæmdar í Heilsuborg.
- **Þátttaka á reglulegum fræðslufundum.** Þátttakendur skrá sig í fræðsluhóp á þeim tíma sem hentar og mæta aðra hverja viku á fræðslufundi í 6 mánuði.
- **Þátttaka á Sidekick.** Þátttakendur fá sendar áskoranir í gegnum smáforritið Sidekick í tengslum við námskeiðið. Einnig skrá þátttakendur ákveðnar neysluvenjur, hreyfingu og líðan í smáforritið. Notast verður við appið fyrstu 16 vikurnar af námskeiðinu.

Hugsanleg áhætta fyrir þátttakendur er engin . Mögulegur ávinningur af þátttöku getur verið bætt heilsa, líðan og aukin þekking varðandi hreyfingu, næringu og streitu.

Hvernig skrái ég mig í rannsóknina?

Öllum þeim sem skrá sig á lífsstílsnámskeiðið í Heilsuborg eða er boðið af Reykjavíkurborg að taka þátt í námskeiðinu stendur til boða að taka þátt í rannsókninni. Þátttaka er valfrjáls og þátttakendur geta hætt í rannsókninni hvenær sem er í ferlinu.

Eru upplýsingarnar um mig öruggar?

Upplýsingunum sem safnað er um þáttakendur verða dulkóðaðar og órekjanlegar til einstaka þátttakenda. Upplýsingarnar verða geymdar í dulkóðuðum gagnagrunni hjá Miðstöð í lýðheilsuvísindum við Háskóla Íslands. Þeir vísindamenn sem vinna með gögnin munu einungis fá gögnin þar sem búið er að fjarlægja persónugreinanlegar upplýsingar. Rannsóknina hefur verið samþykkt af Vísindasiðanefnd.

Hverjir standa að rannsókninni?

Ábyrgðarmaður rannsóknarinnar er Dr. Jóhanna E. Torfadóttir, rannsóknarsérfræðingur við Miðstöð í lýðheilsuvísindum, Háskóla Íslands (jet@hi.is). Meistaranemi í lýðheilsuvísindum kemur að rannsókninni, Íris Björk Ásgeirsdóttir (iris@heilsuborg.is) sem jafnframt vinnur sem leiðbeinandi í lífsstílsnámskeiðinu. Rannsóknin er unnin í samstarfi við Heilsuborg, Sidekick og Stanford háskóla.

Hvar get ég fengið frekari upplýsingar?

Ef spurningar vakna varðandi rannsóknina eða þátttöku þína getur þú sent fyrirspurn á netfangið: iris@heilsuborg.is

Appendix 4: Informed consent

HÁSKÓLI ÍSLANDS

Lífsstílsnámskeið fyrir fullorðna eintaklinga með áhættuþætti efnaskiptasjúkdóma

Um rannsóknina

Rannsóknin er á vegum Háskóla Íslands (HÍ), Heilsuborgar og SidekickHealth. Ábyrgðamaður er Jóhanna Eyrún Torfadóttir, rannsóknasérfræðingur við Miðstöð í Lýðheilsuvísindum við Læknadeild Háskóla Íslands.

Það er von okkar að aðferðafræðin í lífsstílsnámskeinu veiti mikilvægra þekkingu um hvernig hægt er að hafa áhrif á ýmsa þætti er snúa að heilsunni. Ætlunin er að rannsóknin nái til allra fullorðinna einstaklinga sem skrá sig á lífsstílsnámskeið hjá Heilsuborg veturinn 2017-18.

Þér verið veittur aðgangur að **rafrænum spurningalista sem svara þarf fyrir og eftir þátttöku í námskeiðinu** þar sem finna má spurningar um lífsstíl þinn og líðan. Einnig færðu aðstoð við að nota smáforritið Sidekick til að styðja við komandi lífsstílsbreytingar.

Svör við spurningalistum verða geymd í gagnagrunni við Háskóla Íslands. Einnig verða skráðar upplýsingar um hæð, þyngd, mittisummál ásamt niðurstöðum úr blóðprufum fyrir og eftir þátttöku í námskeiðinu.

Gagnasöfnun þessi er gerð með samþykki Vísindasiðanefndar. Öll úrvinnsla á gögnum verður gerð án þess að nein persónuauðkenni komi fram. Niðurstöður rannsókna sem byggja á þessum rannsóknargrunni verða birtar í ritrýndum vísindatímaritum á alþjóðavettvangi. Nafnleyndar og persónuverndar verður ávallt gætt í hverri rannsókn sem hefur aðgang að gögnunum.

Þátttaka er algjörlega valfrjáls; þátttakendur geta valið að sleppa ákveðnum hluta rannsóknarinnar eða að hætta þátttöku alfarið hvenær sem í ferlinu án frekari skýringa eða eftirmála.

Ef þú hefur spurningar um rétt þinn sem þátttakandi í þessari vísindarannsókn eða vilt hætta þátttöku getur þú sent okkur póst á netfangið jet@hi.is.

Upplýst samþykki

Vinsamlegast lesið vel áður en hakað er við samþykkið:

Ég undirrituð/aður hef kynnt mér ofanskráðar upplýsingar um rannsóknina sem ber heitið: Lífsstílsnámskeið fyrir fullorðna eintaklinga með áhættuþætti efnaskiptasjúkdóma

HÁSKÓLI ÍSLANDS

Mér er kunnugt um tilgang rannsóknarinnar og í hverju þátttaka mín er fólgin. Mér er ljóst að þótt ég hafi samþykkt þátttöku þá geti ég hætt henni hvenær sem er.

Nafn:

Kennitala:

Netfang:

Farsímanúmer:

Samstarfsaðilar verkefnisins eru:

Erla Gerður Sveinsdóttir, Yfirlæknir Heilsuborgar

Tryggvi Þorgeirsson, læknir og stofnandi appsins Sidekick

Íris Björk Ásgeirsdóttir, iðjóttafræðingur og meistaranemi í lýðheilsuvísindum við HÍ

Marianna Þórardóttir, doktorsnemi við Læknadeild HÍ

Edda B. Þórðardóttir, nýdoktor við Miðstöð í lýðheilsuvísindum HÍ

Thor Aspelund, prófessor í tölfræði við Miðstöð í lýðheilsuvísindum HÍ

Appendix 5: Questionnaire

Heilsulausnir

Þessi spurningalisti er settur upp af Miðstöð í Lýðheilsuvísindum við Háskóla Íslands.
Hér er spurt um aðstæður, heilsu, líðan og heilsutengda hegðun.

Í upphafi svarar þú þessum lista með því hugarfari að meta hvernig staðan var fyrir námskeiðið. Við munum síðan biðja þig að svara þessum spurningum aftur í lok námskeiðs.

Spurningalistinn er nokkuð ítarlegur. Við hvetjum þig því til að setjast niður þegar tími gefst og svara spurningum samviskusamlega. Ef það hentar ekki að svara öllum spurningum í einu er sá kostur fyrir hendi að velja "Save and return" hnappinn en þar með færð þú sendan staðfestingarkóða með tölvupósti sem er nauðsynlegt að skrá hjá þér og slá inn þegar þú vilt byrja aftur. Þegar þú hefur lokið við að svaraspurningalistanum þá skal velja "Submit" flipann en þar með sendir þú spurningalistann frá þér.

Tilgangur þessa spurningalista er fyrst og fremst fyrir þig til að fara markvisst yfir ýmsa þætti sem snúa að heilsunni þinni til að finna leið til að bæta hana. Spurningalistinn auðveldar leiðbeinendum námskeiðsins að aðstoða þig á þeirri leið. Megin tilgangur listans er þó að rannsaka árangur námskeiðsins.

Fullum trúnaði er heitið með upplýsingar sem fram koma hér.

Til að opna spurningalistann skaltu fara neðst á þessa síðu og smella á "Next" hnappinn.

Með bestu kveðju

Jóhanna E. Torfadóttir, rannsóknarsérfræðingur og ábyrgðamaður rannsóknarinnar um
Lífsstílsnámskeið fyrir fullorðna einstaklinga með áhættuþætti efnaskiptasjúkdóma

Hver er aldur þinn?

- ○ 18
- ○ 19
- ○ 20
- ○ 21
- ○ 22
- ○ 23
- ○ 24
- ○ 25
- ○ 26
- ○ 27
- ○ 28
- ○ 29
- ○ 30
- ○ 31
- ○ 32
- ○ 33
- ○ 34
- ○ 35
- ○ 36
- ○ 37
- ○ 38
- ○ 39
- ○ 40
- ○ 41
- ○ 42
- ○ 43
- ○ 44
- ○ 45
- ○ 46
- ○ 47
- ○ 48
- ○ 49
- ○ 50
- ○ 51
- ○ 52
- ○ 53
- ○ 54
- ○ 55
- ○ 56
- ○ 57
- ○ 58
- ○ 59
- ○ 60
- ○ 61
- ○ 62
- ○ 63
- ○ 64
- ○ 65
- ○ 66
- ○ 67
- ○ 68
- ○ 69

Ert þú karl eða kona?

- ○ Karl
- ○ Kona

Hefur þú fætt barn sem vóg meira en 4,5 kíló við fæðingu?

- ○ Já
- ○ Nei

Ertu í föstu sambandi? ○ Já ○ Nei

Búa einhverjir með þér á heimilinu? ○ Já ○ Nei

Merktu við þá sem búa með þér á heimili þínu.

- ☐ Maki
- ☐ Börn
- ☐ Vinir
- ☐ Systkini
- ☐ Foreldrar eða tengdaforeldrar
- ☐ Aðrir

(Merktu við allt sem á við)

Hve margir búa með þér?

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10

Hver er hæsta prófgráða sem þú hefur lokið?

- ○ Grunnskólapróf eða landspróf
- ○ Framhaldsskólapróf
- ○ Próf í iðngrein
- ○ Háskólapróf
- ○ Annað

Tekjur og atvinna

Á hvaða bili áætlar þú að heildartekjur allra fullorðinna á heimili þínu hafi verið að jafnaði á mánuði, síðustu 12 mánuði?

Átt er við tekjur fyrir skatta, s.s. föst laun, yfirvinnu-, álags-, og aukagreiðslur, auk fjármagnstekna, bóta og lífeyrisgreiðslna. Námslán teljast ekki með.

- ○ Minna en 150 þúsund
- ○ 151-300 þúsund
- ○ 301-500 þúsund
- ○ 501-700 þúsund
- ○ 701-900 þúsund
- ○ 901-1200 þúsund
- ○ 1200 -1500 þúsund
- ○ 1500-2000 þúsund
- ○ Meira en 2 milljónir

(Tekjur þínar meðtaldar)

Hvert eftirtalinna lýsir best núverandi stöðu þinni?

- ☐ Í vinnu
- ☐ Í námi
- ☐ Á örorkubótum
- ☐ Á eftirlaunum
- ☐ Heimavinnandi eða í foreldraorlofi
- ☐ Í lengra en 2ja mánaða veikindaleyfi
- ☐ Atvinnulaus/í atvinnuleit

(Merktu við allt sem á við)

Hvernig er vinnutími þinn allajafna?

- ○ Eingöngu dagvinna
- ○ Óreglulegur vinnutími
- ○ Vaktavinna

Hve löng er vinnuvika þín allajafna?

- ○ Minna en 20 klst
- ○ 20-39 klst
- ○ 40-59 klst
- ○ 60-79 klst
- ○ 80 klst eða meira

Næring

Þegar þú svarar spurningunum um mataræði skaltu hafa í huga mánuðinn áður en námskeið hófst.

Hversu oft borðaðir þú eftirfarandi máltíðir?

	Sjaldan / aldrei	1-3 í mánuði	1-2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Morgunmat	○	○	○	○	○	○
Millibiti fyrir hádegi	○	○	○	○	○	○
Hádegismat	○	○	○	○	○	○
Millibiti eftir hádegi	○	○	○	○	○	○
Kvöldmat	○	○	○	○	○	○
Millibiti eða snarl eftir kvöldmat	○	○	○	○	○	○

Hve oft borðaðir þú eftirfarandi brauð / kökur / kex / morgunkorn?

	Sjaldan / aldrei	1-3 í mánuði	1-2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Fínt eða hvítt brauð	○	○	○	○	○	○
Heilkorna eða gróft brauð	○	○	○	○	○	○
Rúgbrauð, flatkökur	○	○	○	○	○	○
Hrökkbrauð, tekex eða annað ósætt kex	○	○	○	○	○	○
Kex	○	○	○	○	○	○
Vöfflur eða pönnukökur	○	○	○	○	○	○
Vínarbrauð, snúðar eða kleinur	○	○	○	○	○	○
Kökur (súkkulaðikökur, rjómakökur o.s.frv.)	○	○	○	○	○	○
Múslíbar (Corny, Kellogg's o.s.frv.)	○	○	○	○	○	○
Hafragraut, chiagraut eða múslí	○	○	○	○	○	○
Morgunkorn (Cheerios, Cornflakes o.s.frv.)	○	○	○	○	○	○
Sætt morgunkorn (Cocoa Puffs, Lucky Charms o.s.frv)	○	○	○	○	○	○

	Sjaldan / aldrei	1-3 í mánuði	1-2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Hversu oft drakkst þú eða borðaðir mjólkurvörur? (Hér er einnig átt við notkun með t.d morgunkorni en ekki mjólk í kaffidrykkjum)	○	○	○	○	○	○

	Sjaldan / aldrei	1-3 í mánuði	1 í viku	2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Kjúklingur, kalkúnn og annað fuglakjöt	○	○	○	○	○	○	○
Kjöt og kjötréttir (annað en fuglakjöt)	○	○	○	○	○	○	○
Unnar kjötvörur (t.d. pylsur, kjötbollur, bacon, bjúgu, naggar)	○	○	○	○	○	○	○
Pasta- og spagettíréttir með kjöti	○	○	○	○	○	○	○
Fiskur og fiskréttir	○	○	○	○	○	○	○
Magur fiskur (t.d. ýsa, þorskur)	○	○	○	○	○	○	○
Feitur fiskur (t.d. lax, silungur, steinbítur, lúða)	○	○	○	○	○	○	○
Sushi	○	○	○	○	○	○	○
Grænmetisréttir	○	○	○	○	○	○	○
Pizzur	○	○	○	○	○	○	○

Hversu oft borðaðir þú þessar fæðutegundir sem meðlæti með aðalrétt?

	Sjaldan / aldrei	1-3 í mánuði	1-2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Kartöflur (soðnar, bakaðar)	○	○	○	○	○	○
Kartöflur (steiktar, franskar)	○	○	○	○	○	○
Hrísgrjón	○	○	○	○	○	○
Sætar kartöflur	○	○	○	○	○	○
Sósur (t.d. hamborgara- eða pítusósur, brúnar sósur, béarnaise sósur)	○	○	○	○	○	○

Hvaða tegund af fitu notaðir þú helst til steikingar og/eða við bakstur?

- ☐ Smjör
- ☐ Smjörlíki
- ☐ Kókosolíu
- ☐ Repjuolíu (Rapeseed oil)
- ☐ Ólífuolíu
- ☐ ISIO4
- ☐ Aðrar jurtaolíur
- ☐ Annað

(Merktu við allt sem á við)

Þegar þú valdir kornvörur valdir þú þá heilkorna/grófar vörur sem meðlæti (hýðishrísgrjón, heilhveitispaghettí o.s.frv.)?

- ○ Aldrei
- ○ Stundum
- ○ Oftast
- ○ Alltaf

Hversu marga skammta af mjólk og mjólkurvörum drakst/borðaðir þú á dag? (Hér eru mjólkurkaffidrykkir og ostar ekki taldir með. Einn skammtur: 1 glas, 1 lítil dós eða 1 skál)? _____ (Vinsamlegast skráðu heildarfjölda í tölu.)

Hve oft drakst þú eftirfarandi drykki?

	Sjaldan / aldrei	1-3 í mánuði	1-2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Ávaxtahristing eða boozt	○	○	○	○	○	○
Ávaxtasafa eða grænmetissafa	○	○	○	○	○	○
Íþróttadrykki eða próteindrykki	○	○	○	○	○	○
Orkudrykki	○	○	○	○	○	○
Sykurlausa gosdrykki	○	○	○	○	○	○
Sykraða gosdrykki	○	○	○	○	○	○
Vatn eða sódavatn án ávaxtasykurs	○	○	○	○	○	○

Þá daga sem þú drakst sykurlaust gos, hversu mikið drakst þú þann daginn?
- ○ 0 - 250 ml
- ○ 250 - 500 ml
- ○ 500 - 750 ml
- ○ 750 - 1000 ml
- ○ 1000 ml eða meira

Þá daga sem þú drekkur sykrað gos, hversu mikið drekkur þú þann daginn?
- ○ 0 - 250 ml
- ○ 250 - 500 ml
- ○ 500 - 750 ml
- ○ 750 - 1000 ml
- ○ 1000 ml eða meira

Hversu oft borðaðir þú ávexti, grænmeti og hnetur?

	Sjaldan / aldrei	1-3 í mánuði	1-2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Ávextir eða ber	○	○	○	○	○	○
Hnetur eða fræ	○	○	○	○	○	○
Þurrkaðir ávextir	○	○	○	○	○	○
Hrátt grænmeti	○	○	○	○	○	○
Matreitt grænmeti (ekki kartöflur)	○	○	○	○	○	○

Þá daga sem þú borðaðir ávexti eða ber, hversu marga skammta borðaðir þú þann daginn? (Einn skammtur er t.d. lítill banani, meðalstórt epli eða bolli af vínberjum/jarðaberjum)
- ○ 1-2 skammta
- ○ 3-4 skammta
- ○ 5-6 skammta
- ○ 7 eða fleiri skammta

Þá daga sem þú borðaðir grænmeti, hversu marga skammta borðaðir þú þann daginn? (Einn skammtur er t.d. stór gulrót, stór tómatur eða 2 dl af salati.
- ○ 1-2 skammta
- ○ 3-4 skammta
- ○ 5-6 skammta
- ○ 7 eða fleiri skammta

Hversu oft borðaðir þú þessar fæðutegundir eða rétti sem aðalrétt?

(ekki telja með álegg á brauð)

	Sjaldan / aldrei	1-3 í mánuði	1-2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Hversu oft borðaðir þú egg? (T.d. eitt og sér, sem álegg eða í eggjaköku/eggjahræru)	○	○	○	○	○	○

Hversu oft borðaðir þú sætindi, snakk og ís?

	Sjaldan / aldrei	1-3 í mánuði	1-2 í viku	3-4 í viku	5-6 í viku	Daglega / næstum daglega
Súkkulaði ljóst	○	○	○	○	○	○
Súkkulaði dökkt	○	○	○	○	○	○
Annað sælgæti en súkkulaði	○	○	○	○	○	○
Snakk, tortilla flögur, poppkorn, saltstangir	○	○	○	○	○	○
Ís, íspinnar, hristingur o.s.frv.	○	○	○	○	○	○

Notaðir þú eitthvað af eftirfarandi vörum reglulega mánuðinn áður en námskeið hófst?

- ☐ Lýsi (fljótandi eða perlur)
- ☐ Omega-3
- ☐ Fjölvítamín með D-vítamíni
- ☐ Fjölvítamín án D-vítamíns
- ☐ Járn
- ☐ Kalk
- ☐ Mjólkursýrugerlar, Acidophilus
- ☐ D-vítamín (töflur/sprey)
- ☐ Magnesíum
- ☐ B-vítamín
- ☐ Prótínduft- eða stykki
- ☐ Annað
- ☐ Ekkert af ofangreindum

Tókst þú meira en 20 µg af D-vítamíni daglega?

- ○ Já
- ○ Nei
- ○ Veit ekki

Hreyfing

Þegar spurningunum um hreyfingu er svarað er gott að hafa mánuðinn áður en námskeið hófst í huga.

Fékkstu litla sem enga hreyfingu á dæmigerðum degi?
- ◯ Já
- ◯ Nei

Hvað átti best við um þína atvinnu eða nám?
- ◯ Kyrrsetuvinna/nám að mestu (létt líkamleg vinna)
- ◯ Vinna/nám sem krefst göngu eða uppréttrar stöðu (t.d. létt iðnaðarvinna)
- ◯ Vinna/nám sem krefst mikillar göngu og að lyfta eða bera hluti (t.d. sjúkraliði, erfið iðnaðarvinna)
- ◯ Erfið líkamleg vinna/nám (t.d. byggingarvinna)
- ◯ Á ekki við, er ekki í starfi eða námi

Alla jafna, hversu marga daga í viku stundaðir þú hreyfingu af einhverju tagi (gönguferðir, sund, hlaup, jóga, fjallgöngur, boltaíþróttir, líkamsrækt o.s.frv.)?
- ◯ Daglega
- ◯ 5-6 sinnum í viku
- ◯ 3-4 sinnum í viku
- ◯ 1-2 sinnum í viku
- ◯ Sjaldnar en einu sinni í viku
- ◯ Aldrei

Hversu lengi stóð hreyfingin venjulega yfir? (Vinsamlegast taktu saman heildartímann yfir daginn)
- ◯ Styttra en 30 mínútur
- ◯ 30-60 mínútur
- ◯ 61-120 mínútur
- ◯ Lengur en 2 tíma

Hversu erfið var hreyfingin venjulega?
- ◯ Erfið (hraður hjartsláttur og öndun)
- ◯ Miðlungs (nokkuð aukinn hjartsláttur og öndun)
- ◯ Létt (lítið aukinn hjartsláttur og öndun)

Hversu mörgum klukkustundum á dag, mánuðinn áður en námskeið hófst, eyddir þú að meðaltali fyrir framan tölvuskjá/snjallsíma í frítíma þínum?
- ◯ Minna en 1 klst.
- ◯ Milli 1 klst. og 2,5 klst.
- ◯ Yfir 2,5 klst.

Hversu mörgum klukkustundum á dag, síðustu sjö daga áður en námskeið hófst, eyddir þú að meðaltali fyrir framan sjónvarp í frítíma þínum?
- ◯ Minna en 1 klst.
- ◯ Milli 1 klst. og 2,5 klst.
- ◯ Yfir 2,5 klst.

Reykingar, tóbak og áfengi (hafðu í huga tímann áður en námskeið hófst)

Reyktir þú?
- ◯ Nei, ég hef aldrei reykt
- ◯ Nei, en ég reykti áður fyrr
- ◯ Já, en ekki daglega
- ◯ Já, daglega

Hvað reyktir þú marga pakka á dag allajafna?
- ◯ 0 til 1/2
- ◯ 1/2 til 1
- ◯ meira en 1

Hvað er langt síðan þú hættir að reykja?
- ◯ Minna en 1 ár
- ◯ 1 til 5 ár
- ◯ 6 til 10 ár
- ◯ 11 til 15 ár
- ◯ 16 ár eða meira

Notaðir þú reyklaust tóbak dagana áður en námskeið hófst?
- ◯ Já
- ◯ Nei

Almennt heilsufar

Á skala frá 0 til 100, þar sem 0 lýsir versta hugsanlega heilsufari en 100 lýsir besta hugsanlega heilsufari, hvernig myndir þú lýsa heilsu þinni dagana áður en námskeið hófst?

Staðsettu merkið á stikunni hér til hægri með því að smella með músinni.

Versta hugsanlega heilsufar — Besta hugsanlega heilsufar

(Place a mark on the scale above)

Nú ætlum við að fara í gegnum lista af sjúkdómum, sjúkdómseinkennum og fleira þeim tengt.
Vinsamlega merktu við þá sjúkdóma sem læknir hefur greint þig með og annað eftir því sem við á.

Hefur þú einhvern tíma fengið hjartaáfall?
- ○ Já
- ○ Nei

Hefur þú fengið meðhöndlun vegna hjartabilunar? (Þú gætir hafa verið andstutt(ur) og læknir hafa sagt þér að það væri vökvi í lungunum eða að hjartað væri ekki að dæla nógu vel)
- ○ Já
- ○ Nei

Hefur þú farið í aðgerð á slagæðum í fótum til að bæta blóðrennslið?
- ○ Já
- ○ Nei

Hefur þú fengið heilablóðfall, blóðtappa í heila, blæðingar inná heilann eða tímabundið blóðþurrðarkast í heila?
- ○ Já
- ○ Nei

Tekur þú lyf vegna hjartasjúkdóma eða blóðþynningar?
- ○ Já
- ○ Nei

Hafðu í huga mánuðinn áður en námskeið hófst.

Hefur þú greinst með hjartsláttartruflanir?
- ○ Já
- ○ Nei

Tekur þú lyf vegna hjartsláttartruflana?
- ○ Já
- ○ Nei

Hafðu í huga mánuðinn áður en námskeið hófst.

Hefur þú greinst með hækkaðan blóðþrýsting?
- ○ Já
- ○ Nei

Tekur þú lyf til að lækka blóðþrýsting?
- ○ Já
- ○ Nei

Hafðu í huga mánuðinn áður en námskeið hófst.

Hefur þú greinst með röskun á blóðfitum?
- ○ Já
- ○ Nei

Tekur þú lyf til að lækka blóðfitur?
- ○ Já
- ○ Nei

Hafðu í huga mánuðinn áður en námskeið hófst.

Ertu með sykursýki?
- ○ Nei
- ○ Já, meðhöndluð með breyttu mataræði
- ○ Já, meðhöndluð með töflum
- ○ Já, meðhöndluð með lyfjum á sprautuformi

Hvaða tegund af sykursýki ert/varst þú með?
- ○ Týpu 1 (á oftast upphaf sitt í barnæsku)
- ○ Týpu 2 (kemur oftast fram á fullorðinsárum)
- ○ Sykursýki á meðgöngu

Hefurðu verið greind með skert sykurþol?
- ○ Já
- ○ Nei

Áttu systkini sem greinst hafa með sykursýki?
- ○ Já
- ○ Nei

Áttu foreldra sem greinst hafa með sykursýki?
- ○ Já
- ○ Nei

Hefur þú verið greind með fjölblöðrueggjastokka heilkenni (PCO)?
- ○ Já
- ○ Nei

Hefur þú greinst með hækkaða þvagsýru í blóði?
- ○ Já
- ○ Nei

Hefur þú greinst með skerta nýrnastarfsemi (blóðsýni sína hátt gildi af kreatinini?
- ○ Já
- ○ Nei

(Merktu við allt sem á við)

Tekur þú lyf vegna truflunar á starfsemi skjaldkirtils?
- ○ Já
- ○ Nei

Hafðu í huga mánuðinn áður en námskeið hófst.

Ertu með astma?
- ○ Já
- ○ Nei

Tekur þú lyf við astmanum?
- ○ Nei
- ○ Já, en aðeins þegar ég fæ vaxandi einkenni
- ○ Já, ég tek lyf reglulega, óháð einkennum

Hafðu í huga mánuðinn áður en námskeið hófst.

Ertu með lungnaþembu, langvinna berkjubólgu eða langvinna lungnateppu?
- ○ Já
- ○ Nei

Tekur þú lyf við lungnasjúkdómnum?
- ○ Nei
- ○ Já, en aðeins þegar ég fæ vaxandi einkenni
- ○ Já, ég tek lyf reglulega, óháð einkennum

Hafðu í huga mánuðinn áður en námskeið hófst.

Hefur þú greinst með vélindabakflæði eða magabólgur?
- ○ Já
- ○ Nei

Tekur þú lyf vegna vélindabakflæðis eða magabólgu?
- ○ Já
- ○ Nei

Hafðu í huga mánuðinn áður en námskeið hófst.

Hefur þú greinst með kæfisvefn?
- ○ Já
- ○ Nei

Ert þú á meðferð við kæfisvefni (kæfisvefnsvél, góm til að opna öndunarveg)?
- ○ Já
- ○ Nei

Hafðu í huga mánuðinn áður en námskeið hófst.

Hefur þú greinst með svefnleysi (insomnia)?
- ○ Já
- ○ Nei