A CROSS-SECTIONAL ANALYSIS OF THE ASSOCIATION BETWEEN HEALTH RELATED QUALITY OF LIFE AND BODYWEIGHT CHANGES

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PREFACE

My interest for the association between changes in bodyweight and physical activity started as a result of my own experience with years of physical art performance in ballet. I finished a bachelor degree as a ballet teacher and performer, which involved hard training as well as a strong focus on bodyweight. Later I continued my education studying physiotherapy. I finished my second bachelor degree, and physiotherapy is now my occupation. My intension with this master thesis was to focus on the relevance of the topic in physiotherapy practice. The challenge of physical health problems associated with bodyweight is strongly present in physiotherapy practice nowadays. Weight problems are mostly associated with overweight and obesity rather than underweight in the population we study, aged 40-47 years. According to Statistics of Norway and the World Health Organization (WHO) the population is becoming increasingly heavier. Many physiotherapists are involved in the complicated process of helping patients to establish new and healthier routines in daily living, which again can be associated with changes in bodyweight. In Norway an increasing number of clinics for health protection have been established, with strong focus on bodyweight. Many of these clinics focus on interdisciplinary cooperation between health professionals, including physiotherapists.

The main hypothesis in this master thesis has been an idea of a possible association between bodyweight changes and Health Related Quality of Life (HRQL), and a belief that physical activity could improve HRQL. According to International Classification of Function (ICF) developed by WHO, health promotion involves an understanding of health as an extended term, involving both organic, functional, social and mental aspects in physiotherapy intervention. A holistic view of the patient refers to a totality, where the whole is more than the sum of elements. Body and soul as a whole, rather than individual elements referred to as a dualistic view of humanity. A physiotherapy intervention involves an interview, the anamnesis, where patients are asked to describe their health complaints. This can involve organic causes as well as mental and social experiences which can impair patient well-being.

Many people have contributed with help and support through my process of working with this master thesis. I will thank my husband Christian and my children Mario, Nathaniel

and Millie Linnea for their patient support. As a matter of fact the two youngest ones were born during these 3 years of part time further education. I have had two great supervisors PhD Jannike Øyen and Professor Trond Riise, which despite of the long distance have been available through mail or telephone correspondence. According to guidelines for use of data as specified in the following introduction and article, and well earned, my supervisors have been listed as co–writers of the article. My parents have both contributed with advice, technical help and support. My father Professor Arild Hervik is an experienced researcher, and my mother Synnøve Kåresen has recently fulfilled her own master degree in physiotherapy. Besides, my two younger sisters Kjersti and Jorid have contributed with linguistic correction. Additionally, many have contributed with support and encouragement, as well as babysitting.

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SAMMENDRAG (NORWEGIAN)

Innledning Kroppsvektproblematikk blir ofte forbundet med redusert helserelatert livskvalitet (HRQL), mens fysisk aktivitet har vist seg å forbedre HRQL. Få studier har undersøkt effekten av kroppsvektsvingninger på HRQL. Vår hensikt var å undersøke effekten av kroppsvektsvingninger, kroppsvekt, fysisk aktivitet og røyking på HRQL.

Metode I en tverrsnittsanalyse av Helseundersøkelsen i Hordaland (1997-99), ble 9276 menn og 10433 kvinner i alderen 40-47 år inkludert. Vekt og høyde ble målt, og informasjon om kroppsvektendringer, fysisk aktivitet og røyking ble registrert ved hjelp av spørreskjemaer. Her inngikk også det standardiserte spørreskjemaet Medical Outcomes Study MOS kortform-12 (SF-12). De 12 spørsmålene ble stratifisert i en sammensatt fysisk- (PCS) og en sammensatt mental helse score (MCS).

Resultater Resultater fra analysene viste at kroppsvektendringer hadde en markant negativ effekt på både PCS og MCS, med redusert score lineært med økende kroppsvektendringer ($p<0,001$). Kroppsmasseindeks hadde også signifikant sammenheng med variasjoner i PCS og MCS, hvor normalvektige hadde best PCS. De normalvektige hadde overraskende en lavere gjennomsnittlig MCS i forhold til deltakerne med høyere kroppsvekt. Videre ble det funnet en signifikant sammenheng mellom redusert PCS og MCS og lav fysisk aktivitet samt røyking ($p<0,001$). Kvinner hadde signifikant bedre PCS ved høy fysisk aktivitet enn menn, og scoret i gjennomsnitt 5,0 poengenheter høyere fra de minst til de mest fysisk aktive individene, sammenlignet med forskjellen hos menn på 3,2.

Konklusjoner Våre funn viser at kroppsvektendringer har en tydelig negativ innvirkning på fysisk og mental helse. En høy kroppsvekt er relatert til redusert fysisk helse, men ikke mental helse. Videre har kvinner i følge vår analyse en større nytteeffekt av økt fysisk aktivitet enn menn.

ABSTRACT

Introduction Bodyweight outside the normal range is commonly associated with reduced health related quality of life (HRQL), while physical activity has shown to improve HRQL. Few studies have investigated the effect of relative bodyweight changes on HRQL. Our objective was to investigate the effect of bodyweight changes, bodyweight, physical activity and smoking on HRQL.

Methods In the community–based Hordaland Health Study (1997-99), 9276 men and 10433 women aged 40–47 years were included. Weight and height was measured and information on bodyweight changes, physical activity and smoking was obtained from self–administered questionnaires which included the Medical Outcomes Study MOS short form-12 (SF-12). A Physical (PCS) and a Mental health Composite Score (MCS) was derived from these 12 questions.

Results In multivariate analyses bodyweight changes had a significant effect on PCS and MCS, with reduced scores linearly with increasing bodyweight changes ($p<0.001$). Bodyweight was significantly associated with variations in the PCS and MCS. The normal weight individuals had the highest PCS, while they surprisingly had a slightly lower MCS compared to the higher bodyweight categories. Significant associations were found between low PCS and MCS, low physical activity and current smoking ($p<0.001$). Women had a significantly better effect of physical activity on PCS than men with a mean difference of 5.0 score units from the least to the most physically active individuals, compared to the men's score of 3.2 units.

Conclusions Findings show that bodyweight changes are significantly related to a reduced physical and mental health, while a high bodyweight is related to reduced physical health but not mental health. According to analysis women have a greater potential for benefitting from physical activity than men.

Key words

Health related quality of life, physical activity, bodyweight, bodyweight changes, smoking.

Abbreviations

BMI	=	Body Mass Index (bodyweight in kilograms divided by the square of height in meters)
HRQL	=	Health Related Quality of Life
MCS	=	Mental health Composite Score
PCS	=	Physical health Composite Score

1.0 INTRODUCTION

1.1 Presentation of the topics

"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (The World Health Organization (WHO) 1948).

Health Related Quality of Life (HRQL) is commonly used as measurement of health, and has previously been associated with bodyweight issues specified as Body Mass Index (BMI) (1;2), physical activity (3;4), and smoking (5;6). There seems to be an association between physical and mental health and bodyweight; overweight, underweight, weight gain or weight loss. Many negative health issues in association with weight gain, overweight and obesity has previously been reported (7-9). An ongoing overweight epidemic (7;8) has in the resent years led to escalated focus on initiating weight loss among exposed individuals. Since bodyweight is commonly expected to increase with increasing age (10), middle aged adults might be in a target group as exposed individuals. However, the relation between bodyweight changes, due to bodyweight gain or bodyweight loss, and HRQL are less commonly researched (11;12).

There are individual differences in the understanding of physical activity, but one definition is commonly used: *"Physical activity is defined as any bodily movement produced by skeletal muscle that result in energy expenditure beyond resting expenditure*"(13).

1.2 Aims

The aim of this study was to investigate HRQL in relation to bodyweight changes, including weight loss, weight gain and weight maintenance, as well as gender differences. A further aim was to study the association of BMI, physical activity and smoking on HRQL. The hypotheses that were tested in this study were that bodyweight changes can impair HRQL, and that physical activity can improve HRQL.

2.0 PREVIOUS RESEARCH

2.1 Health Related Quality of Life and bodyweight

The average bodyweight in the Norwegian population has increased during the recent decades, while the daily physical activity level has decreased (8;9). WHO states that overweight is one of the most serious public health problems worldwide (7). Overweight commonly leads to health impairment, like impaired physical functioning as a result of increased strain on joints (14-16). Individuals with a high bodyweight tend to report bodily pain to a greater extent than normal weighted (17;18), which can be improved by bodyweight loss (19) and increased physical activity (20). Stigmatization and discrimination of the overweight can impair mental well-being (14;21;22). Some even consider overweight individuals to be less effective than those with normal bodyweight (23). As a result, social pressure might initiate weight loss attempts (20). Notably, underweight can also impair HRQL, and there is an association between underweight and increased mortality and disease (2). However, overweight and obesity is more commonly considered a health threat among middle aged adults than underweight, as a higher proportion of adults tend to gain rather than lose weight over time (2;15-17;21;24). Decreasing total energy expenditure due to changes in resting metabolic rate and activity energy expenditure is commonly seen inversely related to increasing age (10).

2.2 Bodyweight changes

Few studies regarding the effect of bodyweight changes on HRQL have previously been published (2;11;12). Some have investigated the effect of sole factors bodyweight loss or gain on HRQL (18;19;23). Vitality and general physical health has been associated with weight loss (2;18;23). In fact even a small amount of weight loss has been shown to improve HRQL (22). Simply attempts to lose weight might have a pronounced positive effect on general health and vitality in obese individuals (26), with health benefits occurring after loss of only one unit in BMI (27). Even in extremely obese individuals, a bodyweight loss of 5-10% has previously been reported to be beneficial to health as well as HRQL (19;28). However,

unrealistic expectations with a weight loss of more than the recommended 5-15%, is commonly associated with bodyweight gain following bodyweight loss and further bodyweight changes (16). A short term weight loss is quite easily achieved, but many struggle with bodyweight maintenance (16;29;30). According to Dishman (1), one third of the individuals who lose weight regain the weight within 3-5 years. Previous unsuccessful attempts to lose weight are associated with further weight gain (11;15), and consequently bodyweight changes in a long term perspective. Therefore, establishing lifestyle changes which include adjusted diet in combination with increased physical activity are commonly recommended in order to lose weight and to maintain the obtained weight (14;16;29-38). Additionally, changes in diet and physical activity have previously been associated with bodyweight loss, gain and maintenance (25). Help from health professionals can be beneficial in order to establish lifestyle changes and maintain a healthy bodyweight (25;39).

2.3 Physical activity

The relation between physical activity, HRQL and bodyweight has frequently been investigated (1;4;13;40-42). Rates of depression is lower among adults who are even modestly physically active compared to more sedentary adults (1). As an extended term, physical activity includes the total use of energy during a day, including work related in some occupations, housework, transportation from one area to another or leisure time scheduled exercise (40), summarized as a less sedentary lifestyle as a result of daily life activity (13). The time spent inactive has previously been reported to increase in line with increasing age (10). An active lifestyle can simply involve walking instead of driving a car, or spending less time on TV viewing (11;33).

Physical activity is recommended in weight regulation and maintenance (13;16;20;29;43;44), and is shown to have a positive effect on a balanced energy intake in line with energy consumption, body composition, body fat distribution and resting metabolism (13;22). All types of physical activity affects energy balance, and in combination with a restricted diet, bodyweight loss or maintenance can be achieved (13). Hard physical activity with sweating and increased respiratory rate can be associated with a greater weight loss than light physical activity (11). However, light physical activity allows for a lower strain on joints (45).

Some claim that light physical activity, like walking, improves HRQL to a lesser degree than hard physical activity (4), and that this impacts the physical aspects of HRQL to a greater extent than the mental aspects (42). However, only a limited percentage of adults are active enough to achieve health benefit and improved HRQL, and an even smaller percentage are active enough to increase physical fitness (1). The recommendations from WHO for adults, is at least 150 minutes of moderate intensity physical activity a week, performed in bouts of minimum 10 minutes in duration. Alternately, 75 minutes of high intensity physical activity weekly (3). A common recommendation for overweight individuals is light physical activity 30 minutes in duration, performed five days a week as a start (16). If physical fitness is achieved, WHO state a further health benefit from linearly increasing level of physical activity (3), which is sufficient in order to lose weight and maintain the obtained bodyweight in a long term perspective (41;46).

2.4 Gender differences

HRQL has been reported to be lower among women than men (47), and women report bodily pain to a greater extent than men (17). On the other hand, men tend to have a higher BMI than women (23), whereas women report attempts to lose weight to a greater extent than men (21;38;43;46). Both men and women report weight loss attempts in association with their own perception of being very overweight (43). However, women are more likely to perceive themselves as overweight, not necessarily reflecting the actual BMI (43).

Due to Wendel-Vos et al (41), moderate physical activity can be beneficial to physical health in both genders, as well as mental health in men. Women engaging in physical activity are likely to do so because they want to change bodyweight or body composition, and they are also more prone to developing eating disorders than men (48). A large weight gain can be associated with a reduction in both mental and physical health in women, while weight loss mainly is associated with improved physical health (12). Men seem to have other motivations for weight loss than women, such as a desire to become more effective at work or more attractive for the labor marked (49). It has also been reported that men tend to seek more anonymous ways of controlling bodyweight, for example through the internet (35), which has previously been reported insufficient for obtaining the desired bodyweight management in a long term perspective (48).

2.5 Smoking

Smoking has previously been associated with bodyweight, in particular as a result of possible weight gain during smoking cessation (11;44;50). Current smokers tend to weigh less than non-smokers (6), and they are underrepresented among individuals trying to lose weight (46). However, weight loss attempts are rather common among former smokers (46). The reason for smoking being associated with a lower bodyweight is in part considered a result of increased energy expenditure during light physical activity (6). Besides, altered distribution of body fat is associated with smoking, with visceral rather than femoral or subcutaneous fat depositions which further is associated with serious disease (51). In addition, smoking can affect mental health following more self-reported days of impaired well-being among smokers compared to non-smokers (21).

2.6 Other factors that might affect HRQL

Some factors were not taken into consideration in the current study, but should be mentioned due to a more or less important impact on HRQL and bodyweight. As previously mentioned one cannot avoid taking diet into consideration, mainly following recommendations of combining a restricted diet and increased physical activity in order to achieve or maintain a healthy bodyweight (13;19;22;38;39;46). In addition, alcohol consumption in larger amounts has previously been associated with weight gain (11;44).

Social status, income and education is also associated with HRQL and bodyweight (52;53). Obese individuals with a high socioeconomic status have previously been reported to have a better HRQL compared to individuals with a low socioeconomic status (53).

Sleep deprivation (51;54) and stress (55) has previously been associated with both overweight and reduced HRQL. Although this can mainly be explained by unhealthy eating habits, some claim that stress as a single factor may cause metabolic changes, and thereby independently induce bodyweight gain (56;57). The pattern of relation between HRQL and bodyweight varies between different ethnical races, since those of African origin tend to have a lesser impact on mental health by overweight compared to Caucasians (58). Further, individuals of African origin tend to have a higher BMI in general (52).

3.0 METHODS

3.1 Study population

The Hordaland Health Study (HUSK) was conducted during 1997-99 as a collaboration between the National Health Screening Service, the University of Bergen and local health services. The study population included all individuals in Hordaland county born 1953-57 (N=29400) (42). A total of 8598 men and 9983 women participated, yielding a participation rate of 57% for men and 70% for women.

The study also included 2291 men and 2558 women born 1950-51 who had participated in an earlier study in 1992-93 (42). Participation rates in these groups were 73% and 81%, respectively. The HUSK study protocol can be found on www.uib.no/isf/husk, and the HUSK questionnaire is included as attachment 3 later in this master thesis.

3.2 Measurements

The primary purposes of this study were to investigate the impact of bodyweight and bodyweight changes as well as physical activity and smoking on HRQL. Self-administered questionnaires provided information on various health behaviours including questions regarding HRQL, light physical activity and hard physical activity, highest bodyweight and lowest bodyweight the last five years as well as smoking habits. Baseline measurements included height and weight, carried out by a health professional with participants wearing light clothing and no shoes. BMI was calculated as weight in kilograms divided by the square of height in meters, and stratified according to WHO definitions into underweight BMI <18.5, normal weight BMI 18.5-25, overweight BMI 25-30 and obesity BMI >30. A further subdivision commonly used due to underweight and obesity is respectively severe-moderate and mild thinness and obesity class I, II and III. However, subdivision was not used in the current study.

Measurement of HRQL was based on the standardised questionnaire Medical Outcomes Study (MOS) Short Form-12 (SF12). Questions were divided into sections

regarding physical and mental aspects of health (attachment 3). The participants were initially asked to self-report their own health due to diseases and medication. Further, how they currently felt regarding mentally related conditions such as nervousness, anxiety, irritability, happiness, depression and loneliness. Questions from the questionnaires referred to disease in the family due to genetic predisposition, muscle and skeletal problems, health habits as well as health and well-being. It is essential to note that measurement of health through questionnaires involve individual differences in the interpretation and perception of health. However, SF-12 is commonly used and tested for validity and reliability, as well as being reported to be easy and quick to complete (59). A subdivision into eight health related domains is commonly used; physical functioning, role limitation due to physical problems, bodily pain, social functioning, role limitation due to emotional problems, mental health, general health perception and vitality. A further subdivision also commonly used, as well as used in the current study, is stratification into Physical health Composite Score (PCS) and Mental health Composite Score (MCS). The PCS includes primarily the domains of physical functioning, role limitation due to physical problems and bodily pain. The MCS includes primarily health related social functioning, role limitation due to emotional problems, and mental health. The domains of general health perception and vitality load substantially on both scales (59).

Bodyweight changes were self–reported by participants, stating their lowest bodyweight and their highest bodyweight the last five years. Later participants' current bodyweight were measured by a technician. Bodyweight measurement performed by a technician versus self-reported bodyweight is not necessarily coinciding (43), partly due to poor synchronization of weights used for self-measurement and those used for measurements by professionals (11). As much as 10 kilograms in a negative deviation between professionally measured weight and self-reported weight has previously been reported (33). It is essential that the participants actually have measured their own bodyweight the last five years. Additionally, it should be mentioned that solely timing of measurement before or after a meal or fluid intake can interfere with the result. Due to sources of measurement error ≥3 kilograms of deviation between professionally measured bodyweight and self-reported data, was defined as limit for excluding participants from further analysis. In the initial analyses, two groups were established, consisting of participants who misreported their bodyweight ≥3 kilograms respectively higher or lower than currently measured. Thus, these subgroups were later excluded due to space limitation in the article and the risk of interfering with the purity

of the results. To further avoid the major error sources due to bodyweight measurement, all self-reported bodyweight changes were stratified into groups of bodyweight maintainers +/- 5% of BMI, moderate bodyweight changers 5-15% and severe bodyweight changers >15%. Low differences in HRQL among individuals keeping a stable weight compared to individuals with small fluctuations of less than 5% loss or gain has previously been reported (60), which can defend +/-5% as a definition of an upper limit of bodyweight maintenance.

Questions regarding physical activity were in the questionnaires stratified into light physical activity without sweating and being out of breath and hard physical activity with sweating and being out of breath. Four response alternatives were established regarding leisure time spent weekly on light physical activity and hard physical activity, respectively. These alternatives were no physical activity, <1 hour/ week, 1-2 hours/ week and >3 hours/ week. In our analyses the first two alternatives were summarized into simply <1 hour/ week which provided 3 categories of light and hard physical activity, respectively. Intention to be physical active and actual physical activity is not necessarily coinciding (1), and might lead to over reported *actual* physical activity. Therefore, all physical activity was further stratified into groups of 9 increasing activity levels in order to capture a trend in the current population. Weekly leisure time spent on hard physical activity was given a higher sum score than leisure time spent on light physical activity. Light physical activity was given score 1 for no light physical activity, 2 for <1 hour/ week, 3 for 1-2 hours/ week and 4 for >3 hours/ week. Hard physical activity was given score 2 for <1 hour/ week of hard physical activity, 4 for 1 hour/ week, 6 for 1-2 hours/ week, 8 for >3 hours/ week. 10 groups of 9 increasing steps with increasing leisure time spent on physical activity was constituted from the lowest score 3 (1 point for <1 hour/ week of light physical activity plus 2 points for <1 hour/ week of hard physical activity) to the highest score 12 (4 points for >3 hours/ week of hard physical activity plus 8 points for >3 hours/ week of light physical activity).

Smoking habits were self-reported by participants, and provided information on smoking, no smoking or current smoking as well as daily number of cigarettes/cigars/pipes and eventually date of smoking cessation. Additionally, there was one question regarding time spent in smoky environment. However, in the current study smoking was categorized into current smoking, former smoking and non-smoking, and further detailed information regarding smoking was excluded.

Further questions from the HUSK questionnaires which were excluded provided information on coffee/ tea/ alcohol consumption, education, medication, work and eventually number of children (attachment 3).

3.3 Study design

Cross-sectional study design involves data collection from a defined population at a given time. The design can be used with the intention to measure relations between variables or to describe occurrences. In a cross-sectional study design, it is an advantage to have a large number of participants. With 10433 women and 9276 men included in this study, the conclusions are based on a rather large population. However, there are limitations in a cross-sectional design. Casual factors are not measured, specified as causative reasons for impaired HRQL. As presented theoretically there are many factors which independently can be associated with HRQL. Recent changes in participants' life situation can be exemplified by changes in marital status, in occupational situations or in social life. According to theoretical knowledge, there are reasons to believe that disease, changes in civil status, changes in work situation or changes in social life can impair HRQL and bodyweight changes (42;52). This includes a previously reported association between underweight and disease (2). However, few participants in the population analyzed had decreasing bodyweight compared to number of participants with increasing bodyweight, which will be discussed in chapter 4.0. Disease as a sole factor can impair BMI and bodyweight changes as well as HRQL. Neither of these confounding factors was measured in the current study, which could interfere with the result.

3.4 Data and literature search

Main findings in this study are summarized in the article's result chapter. The databases PubMed and Cochrane were used in searches for literature. In the search for studies concerning HRQL, bodyweight changes and physical activity in combination were used as keywords, also including smoking. Since a rather low number of studies concerning bodyweight changes in general were found, studies concerning BMI in combination with HRQL or physical activity were preferably selected. Some studies were singled out using

additional keyword smoking. In searches for literature, about 150 studies and reports were considered relevant through reading the abstract. After reading articles and reports in full text, 37 were singled out as sources in the article and 74 in the introduction thus some coinciding. Studies concerning children, adolescents, older people and other main topics as reason for bodyweight changes or impaired HRQL were excluded (exemplified by cancer or psychiatry). Some sources were referred to as reports from internet which was found in http://www.who.com (The World Health Organization reports), http://www.regjeringen.no (reports from the Norwegian government) and http://www.ssb.no/ (Statistics Norway).

3.5 Statistical analyses and the explanatory power of the model

Multivariate linear regression analyses were conducted using the statistical tool SPSS 19 for windows. The multivariate analyses were stratified by gender. Relative bodyweight changes converted from self-reported kilograms to percent of BMI was used in the analyses. 95% confidence interval (CI) was considered to be statistically significant, meaning that the interval that will cover the correct value of the estimated parameter with the 95% probability did not cover the value zero. All participants were initially included in the statistical analyses. However, because of missing data concerning all variables bodyweight changes, BMI, physical activity and smoking, there were different number of participants (N) in the different categories analysed. Participants with missing data on MCS or PCS were excluded.

Regression analyses were selected as statistical method, due to data available from a population survey and the cross-sectional design. Analyses of the dependent variables PCS and MCS in association with the independent variables bodyweight changes, BMI, physical activity and smoking were specified in the linear regression in univariate analyses ($y = \int(x) + e$) and in multivariate analyses ($y = \int(x_1, x_2, \ldots, xn) + e$). y is the measured value of the dependent variable and x is the independent variables. $\int$ is the function one seek to estimate and e is a residual indicating the measurement error.

Data analyses do nearly always contain measurement errors. Multi regression coefficient (R^2) is a way of measuring to which extent one can rely on the result, depending on whether all relevant explanatory variables are included, the right function has been specified, the right statistical method is chosen and to which extent measurement errors are

avoided. R^2 is listed separately for men's PCS ($R^2 = 0.041$) and MCS ($R^2 = 0.031$) and women's PCS ($R^2 = 0.70$) and MCS ($R^2 = 0.024$), as well as in test of interaction between men and women's PCS ($R^2 = 0.067$) and MCS ($R^2 = 0.031$). The explanatory power for women's PCS was slightly higher than men`s, and the explanatory power for PCS was higher than the one for MCS. However, R^2 measured in this study was in general low which is as an indicator of low explanatory power through the current model. The variation in physical and mental aspects of HRQL could assumedly be further explained by other variables which were not included in the current study due to space limitation. However, low R^2 is commonly seen in studies with a cross-section study design, partly due to lack of a longitudinal view. The choice of other study designs in follow-up studies could strengthen the credibility of the conclusions. Follow–up studies are therefore required in order to draw final conclusions towards changes in clinical practice.

The use of questionnaires in data collection depends on individual differences in the understanding of health and physical activity. More accurate data could be achieved through equipping participants with accelerometers (measuring all physical activity) or through weighing performed by a technician on a regular basis during a defined interval of time. Though the questionnaire SF 12 is commonly used and tested for validity as a measurement of HRQL, this questionnaire relies on participant's perception of health on an individual basis. However, all measurement of HRQL is challenging due to individual differences. Data reliability depends further on participants' sincere statement.

There could be a covariance between the independent variables, which could be further measured through multicollinearity analysis. The independent variables bodyweight changes, BMI, physical activity and smoking may correlate with each other and interfere with the results. However, multicollinearity analyses have not been included in this master thesis. Through stepwise regression analyses, where different variables were included step by step, our results seem not to be very sensible to this problem.

3.6 Other studies based on the Hordaland Health Study (HUSK)

Several authors have based their studies on data from HUSK. Among these some studied HRQL (42;61), and several studied the effect of BMI on different variables (62-70). One

study measured bodyweight change in association with osteoporosis (62). The referenced studies are representing solely a selection of studies based on HUSK. However, no authors have measured this population's HRQL in association with bodyweight changes and physical activity in combination.

3.7 Ethical considerations

The study protocol was approved by the Regional Ethics Committee and by the Norwegian Data Inspectorate. HUSK is recommended by the Regional Ethics Committee, Health Region III and approved by the Data Inspectorate. In the HUSK protocol it is specified that all information obtained in principle shall be available to researchers, including the right to publish the results of the research question. All use must be approved by HUSK management committee and project manager for the current project, which was performed in advance of the work with this master thesis. Publications to be projected require that the project manager is invited as co-author, as specified in the contract under the original protocol. The two supervisors Jannike Øyen and Trond Riise should therefore be listed as co-authors in the article in line with guidelines for use of data from HUSK. The article must further be submitted to the publication committee before submission for publication.

4.0 DISCUSSION

4.1 Main findings

The mean score of the PCS and MCS for men was higher than corresponding means for women. Most men were in the overweight category while most women were normal weighted, which further constituted a larger number of male participants with BMI >25 (table 1). However, more men compared to women maintained their bodyweight, with fluctuations <5%. By comparison, nearly double as many women compared to men had fluctuations >15%. Nearly half of the population had never smoked. The association between HRQL and covariates were similar for men and women, with the exception of statistical significant gender differences due to an interaction of gender differences between BMI and PCS and MCS, and physical activity and PCS.

PCS and MCS fell in line with increasing bodyweight changes, decreasing physical activity and current smoking. A low score on the PCS was significantly associated with high bodyweight change, a high BMI, little physical activity and smoking among both men and women (table 1). Also for MCS there were significant associations to all covariates although they were slightly smaller than for PCS. Analyzing men and women separately and including all covariates in a multivariate general linear model, showed that all covariates remained significant associated with both PCS and MCS for both genders (table 2 and 3).

Physical activity was the variable with the highest effect size related to PCS for both genders, but significantly higher for women than men. Bodyweight change showed the strongest effect size on MCS for both men and women.

4.2 Bodyweight changes

Previously reported impaired HRQL related to bodyweight issues (2;15;23;28;33), correspond to our findings. High bodyweight changes were associated with low HRQL in general. Bodyweight changes had the strongest effect size on mental health in our study which is in line with previously reported results (12). Further, both men and women with 0-5%

fluctuations tended to have the best physical and mental health compared to individuals with greater fluctuations, corresponding to previous findings (60). In the current study, the highest percentage of participants had moderate fluctuations in bodyweight (5-15%). Due to participant age most of the bodyweight changes was expected to be weight gain (10-12). Weight gain is further commonly associated with lower physical functioning (2;18;23), and following lower PCS which was one of our findings.

There were no significant gender differences in bodyweight changes associated with PCS and MCS. Men's and women's HRQL was equally impaired by increasing bodyweight changes. This finding was rather surprising because previous research indicate that women are more affected by bodyweight than men (17;38;43). However, gender differences in BMI related to PCS as well as MCS were found. Initially bodyweight changes were stratified into loss, gain or maintenance, and we found weight gain in 67.3% and 75.5% of the population for men and women, respectively. By comparison weight loss in 1.1% of men and 0.7% of women were found (data shown in table 1x presented later in this chapter). As mentioned previously, two groups of participants misreporting their bodyweight deviating ≥3 kilograms from technician measured bodyweight was initially established. Interestingly the "misreport 1" group who reported their bodyweight to be ≥3 kilograms too high was remarkably smaller than the "misreport 2" group who reported their bodyweight to be ≥3 kilograms too low (table 1x). Previous literature confirm that a tendency to discriminate against overweight and obese individuals is apparent in the community (14;21;23), which can explain why some have a desire to appear slimmer even in anonymous questionnaires. However, some individuals do not self-measure bodyweight, and report estimated bodyweight changes based on measurement made at younger ages, while there is a general tendency of weight gain in line with increasing age (2;15-17;21;24). An excerpt from a previous draft of table 1 is presented here.

Table 1x An excerpt from the table regarding characteristics of the study participants: Bodyweight changes by mean Physical health Composite Score (PCS) and mean Mental health Composite Score (MCS).

		MEN (N = 9276)			WOMEN (N = 10433)		
	Values	**N (%)**	**PCS**	**MCS**	**N (%)**	**PCS**	**MCS**
Bodyweight changes (relative change %) last 5 years[a]	0-5%	2065 (22.3)	51.6	51.7	1358 (13.0)	50.9	51.0
	5-15%	5057 (54.5)	50.9	50.6	5646 (54.1)	49.8	49.5
	>15%	815 (8.8)	48.4	48.1	1791 (17.2)	46.6	47.8
	Misreport 1	47 (0.5)	49.8	50.6	21 (0.2)	47.5	50.4
	Misreport 2	600 (6.5)	50.7	50.6	595 (5.7)	48.4	49.5
	p-value		<0.001	<0.001		<0.001	<0.001
Deviation from mean self-reported bodyweight changes[b]	Lower	100 (1.1)	51.0	49.7	78 (0.7)	50.1	49.6
	Upper	6241 (67.3)	50.6	50.2	7878 (75.5)	49.0	49.1
	Middle	2380 (25.7)	51.6	51.7	1558 (14.9)	50.8	51.0
	p-value		<0.001	<0.001		<0.001	<0.001

The total population (N) used in the analysis may vary between variables due to different number of missing data.

[a] *Misreport 1 = current bodyweight ≥3 kilograms higher than reported highest. Misreport 2 = current weight ≥3 kilograms lower than reported lowest.*

[b] *Lower = current weight >-5% deviation, Upper = current weight >5% deviation, Middle = <-5% to <5% deviation*

4.3 Body Mass Index

BMI levels above 25 was associated with reduced PCS, in line with previous findings stating that overweight and obese individuals have a lower physical functioning in general (71). Further, literature confirms physical impairment to a greater extent than mental impairment due to obesity (14-16) and underweight (2). Those with normal weight tended surprisingly to have the lowest MCS compared to overweighed and obese individuals. Our findings are supported by literature stating that mostly physical aspects of HRQL can be associated with bodyweight (2;18;23). Thus, our findings was with the exception of lower mental aspects of HRQL among underweighted women, which previously has been associated with disease and fear of increased mortality (2). Women were more physically and mentally affected by BMI than men, which are supported by previous findings of a higher share of women reporting dissatisfaction with bodyweight (38;43;46).

4.4 Physical Activity

One of the most important findings in this study was the strong nearly linear association between physical activity and HRQL, as depicted in the figures 1 and 2. Overall, the 95% CI regarding physical activity in association with PCS and MCS were small especially for women, indicating convincing statistical significance. Physical activity had the strongest effect size on physical health, which corresponds with previous studies stating a strong association between physical activity and HRQL (13;22;71-73). Health benefits and well-being due to physical activity is commonly seen (1;4;40;42), even in the absence of weight loss (22;71). Physical activity can counteract weight gain, but does presumably not alone lead to an adequate weight loss if not combined with change of lifestyle (51). However, regular physical activity as well as sedentary lifestyle avoidance is essential due to bodyweight loss maintenance (25). An active lifestyle is recommended for the maintenance of a healthy weight (33), due to the risk of weight gain following inactivity. This can be prevented by increasing time spent on hard physical activity (15;72). It has been reported that regularly hard or moderate physical activity affects HRQL to a greater extent than regularly light physical activity (11;41). In the current study men reported to spend more time on hard physical activity than women, which can partly explain the lower mean PCS and MCS among women. However, women reported more time spent on light physical activity. There was a significant interaction between gender and physical activity on PCS, indicating that physical health benefits were stronger among women than among men (figure 1).

Improved HRQL according to physical activity might occur as a result of changes in level of body fat, body fat distribution and resting metabolic rate (10;22). Further, health benefits due to physical activity and weight loss or maintenance follow an increase in energy expenditure, consisting of resting metabolic rate, activity energy expenditure and energy due to the thermic effect of food (10). Therefore, energy metabolism changes might lead to bodyweight changes (10). Although the questionnaires specify activity level due to the presence or absence of sweating and being out of breath, there might be individual differences in the understanding and definition of physical activity level (11;13;33;40). Intensity and durability of physical activity recommendations in the literature is contradictory (1;3;4;16;41;48), including WHO recommendations mentioned initially. However, our results capture a trend in the current population of gradually increasing PCS and MCS in line with

increased self-reported leisure time physical activity. Simply a minor increase in physical activity level led to an improvement in PCS and MCS. Though the findings according to MCS was slightly less prominent, which has also been reported in previous literature (42).

It has previously been reported that level of physical activity can affect both BMI and bodyweight changes (11;13;16;20;22;43;44). The complicated relationship between independent variables was taken into consideration when the explanatory power in this study was evaluated, and variables with presumed multicolinearity were excluded.

4.5 Smoking, education and left out variables

Current smokers reported the lowest PCS and MCS, while there were small differences between never smokers and previous smokers (table 1). Smoking in association with HRQL can be prominent, which has previously been reported to be due to health complaints or disease among smokers (21). An association between smoking and BMI has also previously been reported (5;6), including a common statement that smoking cessation can be associated with weight gain while smokers tend to have a lower bodyweight in general (6;51). There was no significant gender difference, indicating that current smoking affect HRQL in both genders equally negatively. It is worth mentioning that test for interaction between variables showed a statistically significant association in MCS between smoking and bodyweight changes, and between smoking and BMI (data not shown). The findings are supported by literature stating that smoking can impair bodyweight (6;11;44;46;51). However, no interactions between smoking and other variables were found in PCS (data not shown).

Education was initially considered included in the analyses referring to participant higher or lower socioeconomic status. Higher or lower educated individuals has previously been reported to have higher or lower HRQL, respectively (53). Individuals with high education are overrepresented among individuals trying to lose weight (46). Weight gain during time can also be associated with low education, low income and to be married (52). It is individuals with a higher education who tend to follow the social recommendations of lifestyle changes in order to lose weight (38;46). Adjustment for education was tentatively included in the multivariate analysis, but solely small changes were found in difference from

baseline scores. No changes in R^2 were found. Consequently, education was excluded from the article due to space limitation.

Regarding left out variables diet, socioeconomic status, sleep quality, stress, ethnical race and alcohol consumption, one should take into consideration that measurement of these factors is rather complicated due to definition, geographically or cultural differences. Neither did we have sufficient data about these variables collected through HUSK questionnaires. A healthy diet is complicated to define, thus the energy balance is easily summarized: if energy intake is higher than energy consumption, bodyweight will increase (13;51). Further, recommended lifestyle changes include modest alcohol consumption and smoking cessation in addition to diet and physical activity (74).

4.6 Regression coefficient R^2 and other statistical ratings

The univariate analysis was investigated thoroughly in advance of further analysis and adjustment, in order to select variables with low levels of multicolinearity. Further, interaction between bodyweight changes and smoking, bodyweight changes and BMI as well as BMI and smoking were found in MCS. No significant interactions were found in PCS. The estimated R^2 for the multivariate models were 4.1% for PCS and 3.1% for MCS for men, while the estimates for women were 7.0% and 2.4% for PCS and MCS, respectively. The R^2 scores indicate a low explanatory power of this model, and one can speculate in whether other left out variables have a greater effect on HRQL. However, as previously mentioned low R^2 is also commonly seen in cross-sectional study design, due to lack of information regarding possible causative factors in the past as well as a longitudinal view. However, our findings were convincingly significant due to specification of the p–values and 95% CI. Presumably one could strengthen the explanatory power of this model by including more variables or changing study design.

5.0 CONCLUSIONS

Due to our findings, both mental and physical health is influenced by bodyweight changes, BMI, physical activity and smoking. Especially physical activity tends to affect physical health to a great extent, while bodyweight changes have the greatest affection on mental health. Women benefit even more than men in relation to physical health by increasing level of physical activity. Further, women are more physically and mentally affected by BMI than men. In addition, never smokers and previous smokers have better mental and physical health compared to current smokers.

REFERENCE LIST

(1) Dishman RK. The impact of behavior on quality of life. Qual Life Res 2003;12 Suppl 1:43-9.

(2) Ford ES, Moriarty DG, Zack MM, Mokdad AH, Chapman DP. Self-reported body mass index and health-related quality of life: findings from the Behavioral Risk Factor Surveillance System. Obes Res 2001 Jan;9(1):21-31.

(3) World Health Organization (WHO). Global Recommendations on Physical Activity for Health. 2010.

(4) Bize R, Johnson JA, Plotnikoff RC. Physical activity level and health-related quality of life in the general adult population: a systematic review. Prev Med 2007 Dec;45(6):401-15.

(5) Perkins KA. Metabolic effects of cigarette smoking. J Appl Physiol 1992 Feb;72(2):401-9.

(6) Hultquist CM, Meyers AW, Whelan JP, Klesges RC, Peacher-Ryan H, DeBon MW. The effect of smoking and light activity on metabolism in men. Health Psychol 1995 Mar;14(2):124-31.

(7) World Health Organization (WHO). Obesity and overweight. Fact sheet nr 311. www.who.int/mediacentre/factsheets/fs311/en/index.html; 2006 Sep.

(8) Statistcs Norway (SSB). Statistical Yearbook. Report no 110. http://www.ssb.no/; 2011. Report No.: 10.

(9) The Norwegian Government. Resept for et sunnere Norge. Folkehelsepolitikken. http://www.regjeringen.no/Rpub/STM/20022003/016/PDFS/STM200220030016000DDDPDFS.pdf: Regjeringen; 2003. Report No.: 16.

(10) Manini TM. Energy expenditure and aging. Ageing Res Rev 2010 Jan;9(1):1-11.

(11) Coakley EH, Rimm EB, Colditz G, Kawachi I, Willett W. Predictors of weight change in men: results from the Health Professionals Follow-up Study. Int J Obes Relat Metab Disord 1998 Feb;22(2):89-96.

(12) Fine JT, Colditz GA, Coakley EH, Moseley G, Manson JE, Willett WC, et al. A prospective study of weight change and health-related quality of life in women. JAMA 1999 Dec 8;282(22):2136-42.

(13) Luis GJ, Maria MJ, Barbany M, Contreras J, Amigo P, Salas-Salvado J. Physical activity, energy balance and obesity. Public Health Nutr 2007 Oct;10(10A):1194-9.

(14) Arrebola E, Gomez-Candela C, Fernandez-Fernandez C, Loria V, Munoz-Perez E, Bermejo LM. Evaluation of a lifestyle modification program for treatment of overweight and nonmorbid obesity in primary healthcare and its influence on health-related quality of life. Nutr Clin Pract 2011 Jun;26(3):316-21.

(15) Coakley EH, Kawachi I, Manson JE, Speizer FE, Willet WC, Colditz GA. Lower levels of physical functioning are associated with higher body weight among middle-aged and older women. Int J Obes Relat Metab Disord 1998 Oct;22(10):958-65.

(16) Hainer V, Toplak H, Mitrakou A. Treatment modalities of obesity: what fits whom? Diabetes Care 2008 Feb;31 Suppl 2:S269-S277.

(17) Heim N, Snijder MB, Deeg DJ, Seidell JC, Visser M. Obesity in older adults is associated with an increased prevalence and incidence of pain. Obesity (Silver Spring) 2008 Nov;16(11):2510-7.

(18) Han TS, Tijhuis MA, Lean ME, Seidell JC. Quality of life in relation to overweight and body fat distribution. Am J Public Health 1998 Dec;88(12):1814-20.

(19) Pan HJ, Cole BM, Geliebter A. The benefits of body weight loss on health-related quality of life. J Chin Med Assoc 2011 Apr;74(4):169-75.

(20) Chan RS, Lok KY, Sea MM, Woo J. Clients' experiences of a community based lifestyle modification program: a qualitative study. Int J Environ Res Public Health 2009 Oct;6(10):2608-22.

(21) Hassan MK, Joshi AV, Madhavan SS, Amonkar MM. Obesity and health-related quality of life: a cross-sectional analysis of the US population. Int J Obes Relat Metab Disord 2003 Oct;27(10):1227-32.

(22) Rippe JM, Hess S. The role of physical activity in the prevention and management of obesity. J Am Diet Assoc 1998 Oct;98(10 Suppl 2):S31-S38.

(23) Fontaine KR, Barofsky I, Andersen RE, Bartlett SJ, Wiersema L, Cheskin LJ, et al. Impact of weight loss on health-related quality of life. Qual Life Res 1999 May;8(3):275-7.

(24) Frable PJ, Dart L, Bradley PJ. Healthy Weigh (El camino saludable) phase 1: a retrospective critical examination of program evaluation. Prev Chronic Dis 2006 Jul;3(3):A98.

(25) Phelan S, Liu T, Gorin A, Lowe M, Hogan J, Fava J, et al. What distinguishes weight-loss maintainers from the treatment-seeking obese? Analysis of environmental, behavioral, and psychosocial variables in diverse populations. Ann Behav Med 2009 Oct;38(2):94-104.

(26) Fontaine KR, Bartlett SJ, Barofsky I. Health-related quality of life among obese persons seeking and not currently seeking treatment. Int J Eat Disord 2000 Jan;27(1):101-5.

(27) Hakim Z, Wolf A, Garrison LP. Estimating the effect of changes in body mass index on health state preferences. Pharmacoeconomics 2002;20(6):393-404.

(28) Hwu CM. The complicated relationship between weight loss and health-related quality of life: satisfaction not guaranteed. J Chin Med Assoc 2011 Apr;74(4):149-50.

(29) Abildso CG, Zizzi SJ, Reger-Nash B. Evaluating an insurance-sponsored weight management program with the RE-AIM Model, West Virginia, 2004-2008. Prev Chronic Dis 2010 May;7(3):A46.

(30) Kalter-Leibovici O, Younis-Zeidan N, Atamna A, Lubin F, Alpert G, Chetrit A, et al. Lifestyle intervention in obese Arab women: a randomized controlled trial. Arch Intern Med 2010 Jun 14;170(11):970-6.

(31) Briancon S, Bonsergent E, Agrinier N, Tessier S, Legrand K, Lecomte E, et al. PRALIMAP: study protocol for a high school-based, factorial cluster randomised interventional trial of three overweight and obesity prevention strategies. Trials 2010;11:119.

(32) Dyer RG. Traditional treatment of obesity: does it work? Baillieres Clin Endocrinol Metab 1994 Jul;8(3):661-88.

(33) Goldfinger JZ, Arniella G, Wylie-Rosett J, Horowitz CR. Project HEAL: peer education leads to weight loss in Harlem. J Health Care Poor Underserved 2008 Feb;19(1):180-92.

(34) McConnon A, Kirk SF, Cockroft JE, Harvey EL, Greenwood DC, Thomas JD, et al. The Internet for weight control in an obese sample: results of a randomised controlled trial. BMC Health Serv Res 2007;7:206.

(35) Morgan PJ, Lubans DR, Collins CE, Warren JM, Callister R. The SHED-IT randomized controlled trial: evaluation of an Internet-based weight-loss program for men. Obesity (Silver Spring) 2009 Nov;17(11):2025-32.

(36) Perusse-Lachance E, Tremblay A, Drapeau V. Lifestyle factors and other health measures in a Canadian university community. Appl Physiol Nutr Metab 2010 Aug;35(4):498-506.

(37) Wadden TA, West DS, Neiberg RH, Wing RR, Ryan DH, Johnson KC, et al. One-year weight losses in the Look AHEAD study: factors associated with success. Obesity (Silver Spring) 2009 Apr;17(4):713-22.

(38) Kruger J, Galuska DA, Serdula MK, Jones DA. Attempting to lose weight: specific practices among U.S. adults. Am J Prev Med 2004 Jun;26(5):402-6.

(39) Franz MJ, VanWormer JJ, Crain AL, Boucher JL, Histon T, Caplan W, et al. Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical

trials with a minimum 1-year follow-up. J Am Diet Assoc 2007 Oct;107(10):1755-67.

(40) Jurakic D, Pedisic Z, Greblo Z. Physical activity in different domains and health-related quality of life: a population-based study. Qual Life Res 2010 Nov;19(9):1303-9.

(41) Wendel-Vos GC, Schuit AJ, Tijhuis MA, Kromhout D. Leisure time physical activity and health-related quality of life: cross-sectional and longitudinal associations. Qual Life Res 2004 Apr;13(3):667-77.

(42) Riise T, Moen BE, Nortvedt MW. Occupation, lifestyle factors and health-related quality of life: the Hordaland Health Study. J Occup Environ Med 2003 Mar;45(3):324-32.

(43) Lemon SC, Rosal MC, Zapka J, Borg A, Andersen V. Contributions of weight perceptions to weight loss attempts: differences by body mass index and gender. Body Image 2009 Mar;6(2):90-6.

(44) Butler SM, Black DR, Blue CL, Gretebeck RJ. Change in diet, physical activity, and body weight in female college freshman. Am J Health Behav 2004 Jan;28(1):24-32.

(45) Jette AM, Keysor JJ. Disability models: implications for arthritis exercise and physical activity interventions. Arthritis Rheum 2003 Feb 15;49(1):114-20.

(46) Bish CL, Blanck HM, Serdula MK, Marcus M, Kohl HW, III, Khan LK. Diet and physical activity behaviors among Americans trying to lose weight: 2000 Behavioral Risk Factor Surveillance System. Obes Res 2005 Mar;13(3):596-607.

(47) Cherepanov D, Palta M, Fryback DG, Robert SA. Gender differences in health-related quality-of-life are partly explained by sociodemographic and socioeconomic variation between adult men and women in the US: evidence from four US nationally representative data sets. Qual Life Res 2010 Oct;19(8):1115-24.

(48) Modolo VB, Antunes HK, Gimenez PR, Santiago ML, Tufik S, Mello MT. Negative addiction to exercise: are there differences between genders? Clinics (Sao Paulo) 2011;66(2):255-60.

(49) Sabinsky MS, Toft U, Raben A, Holm L. Overweight men's motivations and perceived barriers towards weight loss. Eur J Clin Nutr 2007 Apr;61(4):526-31.

(50) Koopmann A, Dinter C, Grosshans M, von der GC, Hentschel R, Dahmen N, et al. Psychological and hormonal features of smokers at risk to gain weight after smoking cessation--results of a multicenter study. Horm Behav 2011 Jun;60(1):58-64.

(51) Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. N Engl J Med 2011 Jun 23;364(25):2392-404.

(52) Kahn HS, Williamson DF. Is race associated with weight change in US adults after adjustment for income, education, and marital factors? Am J Clin Nutr 1991 Jun;53(6 Suppl):1566S-70S.

(53) Burkert NT, Freidl W, Muckenhuber J, Stronegger WJ, Rasky E. Self-perceived health, quality of life, and health-related behavior in obesity: is social status a mediator? Wien Klin Wochenschr 2012 Apr;124(7-8):271-5.

(54) Meyer KA, Wall MM, Larson NI, Laska MN, Neumark-Sztainer D. Sleep Duration and BMI in a Sample of Young Adults. Obesity (Silver Spring) 2012 Jun;20(6):1279-87.

(55) Epel E, Lapidus R, McEwen B, Brownell K. Stress may add bite to appetite in women: a laboratory study of stress-induced cortisol and eating behavior. Psychoneuroendocrinology 2001 Jan;26(1):37-49.

(56) Kyrou I, Tsigos C. Stress hormones: physiological stress and regulation of metabolism. Curr Opin Pharmacol 2009 Dec;9(6):787-93.

(57) Michel C, Levin BE, Dunn-Meynell AA. Stress facilitates body weight gain in genetically predisposed rats on medium-fat diet. Am J Physiol Regul Integr Comp Physiol 2003 Oct;285(4):R791-R799.

(58) Bentley TG, Palta M, Paulsen AJ, Cherepanov D, Dunham NC, Feeny D, et al. Race and gender associations between obesity and nine health-related quality-of-life measures. Qual Life Res 2011 Jun;20(5):665-74.

(59) Hurst NP, Ruta DA, Kind P. Comparison of the MOS short form-12 (SF12) health status questionnaire with the SF36 in patients with rheumatoid arthritis. Br J Rheumatol 1998 Aug;37(8):862-9.

(60) Mathias SD, Williamson CL, Colwell HH, Cisternas MG, Pasta DJ, Stolshek BS, et al. Assessing health-related quality-of-life and health state preference in persons with obesity: a validation study. Qual Life Res 1997 May;6(4):311-22.

(61) Nortvedt MW, Riise T. The use of quality of life measures in multiple sclerosis research. Mult Scler 2003 Feb;9(1):63-72.

(62) Meyer HE, Sogaard AJ, Falch JA, Jorgensen L, Emaus N. Weight change over three decades and the risk of osteoporosis in men: the Norwegian Epidemiological Osteoporosis Studies (NOREPOS). Am J Epidemiol 2008 Aug 15;168(4):454-60.

(63) Bjorvatn B, Sagen IM, Oyane N, Waage S, Fetveit A, Pallesen S, et al. The association between sleep duration, body mass index and metabolic measures in the Hordaland Health Study. J Sleep Res 2007 Mar;16(1):66-76.

(64) Bjorge T, Engeland A, Tretli S, Weiderpass E. Body size in relation to cancer of the uterine corpus in 1 million Norwegian women. Int J Cancer 2007 Jan 15;120(2):378-83.

(65) Engeland A, Tretli S, Hansen S, Bjorge T. Height and body mass index and risk of lymphohematopoietic malignancies in two million Norwegian men and women. Am J Epidemiol 2007 Jan 1;165(1):44-52.

(66) Raeder MB, Bjelland I, Emil VS, Steen VM. Obesity, dyslipidemia, and diabetes with selective serotonin reuptake inhibitors: the Hordaland Health Study. J Clin Psychiatry 2006 Dec;67(12):1974-82.

(67) Bjorge T, Tretli S, Engeland A. Height and body mass index in relation to cancer of the small intestine in two million Norwegian men and women. Br J Cancer 2005 Oct 3;93(7):807-10.

(68) Engeland A, Tretli S, Austad G, Bjorge T. Height and body mass index in relation to colorectal and gallbladder cancer in two million Norwegian men and women. Cancer Causes Control 2005 Oct;16(8):987-96.

(69) Nystad W, Meyer HE, Nafstad P, Tverdal A, Engeland A. Body mass index in relation to adult asthma among 135,000 Norwegian men and women. Am J Epidemiol 2004 Nov 15;160(10):969-76.

(70) Engeland A, Bjorge T, Selmer RM, Tverdal A. Height and body mass index in relation to total mortality. Epidemiology 2003 May;14(3):293-9.

(71) Lee PH, Chang WY, Liou TH, Chang PC. Stage of exercise and health-related quality of life among overweight and obese adults. J Adv Nurs 2006 Feb;53(3):295-303.

(72) Coleman KJ, Rosenberg DE, Conway TL, Sallis JF, Saelens BE, Frank LD, et al. Physical activity, weight status, and neighborhood characteristics of dog walkers. Prev Med 2008 Sep;47(3):309-12.

(73) Cecchini M, Sassi F, Lauer JA, Lee YY, Guajardo-Barron V, Chisholm D. Tackling of unhealthy diets, physical inactivity, and obesity: health effects and cost-effectiveness. Lancet 2010 Nov 20;376(9754):1775-84.

(74) Brown HE, Gilson ND, Burton NW, Brown WJ. Does physical activity impact on presenteeism and other indicators of workplace well-being? Sports Med 2011 Mar 1;41(3):249-62.

ARTICLE

BODYWEIGHT CHANGES IS ASSOCIATED WITH REDUCED HEALTH RELATED QUALITY OF LIFE

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ABSTRACT

Introduction Bodyweights outside the normal range are commonly associated with reduced health related quality of life (HRQL), while physical activity has shown to improve HRQL. Few studies have investigated the effect of relative changes in bodyweight on HRQL.

Methods In the community–based Hordaland Health Study (1997-99), 9276 men and 10433 women aged 40–47 years were included. Weight and height were measured and information on bodyweight changes, physical activity and smoking was obtained from self–administered questionnaires including the Medical Outcomes Study MOS short form-12 (SF-12). A Physical (PCS) and a Mental health Composite Score (MCS) were derived from these questions.

Results In multivariate analyses bodyweight changes showed a marked effect on PCS and MCS with reduced scores associated with increasing bodyweight changes ($p<0.001$). Bodyweight defined by four categories according to Body Mass Index was significantly associated with variations in the PCS and MCS. Normal weight individuals had the best PCS, while they surprisingly had a slightly lower mean score of MCS compared to the higher bodyweight categories. Marked associations were found between little physical activity, smoking and decreased PCS and MCS ($p<0.001$). Women had significantly higher effect of physical activity on PCS (test of interaction) with a mean improvement of 5.0 from the least- to the most physically active individuals, compared to men's improvement of 3.2.

Conclusions Our findings indicate that increasing bodyweight changes are markedly related to a reduced physical and mental health, while a high bodyweight in general seems to be related to a reduced physical health but not mental health. Women compared to men have a greater potential for benefitting from increased physical activity according to analysis.

INTRODUCTION

Weight gain along with increasing age in the population is a growing community problem according to The World Health Organization (WHO) (1). Overweight and obesity is strongly associated with a poor Health Related Quality of Life (HRQL) (2). Besides, underweight has also been associated with reduced HRQL, as a possible result of disease and increased mortality (3). However, individuals in their forties are more likely to maintain or gain weight during time rather than losing weight (4-6).

In the Norwegian population average bodyweight has increased the recent decades in line with decreased daily physical activity (7). It is estimated that more than half of the Norwegian population have a too low physical activity level (7). There is a significant association between decreased physical activity and weight gain (8). In general, HRQL can be improved by regular physical activity (2;9-11), and increased physical activity is also essential in order to lose weight and maintain the weight loss, especially in combination with a restricted diet (10;12-14).

Health benefits of weight loss seem to be more prominent in people from their forties and older, since interventions tend to delay the onset of chronic diseases and pain (15). A loss of 5-10% might be enough for achieving health benefits, and improving HRQL (16), and similar benefits can be seen in individuals solely attempting to lose weight (17). A short term weight loss is quite easily achieved, but many struggle with weight loss maintenance which initiate bodyweight changes (10;18). Women more often than men tend to report attempts to lose weight (19-21), partly due to a higher percentage of women trying to lose weight at a lower BMI (21). In addition, women are more likely to perceive themselves as overweight, without accounting for actual BMI (19).

Smoking has an impact on body weight as a consequence of an increased whole body metabolism which seems to be temporary (22). Current smokers tend to have a lower BMI than non-smokers (23), and quitting smoking is associated with weight gain (4;24). Further, in current smokers impaired HRQL has been observed and the primary cause is more reported unhealthy days than non-smokers (9).

Most previous studies concerning adults and HRQL focus on either weight loss or weight gain (9;20;25;26). Only a few studies measure bodyweight change in general, and in

association with HRQL (4;6;27). Thus, the aims of the study were to investigate HRQL in relation to bodyweight change over time adjusted for current BMI, physical activity and smoking.

MATERIALS AND METHODS

Study population

The study subjects were participants of The Hordaland Health Study (HUSK) in Western Norway where the baseline examination were conducted during 1997-1999 (28). A total of 29400 subjects born 1953-57 (aged 40-47 years) were invited and 8598 men and 9983 women participated, yielding a participation rate of 57% and 70% for men and women, respectively. In addition 2291 men and 2558 women born 1950-51 (aged 41-43 years) from a previous survey in 1992–1993 (28) were included. Participation rates in these groups were 73% and 81%, respectively. Participants with missing data regarding HRQL were excluded. Thus, 9276 men and 10433 women were included in the current study.

Measurements

Baseline measurements included height and weight, carried out by a health professional, with participants wearing light clothing and no shoes. Self-administered questionnaires provided information on various health behaviours including questions about HRQL, physical activity, highest weight and lowest weight last five years and smoking habits. Smoking was categorized as current smoking, former smoking and non-smoking. Measurement of HRQL includes the validated Medical Outcomes Study MOS short form-12 (SF12) questionnaire (29). The 12 questions in this questionnaire are summarized into a Physical Health Composite Score (PCS) and Mental Health Composite Score (MCS). The PCS includes primarily the health related domains physical functioning, role limitation due to physical problems and bodily pain, while the MCS includes primarily health related social functioning, role limitation due to emotional problems, mental health. The domains general health perception and vitality load substantially on both scales.

Physical activity was registered as the number of hours spent weekly on light (without sweating or being out of breath) and heavy (causing sweating and breathlessness). This was categorized into 3 levels: <1 hour/ week, 1-3 hours/ week and >3 hours/ week. In the multivariate analyses we combined the effect of light and heavy physical activity by giving

weekly hours spent on hard physical activity a higher sum score than hours spent on light physical activity to adjust effects. Light physical activity was scored 1 for no light physical activity, 2 for <1 hour/ week, 3 for 1-2 hours/week and 4 for 3 hours/ week. Hard physical activity was scored 2 for no hard physical activity, 4 for 1 hour/ week, 6 for 1-2 hours/ week, 8 for >3 hours/ week. A summary score for physical activity was created by adding hard and light activity ranging from the lowest score of 3 (no light physical activity + no hard physical activity) to the highest score of 12 (>3 hours/ week hard physical activity + >3 hours/ week light physical activity).

BMI was calculated as weight in kilograms divided by the square of height in meters. WHO categories of BMI classification was used in the analysis: underweight BMI <18.5, normal weight 18.5-25, overweight 25-30 and obese >30. Bodyweight changes during the last 5 years was classified into 0-5%, 5-15% and >15%. Participants with a current weight <5% lower or higher than mean bodyweight change was considered weight maintainers. Participants who were measured to have a weight that was more than 3 kilograms outside the self-reported bodyweight range during the last five years were excluded.

The study protocol was approved by the Regional Ethics Committee and by the Norwegian Data Inspectorate.

Statistical analyses

Analyses was performed using the statistical tool Statistics Package for Social Science (SPSS) 19 for windows, using generalized linear models to estimate the association between the bodyweight changes, BMI, physical activity and smoking and the PCS and MCS. Multivariate analyses were performed stratified by gender. Differences in the associations between men and women were tested by including interactions terms in the model and including both men and women. Two tailed P values <0.05 were considered statistically significant.

RESULTS

The mean BMI was 26.2 for men and 24.7 for women. A total of 62.1% of the male population were overweight or obese compared to 49.7% for women (table 1). Among men 22.3% reported a weight change during the last 5 years of less than 5% compared to only 13.0% among women. Around 50% of both men and women had never smoked.

The mean score of the PCS and MCS for men was 50.8 (standard deviation (SD) 7.4) and 50.6 (SD 8.1), respectively. Corresponding means for women were 49.3 (SD 8.9) for PCS and 49.5 (SD 8.9) for MCS. A low score on the PCS was significantly associated with high bodyweight changes, high BMI, little physical activity and smoking among both men and women (table 1).

Also for MCS there were significant associations to all covariates although the differences were slightly smaller than for PCS. Nearly double as many women (17.2%) compared to men (8.8%) reported bodyweight changes >15% and these individuals had the lowest mean PCS and MCS scores for both men and women. Further, non-smoking men (36.5%) and women (37.0%) reported the best PCS and MCS compared to current smokers. The differences between non-smokers and current smokers regarding PCS and MCS were small (Table 1).

In multivariate general linear analyses separately for men and women, all covariates remained significant associated with both PCS and MCS in both genders (table 2 and 3). Physical activity was the variable with the highest effect size related to PCS for both men and women. Bodyweight changes showed the strongest effect size on MCS for both genders.

An interesting finding was that BMI levels >25 was associated with reduced PCS compared to those with BMI <25, but not for MCS. Further, after adjustment for bodyweight changes and the other covariates there was actually a slightly increased MCS for BMI >25, particularly for men (table 2 and 3).

To test for difference in the associations between men and women we introduced interaction terms when including both men and women in the model. There was a significant interaction between gender and physical activity on PCS, showing that the effect of physical

functioning was stronger among women than among men (figure 1). No other significant interaction effects were found.

The estimated R^2 for the multivariate models excluding interactions were 4.1% for PCS and 3.1% for MCS for men, while the estimates for women were 7.0% for PCS and 2.4% for MCS.

DISCUSSION

In this study the lowest PCS was found among individuals with high bodyweight changes, high BMI, little physical activity and among current smokers. PCS increased almost linearly with increased physical activity, leaving physical activity as the variable with the strongest association to physical health. The findings in MCS were similar to PCS, though less prominent. The variable with the strongest effect size on mental health was bodyweight changes.

HRQL in relation to bodyweight changes

Bodyweight changes had the strongest effect size on mental health in our study, which is in accordance with the results reported by Fine et al. (6). Low differences in HRQL among individuals keeping a stable weight compared to individuals with small fluctuations of less than 5 % has previously been reported (30). In the current study, both men and women with 0-5% fluctuations tended to have the best physical and mental health compared to individuals with greater fluctuations. A greater amount of the men tended to maintain a stable bodyweight, while nearly the double as many women compared to men reported greater bodyweight changes (>15%). However, the largest percentage of participants had moderate fluctuations in weight (5-15%), which is in accordance with previously reported bodyweight gain due to age (4-6). Weight gain is commonly associated with lower physical functioning (3;25;31). Unrealistic expectations of weight loss more than 15% might be a major reason for weight management failure and variations (18), as well as previous attempts to lose weight, which can be associated with current weight gain or greater variations (4;32).

HRQL in relation to BMI

HRQL has been shown to be affected by bodyweight issues in a number of previous studies (3;16;25;32;33). We found that physical health was lower among overweighet and obese individuals as well as in underweighted men. After adjustment, normal weighed tended

surprisingly to have slightly poorer mental health compared to the other weight categories. Our findings according to MCS are in accordance with previous literature stating that mostly physical aspects of HRQL can be associated with bodyweight (3;25;31). Further, we also found that underweighted women scored lowest on mental health. Underweight is commonly associated with poor physical health, disease and increased mortality (3), while overweight and obese individuals have a lower physical functioning in general (2). Our results also showed that women were more physically and mentally affected by BMI than men, which also has been reported earlier (19-21).

HRQL in relation to physical activity

The strong association between physical health and physical activity in our study is in accordance with previous findings (11;34;35). Our findings indicate that some of the impairment in PCS and MCS due to bodyweight changes could be prevented if the level of physical activity is simultaneously increased, which corresponds with previous observations (34-36). Further, our results show that women more than men may benefit from increasing the level of physical activity. Physical activity can counteract weight gain, but does presumably not alone lead to a adequate weight loss if not combined with change of lifestyle (37). An active lifestyle is recommended for the maintenance of a healthy weight (33). Hard physical activity is recommended to decrease the risk of weight gain (27;32). In the current study, men reported to spend more hours on hard physical activity than women, whereas women reported more hours spent on light physical activity. Some claim that regularly moderate or hard physical activity affects HRQL to a greater extent than regularly light physical activity (4;36). We found about the same effect for these two types of physical activity for both men and women. Improved HRQL according to physical activity might occur as a result of changes in level of body fat, body fat distribution and resting metabolic rate which potentially can lead to bodyweight changes (5;11). Further, health benefits due to physical activity and weight loss or maintenance, follow an increase in energy expenditure and total energy metabolism (5). Regardless, we found a strong effect of physical activities also after adjusting for BMI and bodyweight changes, supporting that the beneficial effect of physical activities goes beyond weight loss. These findings are supported by previous research claiming that health benefits and well-being due to physical activity might occur even in the absence of weight loss (2;11) .

HRQL in relation to smoking

About half of the participants in our study had never smoked. We found a lower score on physical and mental health among current smokers than in non-smokers. This may be due to health complaints or disease among smokers (9). There is a strong association between smoking and BMI (22;23), with lower mean bodyweight among smokers as well as weight gain associated with smoking cessation (23;37). Our finding of a negative effect of smoking also in the multivariate model underlines the adverse effects of smoking in addition to effects related to weight issues.

Strengths and limitations

The main strength of this study is the large number of community-dwelling participants. However, the cross-sectional nature of the study precludes any interference about causality. Low R^2 scores due to lack of longitudinal perspective or left out variables was seen.

BMI and weight perception are not necessarily coinciding (19), which was the reason why we excluded participants with self-reported bodyweight changes deviating ≥3 kilograms from currently measured weight. Self-reported bodyweight can commonly deviate 1 kilograms from technician measured body weight (4), and as much as 10 kilograms deviation in minus between self-reported weight and measured weight has previously been reported among women (33).

Clinical practice and follow-up studies

Clinicians handling bodyweight change in clinical practice, can beneficially focus on lifestyle changes including reduction of bodyweight variations and increased physical activity (37). However, follow–up studies are needed to determine whether bodyweight changes are related to changes in HRQL in a longitudinal perspective.

CONCLUSIONS

Our results show that reduced HRQL was markedly associated with large fluctuations in bodyweight, low levels of light and hard physical activity and current smoking. Improved mental health and especially physical health, was strongly and almost linearly associated with increased total physical activity, and women seem to benefit even more than men.

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REFERENCE LIST

(1) World Health Organization (WHO). Obesity and overweight. Fact sheet nr 311. www.who.int/mediacentre/factsheets/fs311/en/index.html; 2006 Sep.

(2) Lee PH, Chang WY, Liou TH, Chang PC. Stage of exercise and health-related quality of life among overweight and obese adults. J Adv Nurs 2006 Feb;53(3):295-303.

(3) Ford ES, Moriarty DG, Zack MM, Mokdad AH, Chapman DP. Self-reported body mass index and health-related quality of life: findings from the Behavioral Risk Factor Surveillance System. Obes Res 2001 Jan;9(1):21-31.

(4) Coakley EH, Rimm EB, Colditz G, Kawachi I, Willett W. Predictors of weight change in men: results from the Health Professionals Follow-up Study. Int J Obes Relat Metab Disord 1998 Feb;22(2):89-96.

(5) Manini TM. Energy expenditure and aging. Ageing Res Rev 2010 Jan;9(1):1-11.

(6) Fine JT, Colditz GA, Coakley EH, Moseley G, Manson JE, Willett WC, et al. A prospective study of weight change and health-related quality of life in women. JAMA 1999 Dec 8;282(22):2136-42.

(7) The Norwegian Government. Resept for et sunnere Norge. Folkehelsepolitikken. http://www.regjeringen.no/Rpub/STM/20022003/016/PDFS/STM200220030016000DDDPDFS.pdf: Regjeringen; 2003. Report No.: 16.

(8) Jamison RN, Stetson B, Sbrocco T, Parris WC. Effects of significant weight gain on chronic pain patients. Clin J Pain 1990 Mar;6(1):47-50.

(9) Hassan MK, Joshi AV, Madhavan SS, Amonkar MM. Obesity and health-related quality of life: a cross-sectional analysis of the US population. Int J Obes Relat Metab Disord 2003 Oct;27(10):1227-32.

(10) Kalter-Leibovici O, Younis-Zeidan N, Atamna A, Lubin F, Alpert G, Chetrit A, et al. Lifestyle intervention in obese Arab women: a randomized controlled trial. Arch Intern Med 2010 Jun 14;170(11):970-6.

(11) Rippe JM, Hess S. The role of physical activity in the prevention and management of obesity. J Am Diet Assoc 1998 Oct;98(10 Suppl 2):S31-S38.

(12) Arrebola E, Gomez-Candela C, Fernandez-Fernandez C, Loria V, Munoz-Perez E, Bermejo LM. Evaluation of a lifestyle modification program for treatment of overweight and nonmorbid obesity in primary healthcare and its influence on health-related quality of life. Nutr Clin Pract 2011 Jun;26(3):316-21.

(13) Abildso CG, Zizzi SJ, Reger-Nash B. Evaluating an insurance-sponsored weight management program with the RE-AIM Model, West Virginia, 2004-2008. Prev Chronic Dis 2010 May;7(3):A46.

(14) Perusse-Lachance E, Tremblay A, Drapeau V. Lifestyle factors and other health measures in a Canadian university community. Appl Physiol Nutr Metab 2010 Aug;35(4):498-506.

(15) Cecchini M, Sassi F, Lauer JA, Lee YY, Guajardo-Barron V, Chisholm D. Tackling of unhealthy diets, physical inactivity, and obesity: health effects and cost-effectiveness. Lancet 2010 Nov 20;376(9754):1775-84.

(16) Hwu CM. The complicated relationship between weight loss and health-related quality of life: satisfaction not guaranteed. J Chin Med Assoc 2011 Apr;74(4):149-50.

(17) Fontaine KR, Bartlett SJ, Barofsky I. Health-related quality of life among obese persons seeking and not currently seeking treatment. Int J Eat Disord 2000 Jan;27(1):101-5.

(18) Hainer V, Toplak H, Mitrakou A. Treatment modalities of obesity: what fits whom? Diabetes Care 2008 Feb;31 Suppl 2:S269-S277.

(19) Lemon SC, Rosal MC, Zapka J, Borg A, Andersen V. Contributions of weight perceptions to weight loss attempts: differences by body mass index and gender. Body Image 2009 Mar;6(2):90-6.

(20) Bish CL, Blanck HM, Serdula MK, Marcus M, Kohl HW, III, Khan LK. Diet and physical activity behaviors among Americans trying to lose weight: 2000 Behavioral Risk Factor Surveillance System. Obes Res 2005 Mar;13(3):596-607.

(21) Kruger J, Galuska DA, Serdula MK, Jones DA. Attempting to lose weight: specific practices among U.S. adults. Am J Prev Med 2004 Jun;26(5):402-6.

(22) Perkins KA. Metabolic effects of cigarette smoking. J Appl Physiol 1992 Feb;72(2):401-9.

(23) Hultquist CM, Meyers AW, Whelan JP, Klesges RC, Peacher-Ryan H, DeBon MW. The effect of smoking and light activity on metabolism in men. Health Psychol 1995 Mar;14(2):124-31.

(24) Butler SM, Black DR, Blue CL, Gretebeck RJ. Change in diet, physical activity, and body weight in female college freshman. Am J Health Behav 2004 Jan;28(1):24-32.

(25) Fontaine KR, Barofsky I, Andersen RE, Bartlett SJ, Wiersema L, Cheskin LJ, et al. Impact of weight loss on health-related quality of life. Qual Life Res 1999 May;8(3):275-7.

(26) Pan HJ, Cole BM, Geliebter A. The benefits of body weight loss on health-related quality of life. J Chin Med Assoc 2011 Apr;74(4):169-75.

(27) Coleman KJ, Rosenberg DE, Conway TL, Sallis JF, Saelens BE, Frank LD, et al. Physical activity, weight status, and neighborhood characteristics of dog walkers. Prev Med 2008 Sep;47(3):309-12.

(28) Riise T, Moen BE, Nortvedt MW. Occupation, lifestyle factors and health-related quality of life: the Hordaland Health Study. J Occup Environ Med 2003 Mar;45(3):324-32.

(29) Hurst NP, Ruta DA, Kind P. Comparison of the MOS short form-12 (SF12) health status questionnaire with the SF36 in patients with rheumatoid arthritis. Br J Rheumatol 1998 Aug;37(8):862-9.

(30) Mathias SD, Williamson CL, Colwell HH, Cisternas MG, Pasta DJ, Stolshek BS, et al. Assessing health-related quality-of-life and health state preference in persons with obesity: a validation study. Qual Life Res 1997 May;6(4):311-22.

(31) Han TS, Tijhuis MA, Lean ME, Seidell JC. Quality of life in relation to overweight and body fat distribution. Am J Public Health 1998 Dec;88(12):1814-20.

(32) Coakley EH, Kawachi I, Manson JE, Speizer FE, Willet WC, Colditz GA. Lower levels of physical functioning are associated with higher body weight among middle-aged and older women. Int J Obes Relat Metab Disord 1998 Oct;22(10):958-65.

(33) Goldfinger JZ, Arniella G, Wylie-Rosett J, Horowitz CR. Project HEAL: peer education leads to weight loss in Harlem. J Health Care Poor Underserved 2008 Feb;19(1):180-92.

(34) Bize R, Johnson JA, Plotnikoff RC. Physical activity level and health-related quality of life in the general adult population: a systematic review. Prev Med 2007 Dec;45(6):401-15.

(35) Dishman RK. The impact of behavior on quality of life. Qual Life Res 2003;12 Suppl 1:43-9.

(36) Wendel-Vos GC, Schuit AJ, Tijhuis MA, Kromhout D. Leisure time physical activity and health-related quality of life: cross-sectional and longitudinal associations. Qual Life Res 2004 Apr;13(3):667-77.

(37) Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. N Engl J Med 2011 Jun 23;364(25):2392-404.

ATTACHMENT 1: Tables related to the article

Table 1 Characteristics of the study participants in the Hordaland Health Study. Mean Physical health Composite Score (PCS) and mean Mental health Composite Score (MCS) due to Body Mass Index, bodyweight changes, physical activity and smoking in men and women separately.

		MEN (N = 9276)			**WOMEN (N = 10433)**		
	Values	**N (%)**	**PCS**	**MCS**	**N (%)**	**PCS**	**MCS**
Body Mass Index	≤18.5	39 (0.4)	48.0	50.2	230 (2.2)	49.0	47.8
	18.5–25	3471 (37.5)	51.4	50.2	6145 (59.0)	50.2	49.6
	25–30	4620 (49.9)	50.8	50.9	3014 (29.0)	48.8	49.5
	>30	1131 (12.2)	49.1	50.6	1021 (9.8)	45.6	49.1
	p-value		<0.001	<0.001		<0.001	0.017
Bodyweight changes in percent last 5 years.	0-5%	2065 (22.3)	51.6	51.7	1358 (13.0)	50.9	51.0
	5-15%	5057 (54.5)	50.9	50.6	5646 (54.1)	49.8	49.5
	>15%	815 (8.8)	48.4	48.1	1791 (17.2)	46.6	47.8
	p-value		<0.001	<0.001		<0.001	<0.001
Hard physical activity (with sweating and being out of breath)	<1h/ week	4890 (53.9)	50.0	50.1	5976 (59.4)	48.3	48.9
	1-2h/ week	2605 (28.7)	51.5	51.0	3002 (29.8)	50.7	50.1
	≥3h/ week	1576 (17.4)	52.1	51.6	1091 (10.8)	51.3	50.7
	p-value		<0.001	<0.001		<0.001	<0.001
Light physical activity (without sweating and being out of breath)	<1h/ week	1944 (21.5)	49.5	49.5	1613 (15.8)	47.1	48.0
	1-2h/ week	3352 (37.1)	50.9	50.5	3901 (38.1)	49.3	49.4
	≥3h/ week	3750 (41.5)	51.3	51.2	4715 (46.1)	49.9	50.0
	p-value		<0.001	<0.001		<0.001	<0.001
Current smoking	No	3377 (36.5)	51.2	51.0	3847 (37.0)	50.0	50.2
	Yes	3257 (35.2)	49.9	49.6	3720 (35.8)	48.1	48.4
	Previous	2623 (28.3)	51.1	51.3	2838 (27.3)	49.9	49.8
	p-value		<0.001	<0.001		<0.001	<0.001

The total number between variables may vary due to different number of missing data.

Table 2 Associations between bodyweight changes, Body Mass Index, smoking, physical activity and Physical (PCS) and Mental health Composite Score (MCS) in general linear multivariate model for male study participants (N=9276) in the Hordaland Health study.

		Physical Component Summary				**Mental Component Summary**			
MEN		Crude Mean	Diff adjusted[a]	95% Confidence Interval	Eta-squared[b]	Crude Mean	Diff adjusted[a]	95% Confidence Interval	Eta-squared[b]
Body weight change	0-5%	51.6	0	-	0.007	51.7	0	-	0.014
	5-15%	50.9	-0.5	-0.9, -0.1		50.6	-1.4	-1.8, -1.0	
	>15%	48.4	-2.5	-3.1, -2.0		48.1	-4.0	-4.6, -3.3	
	Missing	50.5	-0.7	-1.2, -0.1		50.6	-1.5	-2.1, -0.9	
Body Mass Index	<18.5	48.8	-2.8	-5.1, -0.5	0.006	48.2	1.0	-1.5, 3.6	0.004
	18.5-25	50.6	0	-		49.8	0	-	
	25-30	50.0	-0.5	-0.8, -0.1		50.4	1.1	0.7, 1.4	
	>30	47.4	-1.8	-2.3, -1.3		49.9	1.3	0.7, 1.9	
Smoking	Never	50.7	0	-	0.005	50.6	0	-	0.006
	Current	49.0	-1.1	-1.5, -0.8		49.0	-1.1	-1.5, -0.7	
	Previous	50.4	-0.1	-0.5, -0.3		50.5	0.4	-0.0, -0.8	
Physical activity[c]		-	3.2	2.7, 3.7	0.023		2.3	1.7, 2.9	0.006

[a] *Differences adjusted for all other covariates.*
[b] *Relative effect size.*
[c] *Included as continuous variable in the model with estimate corresponding to a difference between minimum (no light and hard physical activity) and maximum (>3 hours of both light and hard physical activity).*
Overall P-value for all variables <0.001.

Table 3 Associations between bodyweight changes, Body Mass Index, smoking, physical activity and Physical (PCS) and Mental health Composite Score (MCS) in general linear multivariate model for female study participants (N=10433) in the Hordaland Health study.

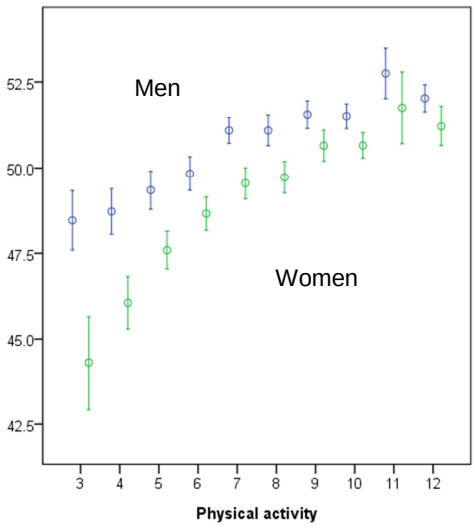
		Physical Component Summary				**Mental Component Summary**			
WOMEN		Crude Mean	Diff adjusted[a]	95% Confidence Interval	Eta-squared[b]	Crude Mean	Diff adjusted[a]	95% Confidence Interval	Eta-squared[b]
Body weight change	0-5%	50.9	0	-	0.011	51.0	0	-	0.009
	5-15%	49.8	-1.0	-1.5, -0.5		49.5	-1.7	-2.2, -1.1	
	>15%	46.6	-3.2	-3.8, -2.5		47.8	-3.2	-3.8, -2.5	
	Missing	49.2	-1.1	-1.7, -0.4		50.0	-1.3	-2.0, -0.6	
Body Mass Index	<18.5	49.0	-0.6	-1.7, 0.6	0.015	47.8	-1.4	-2.6, -0.2	0.001
	18.5-25	50.2	0	-		49.6	0	-	
	25-30	48.8	-0.9	-1.3, -0.6		49.5	0.2	-0.2, 0.6	
	>30	45.6	-3.8	-4.4, -3.2		49.1	0.2	-0.4, 0.8	
Smoking	Never	50.0	0	-	0.007	50.2	0	-	0.004
	Current	48.1	-1.5	-1.9, -1.1		48.4	-1.3	-1.8, -0.9	
	Previous	49.9	-0.1	-0.5, 0.4		49.8	-0.3	-0.7, -0.2	
Physical activity[c]		-	5.0	4.4, 5.7	0.023	-	2.8	2.1,3.4	0.007

[a] *Differences adjusted for all other covariates.*
[b] *Relative effect size.*
[c] *Included as continuous variable in the model with estimate corresponding to a difference between minimum (no light and hard physical activity) and maximum (>3 hours of both light and hard physical activity).*
Overall P-value for all variables <0.001

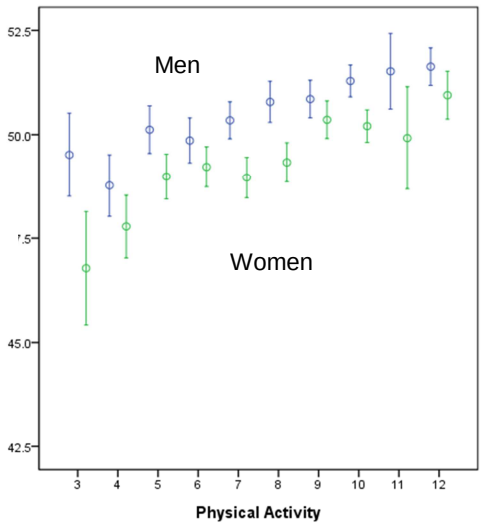
ATTACHMENT 2: Figures related to the article

Figure 1 Physical health Composite Score (PCS)* and Mental health Composite Score (MCS)* by physical activity in men (N=9276) and women (N=10433) in the Hordaland Health Study. Physical activity is calculated as a weighted sum of hard and light physical activity with 3 corresponding to no light and hard physical activity and 12 corresponding to >3 hours/ week of both light and hard physical activity.

PCS



MCS



** Mean scores and 95% confidence interval based on raw scores. Similar effects were found after adjustment for confounding factors (Body Mass Index, bodyweight changes and smoking).*

ATTACHMENT 3: The Hordaland Health Study. Questionnaire. (Norwegian)

HELSEUNDERSØKELSEN
I HORDALAND 1997-99

☐ Adresse endring

Personlig innbydelse

SP02B

Spørreskjemaet er en viktig del av helseundersøkelsen. Vennligst fyll ut skjemaet på forhånd og ta det med til helseundersøkelsen. Dersom enkelte spørsmål er uklare, lar du dem stå ubesvart til du møter fram, og drøfter dem med personalet som gjennomfører undersøkelsen.
Alle svar vil bli behandlet strengt fortrolig.

Det utfylte skjemaet vil bli lest av en maskin. Bruk blå eller sort farge ved utfylling. Det er viktig at du går fram slik:

- i de små boksene setter du kryss for det svaret som passer best for deg
- i de store boksene skriver du tall eller blokkbokstaver – NB! innenfor rammen for boksen.

Eksempler:
Avkryssing: [X] Tall: [1][2][3][4][5][6][7][8][9][0] Bokstaver: [A][B][C]

Med vennlig hilsen

Statens helseundersøkelser ♥ Kommunehelsetjenesten ♥ Helseundersøkelsen i Hordaland

1. EGEN HELSE

Hvordan er helsen din nå? *(Sett bare ett kryss)*

Dårlig	Ikke helt god	God	Svært god
☐ 1	☐ 2	☐ 3	☐ 4

Har du, eller har du hatt:	JA	NEI	Alder første gang
Hjerteinfarkt	☐	☐	[ ][ ] år
Angina pectoris (hjertekrampe)	☐	☐	[ ][ ] år
Hjerneslag/hjerneblødning	☐	☐	[ ][ ] år
Astma	☐	☐	[ ][ ] år
Diabetes (sukkersyke)	☐	☐	[ ][ ] år
Multippel sklerose	☐	☐	[ ][ ] år

Bruker du medisin mot høyt blodtrykk?

Nå	Før, men ikke nå	Aldri brukt
☐ 1	☐ 2	☐ 3

Har du noen gang det siste året hatt eksem (rød, kløende, sår og sprukken hud):	JA	NEI
På hendene?	☐	☐
I ansiktet?	☐	☐
Andre steder på kroppen?	☐	☐

	JA	NEI
Med «hvite fingre» mener vi plager i form av at en eller flere fingre blir hvite og at man samtidig mister følelsen i dem når det er kaldt. Har du slike plager?	☐	☐

2. HVORDAN FØLER DU DEG?

Har du de siste to ukene følt deg:

	Nei	Litt	En god del	Svært mye
Nervøs og urolig?	☐	☐	☐	☐
Plaget av angst?	☐	☐	☐	☐
Trygg og rolig?	☐	☐	☐	☐
Irritabel?	☐	☐	☐	☐
Glad og optimistisk?	☐	☐	☐	☐
Nedfor/deprimert?	☐	☐	☐	☐
Ensom?	☐	☐	☐	☐
	1	2	3	4

3. SYKDOM I FAMILIEN

	JA	NEI	VET IKKE
Har en eller flere av foreldre eller søsken hatt hjerteinfarkt (sår på hjertet) eller angina pectoris (hjertekrampe)?	☐	☐	☐
Har en eller flere foreldre/søsken hatt:			
Hjerteinfarkt *før* de fylte 60 år?	☐	☐	☐
Hjerneslag/hjerneblødning *før* de fylte 70 år?	☐	☐	☐

4. MUSKEL- OG SKJELETTPLAGER

	JA	NEI
Har du i løpet av det siste året vært plaget med smerter og/eller stivhet i muskler og ledd som har vart i minst 3 måneder sammenhengende?	☐	☐

Hvis NEI, gå til avsnitt 5.
Hvis JA, svar på følgende:

Hvor har du hatt disse plagene?	JA	NEI
Nakke	☐	☐
Skuldre (aksler)	☐	☐
Albuer	☐	☐
Håndledd/hender	☐	☐
Bryst, mage	☐	☐
Øvre del av ryggen	☐	☐
Korsryggen	☐	☐
Hofter	☐	☐
Knær	☐	☐
Ankler, føtter	☐	☐

Hvor lenge har plagene vart sammenhengende?
Svar for det området hvor plagene har vart lengst.

Hvis under 1 år, oppgi antall måneder. .....*Antall mnd.* [ ][ ]

Hvis 1 år eller mer, oppgi antall år .....*Antall år* [ ][ ]

Har plagene redusert din arbeidsevne det siste året?
Gjelder også hjemmearbeidende. Sett bare ett kryss.

Nei/ubetydelig	I noen grad	I betydelig grad	Vet ikke
☐ 1	☐ 2	☐ 3	☐ 4

	JA	NEI	Ikke i arbeid
Har du vært sykmeldt p.g.a. disse plagene det siste året?	☐	☐	☐

	JA	NEI
Har plagene ført til redusert aktivitet i fritiden?	☐	☐

5. MOSJON

Hvordan har din fysiske aktivitet i fritiden vært det siste året?
Tenk deg et ukentlig gjennomsnitt for året.
Arbeidsvei regnes som fritid. Besvar begge spørsmålene.

	Timer pr. uke: Ingen	Under 1	1-2	3 og mer
Lett aktivitet *(ikke svett/andpusten)*	☐	☐	☐	☐
Hard fysisk aktivitet *(svett/andpusten)*	☐	☐	☐	☐
	1	2	3	4

6. KAFFE / TE / ALKOHOL

Hvor mange kopper kaffe/te drikker du daglig?
Sett 0 hvis du ikke drikker kaffe/te daglig.

Antall kopper daglig

Kokekaffe	Annen kaffe	Te
☐☐	☐☐	☐☐

	JA	NEI
Er du total avholdsmann/-kvinne?	☐	☐

Hvor mange ganger i måneden drikker du vanligvis alkohol? *Regn ikke med lettøl.*
Sett 0 hvis mindre enn 1 gang i mnd. ..... *Antall ganger* ☐☐

Hvor mange glass øl, vin eller brennevin drikker du VANLIGVIS i løpet av to uker?
Regn ikke med lettøl. Sett 0 hvis du ikke drikker alkohol.

Glass øl	Glass vin	Glass brennevin
☐☐	☐☐	☐☐

7. RØYKING

Hvor lenge er du vanligvis daglig tilstede i røykfylt rom? ..... *Antall hele timer* ☐☐
Sett 0 hvis du ikke oppholder deg i røykfylt rom.

Røyker du selv:	JA	NEI
Sigaretter daglig?	☐	☐
Sigarer/sigarillos daglig?	☐	☐
Pipe daglig?	☐	☐

Aldri røykt daglig ..... (Sett kryss) ☐

Hvis du har røykt daglig tidligere, hvor lenge er det siden du sluttet? ..... *Antall år* ☐☐

Hvis du røyker daglig nå eller har røykt tidligere:

Hvor mange sigaretter røyker eller røykte du vanligvis daglig? ..... *Antall sigaretter* ☐☐

Hvor gammel var du da du begynte å røyke daglig? ..... *Alder i år* ☐☐

Hvor mange år til sammen har du røykt daglig? ..... *Antall år* ☐☐

8. ENDRING AV HELSEVANER

Dette gjelder din interesse for å endre helsevaner. Røykespørsmålet besvares bare av dem som røyker.

	Spise sunnere		Trimme mer		Slutte å røyke	
	JA	NEI	JA	NEI	JA	NEI
Har du de siste 12 mnd. forsøkt å:	☐	☐	☐	☐	☐	☐
Om 5 år, tror du at du har endret vaner på noen av disse områdene?	☐	☐	☐	☐	☐	☐

Anslå din høyeste og laveste vekt i løpet av de siste 5 år. *(Hele kg)* *(Se bort fra vekt under svangerskap)*	Høyeste vekt	Laveste vekt
	☐☐☐	☐☐☐

9. UTDANNING

Hvilken utdanning er den høyeste du har fullført?
Sett bare ett kryss.

Mindre enn 7 år grunnskole	☐
Grunnskole 7-10 år, framhaldsskole, folkehøgskole	☐ 1
Realskole, middelskole, yrkesskole, 1-2 årig videregående skole	☐ 2
Artium, øk.gymnas, allmennfaglig retning i videregående skole	☐ 3
Høgskole/universitet, mindre enn 4 år	☐ 4
Høgskole/universitet, 4 år eller mer	☐ 5

10. HELSE OG TRIVSEL

De neste spørsmålene handler om hvordan du ser på din egen helse. Hvis du er usikker på hva du skal svare, vennligst svar så godt du kan.

Er din helse slik at den begrenser deg i utførelsen av disse aktivitetene NÅ?

Moderate aktiviteter som å flytte bord, støvsuge, gå en tur eller drive med hagearbeid:

Ja, begrenser meg mye	Ja, begrenser meg litt	Nei, begrenser meg ikke i det hele tatt
☐	☐	☐

Gå opp trappen flere etasjer:

Ja, begrenser meg mye	Ja, begrenser meg litt	Nei, begrenser meg ikke i det hele tatt
☐	☐	☐

I løpet av de siste 4 ukene, har du hatt noen av de følgende problemer i ditt arbeid eller i andre av dine daglige gjøremål på grunn av din fysiske helse?	JA	NEI
Du har utrettet mindre enn du hadde ønsket	☐	☐
Du har vært hindret i å utføre visse typer arbeid eller gjøremål	☐	☐

I løpet av de siste 4 ukene, har du hatt noen av de følgende problemer i ditt arbeid eller i andre av dine daglige gjøremål p.g.a. følelsesmessige problemer? *(Som f.eks. å være deprimert eller engstelig)*	JA	NEI
Du har utrettet mindre enn du hadde ønsket	☐	☐
Du har utført arbeidet eller andre gjøremål mindre grundig enn vanlig	☐	☐

I løpet av de siste 4 ukene, hvor mye har smerter påvirket ditt vanlige arbeid?
(Gjelder både i og utenfor hjemmet) Sett bare ett kryss.

	JA
Ikke i det hele tatt	☐ 1
Litt	☐ 2
En del	☐ 3
Mye	☐ 4
Svært mye	☐ 5

Hvor ofte i løpet av de siste 4 ukene har du følt deg rolig og harmonisk? Sett bare ett kryss.

	JA
Hele tiden	☐ 1
Nesten hele tiden	☐ 2
Mye av tiden	☐ 3
En del av tiden	☐ 4
Litt av tiden	☐ 5
Ikke i det hele tatt	☐ 6

Hvor ofte i løpet av de siste 4 ukene har du hatt mye overskudd? Sett bare ett kryss.

	JA
Hele tiden	☐ 1
Nesten hele tiden	☐ 2
Mye av tiden	☐ 3
En del av tiden	☐ 4
Litt av tiden	☐ 5
Ikke i det hele tatt	☐ 6

Hvor ofte i løpet av de siste 4 ukene har du følt deg nedfor og trist? Sett bare ett kryss.

	JA
Hele tiden	☐ 1
Nesten hele tiden	☐ 2
Mye av tiden	☐ 3
En del av tiden	☐ 4
Litt av tiden	☐ 5
Ikke i det hele tatt	☐ 6

I løpet av de siste 4 ukene, hvor mye av tiden har din fysiske helse eller følelsesmessige problemer påvirket din sosiale omgang(som det å besøke venner, slekt)? Sett bare ett kryss.

	JA
Hele tiden	☐ 1
Nesten hele tiden	☐ 2
Mye av tiden	☐ 3
En del av tiden	☐ 4
Litt av tiden	☐ 5
Ikke i det hele tatt	☐ 6

Stort sett, vil du si at din helse er:

Utmerket	Meget god	God	Nokså god	Dårlig
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

11. BRUK AV MEDISINER

Med medisiner mener vi her alle slags medisiner, både:
- *med og uten resept, naturmedisin, vitaminer og mineraler*
- *medisin som svelges, inhaleres eller injiseres, stikkpiller, salver, kremer eller dråper.*

	JA	NEI
Tok du noen slags medisiner I GÅR?	☐	☐

Hvis NEI, kan du gå til avsnitt 12.
Hvis JA, besvar følgende:
Hvilke medisiner tok du I GÅR, og hva var grunnen til at du tok medisinen (diagnose, sykdom, symtom, helseeffekt)?
Sett svarene inn i skjemaet nedenfor, en linje for hver medisin.
Kryss av for ja om du bruker medisinen daglig eller nesten daglig.

Navn på medisinen *(ett navn pr. linje):*	Grunn til bruk av medisinen I GÅR var:	Daglig JA	Daglig NEI

Dersom det ikke er nok plass her, kan du fortsette på eget ark som legges ved.

12. ARBEID

Besvares av dem som har hatt inntektsgivende arbeid i minst 100 timer det siste året:
Beskriv virksomheten på det arbeidsstedet der du utførte inntektsgivende arbeid i lengst tid de siste 12 mnd. *(Skriv f.eks. jordbruk, barneavd. på sykehus, snekkeravd. på skipsverft e.l.).*

Virksomhet:

Hvilket yrke/tittel har eller hadde du på dette arbeidsstedet? *(Skriv f.eks. kornbonde, anestesisykepleier, snekker e.l.)*

Yrke:

Hvor lenge har du praktisert i dette yrket i ditt liv? ..... *Antall år i yrket* ☐☐

Har du noen av de følgende yrker (*heltid eller deltid*)? *Sett kryss for hvert spørsmål.*

	JA	NEI
Sjåfør	☐	☐
Bonde/gårdbruker	☐	☐
Fisker	☐	☐

Har du tidligere i ditt liv (*Ikke i dag*) hatt inntektsgivende arbeid som:

	JA	NEI
Bilmekaniker/biloppretter	☐	☐
Frisør	☐	☐

13. SAMLIV

Oppgi antall egne barn (eventuelt 0) av hvert kjønn:

Antall gutter ☐☐ *Antall jenter* ☐☐

Har du noen gang hatt regelmessig samliv uten prevensjon i ett år eller mer uten at det har ført til graviditet? JA ☐ NEI ☐
Med prevensjon menes også mer usikre metoder som avbrutt samleie, «sikre perioder» etc.

De følgende spørsmål besvares bare av kvinner

Har du noen gang spontanabortert (ufrivillig mistet fosteret) etter at graviditet var sikkert påvist?

NEI	USIKKER	JA	Hvis JA:
☐	☐	☐	*Antall ganger* ☐☐

Følgende spørsmål besvares bare hvis du har vært gravid:
Oppgi antall måneder det tok med regelmessig samliv uten prevensjon (eller evt. amming), til du ble gravid:

Siste svangerskap ..... ☐☐ *mnd. uten prevensjon*

Nest siste svangerskap..... ☐☐ *mnd. uten prevensjon*

Tredje siste svangerskap ..... ☐☐ *mnd. uten prevensjon*

14. ETTERUNDERSØKELSE

Hvis denne helseundersøkelsen viser at du bør undersøkes nærmere, hvilken allmennpraktiserende lege/kommunelege ønsker du da å bli henvist til? *Oppgi legens navn:*

Ikke skriv i disse rutene ☐☐☐ ☐☐☐

Takk for utfyllingen!
Nok en gang: *Velkommen til undersøkelsen*

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