

Socioeconomic aspects of lifestyle and women´s health: a primary care and population perspective

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Gothenburg 2020

Cover illustration: Maria Waller

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ISBN 978-91-7833-786-6 (PRINT)
ISBN 978-91-7833-787-3 (PDF)
<http://hdl.handle.net/2077/62686>

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Printed in Gothenburg, Sweden 2020
BrandFactory AB

“WHO, and other global organizations now come together in taking action to improve the lives of the world’s citizens. Achieving health equity within a generation is achievable, it is the right thing to do, and now is the right time to do it.”

(WHO, Closing the gap in a generation, 2008)

“To Erik, Louise, Oscar and Sigrid”

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ABSTRACT

General aims: To study the impact of socioeconomic aspects on lifestyle development, lifestyle effects and lifestyle changes in relation to physical activity, well-being and mental stress.

Specific aims: To estimate growth characteristics and socioeconomic factors in relation to overweight/obesity among 4-year-old children. To explore whether a primary care lifestyle programme reached and engaged socioeconomically vulnerable groups to the same extent as higher socioeconomic groups. To examine trends in physical activity in relation to socioeconomic position in middle-aged women. To monitor trends in well-being and mental stress among middle-aged women and their associations with socioeconomic position.

Methods: Paper I (n=309) was a retrospective, cross-sectional study. We compared the growth (from medical records) and development of overweight/obesity among 4-year-old children in two socioeconomic diverse areas (Child Health Centres) in Gothenburg. BMI standard deviation scores were used. Paper II (n=2121) was a prospective study. Patients aged 18-79 years, visiting public primary health care centres, were offered to attend a lifestyle programme "Pro-Health". The participants answered in addition questions concerning education, employment, ethnicity, living situation and also motivation for change. Paper III (n=977) was a cohort comparison study. Women recruited in 1980 and 2004 in the Population Study of Women in Gothenburg were studied regarding physical activity at work and leisure time in relation

to socioeconomic position. Paper IV (n=1550) was a cohort comparison study. Women recruited in 1980, 2004 and 2016 in the Population Study of Women in Gothenburg were studied regarding well-being and mental stress in relation to socioeconomic position.

Results: Paper I showed a significantly higher proportion of children with overweight/obesity in the district with lower socioeconomic status. Paper II showed that socioeconomically vulnerable groups could be reached and engaged in the lifestyle programme “Pro-Health” and had comparable odds for lifestyle improvements after one year, compared to participants without vulnerability factors. Paper III showed increased physical activity levels at work and leisure time among 38- and 50-year-old women. There were no significant differences between the socioeconomic groups. Paper IV showed increased perception of good well-being in 50-year-old women 1980 to 2016. Women with low socioeconomic position had lower well-being in 1980 but not in 2016. Perceived high mental stress increased from 1980 to 2016 concerning all women, irrespective of socioeconomic position.

Conclusions: Low socioeconomic status was an independent determinant of overweight and high BMI for four-year-olds. Socioeconomically vulnerable groups can be reached and engaged in a lifestyle programme “Pro-Health” to the same extent and with the same positive results as higher socioeconomic groups. Women in different socioeconomic groups improved their physical activity to the same extent from 1980 to 2004. Women of today generally have high perceptions of good well-being and high mental stress irrespective of socioeconomic position. Primary health care - reaching the entire population - needs a socioeconomic perspective. It is urgent to improve the conditions for preventive work to reduce health disparities.

Keywords: Socioeconomic position, childhood obesity, lifestyle, primary health care, motivation for change, women, physical activity, well-being, mental stress

ISBN: 978-91-7833-786-6

SAMMANFATTNING PÅ SVENSKA

Bakgrund: Övervikt och fetma hos barn är alltmer förekommande i de flesta delar av världen. Socioekonomisk sårbarhet är en av många faktorer som påverkar detta. Folkhälsodata i ett land visar tydligt att befolkningens levnadsvanor har störst betydelse för landets hälsotillstånd. Skillnader i hälsa har en stark koppling till socioekonomiska faktorer. Det hälsofrämjande arbetet ska ge en jämlik och positiv hälsa för hela befolkningen. I Sverige har klyftan ökat de senaste åren gällande hälsa och sjuklighet mellan individer med låg respektive hög socioekonomisk status. Primärvården har en betydelsefull roll i arbetet med att förebygga sjukdom. Livsstilsprogram för att bland annat stimulera till ökad fysisk aktivitet och minskad stress bör vara anpassade för socioekonomiskt sårbara grupper.

Syfte: Att studera socioekonomiska aspekter på livsstilsutveckling och livsstilsförändringar i relation till fysisk aktivitet, upplevd hälsa och mental stress.

Metod: Studie I: Vi jämförde utvecklingen av övervikt/fetma bland fyraåriga barn i två socioekonomiskt olika områden i Göteborg. Studie II: Sökande i åldrarna 18-79 år, som besökte vårdcentraler i Göteborg, erbjöds att delta i ett livsstilsprogram "Hälsolyftet". Deltagarna svarade även på frågor gällande: utbildning, sysselsättning, etnicitet, levnadssituation samt motivation. Studie III och IV: kvinnor deltog år 1980, 2004 och 2016 i Kvinnoundersökningen i Göteborg. Data via frågeformulär gällande fysisk aktivitet, upplevd hälsa och mental stress studerades i relation till socioekonomisk position.

Resultat: Vi fann en signifikant högre andel barn med övervikt i området med lägre socioekonomisk status. Socioekonomiskt utsatta grupper kunde nås och engageras i livsstilsprogrammet "Hälsolyftet" och dessa deltagare hade positiva livsstilsförbättringar efter ett år jämfört med deltagare utan sårbarhetsfaktorer. Vi fann ökade fysiska aktivitetsnivåer bland 38- och 50-åriga kvinnor. Det fanns inga skillnader mellan de olika socioekonomiska grupperna. En förbättrad upplevd hälsa sågs hos 50-åriga kvinnor år 2016 jämfört med 1980. Kvinnor med låg socioekonomisk position hade lägre upplevd hälsa

1980 men inte 2016. Andelen kvinnor som upplevde hög mental stress ökade från 1980 till 2016 oberoende av socioekonomisk position.

Slutsatser: Låg socioekonomisk status för området var en oberoende determinant för övervikt och hög BMI vid fyra års ålder. Socioekonomiskt utsatta grupper kunde nås och engageras i livsstilsprogrammet "Hälsolyftet". Kvinnor i olika socioekonomiska grupper förbättrade fysisk aktivitets-nivåer i samma utsträckning från 1980 till 2004. Dagens kvinnor upplever generellt god hälsa och hög mental stress oavsett socioekonomisk position. Samhällets utmaning är att arbeta för en jämlik god hälsa för hela befolkningen. Det är viktigt att stärka primärvårdens förutsättningar för att arbeta med prevention då prevention kan ge förutsättningar för en mer jämlik god hälsa för hela befolkningen.

LIST OF PAPERS

This thesis is based on the following studies, referred to in the text by their Roman numerals.

- I. Thorn J, Waller M, Johansson M, Mårild S. Overweight among Four-Year-Old Children in Relation to Early Growth Characteristics and Socioeconomic Factors. *J Obes.* 2010; 2010. pii: 580642. Doi; 10.1155/2010/580642.
- II. Waller M, Blomstrand A, Högberg T, Ariai N, Thorn J, Hange D, Björkelund C. A primary care lifestyle programme suitable for socioeconomically vulnerable groups – an observational study. *Scand J Prim Health Care.* 2016; 34(4):352-359.
- III. Waller M, Lissner L, Hange D, Sund V, Blomstrand A, Björkelund C. Socioeconomic disparities in physical activity among Swedish women and trends over time – the population study of women in Gothenburg. *Scand J Prim Health Care.* 2018; 36(4):363-371.
- IV. Waller M, Lissner L, Hange D, Sundh V, Blomstrand A, Björkelund C. Well-being and mental stress in the Population Study of Women in Gothenburg, Sweden: 36-year trends and socioeconomic disparities. Submitted.

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ABBREVIATIONS

BMI	Body Mass Index
BP	Blood pressure
BMISDS	Body Mass Index Standard Deviation Score
CI	Confidence intervals
CHC	Child Health Centres
CVD	Cardiovascular disease
GP	General Practitioner
GQL	Gothenburg Quality of Life Instrument
NCDs	Non-communicable diseases
OR	Odds ratio
PA	Physical activity
PCC	Primary Care Centre
PSWG	Population Study of Women in Gothenburg
RCT	Randomized Controlled Trial
SRH	Self-rated health
SEP	Socioeconomic position
SES	Socioeconomic status
WC	Waist circumference
WHO	World Health Organization

PREFACE

I studied Medicine at Lund University and took my examination in 1997. I have always been more interested in how to promote health and prevent illness, before that just treating diseases. During my education in Lund, I always missed the salutogenic perspective as an approach to illness in general. I think that the greatest challenge is to work for greater equality in life circumstances and to promote health for all residents in Sweden. With my research I want to highlight the socioeconomic aspects of lifestyle and women's health.

After two years in Norway working as doctor in training (AT-läkare), I returned to my hometown, Gothenburg. I worked for several years at primary health care centres as a doctor (ST-läkare). What I reflected a great deal about was the importance of living habits in people's lives. The knowledge gained from teamwork within the primary health care centre increased my interest in methods to facilitate health promotion interventions. I appreciated the close collaboration with the "lifestyle nurse".

My research actually started with a project (ST-arbete). My colleague Maria Johansson and I studied the prevalence of overweight and obesity among four-year-old children and association with socioeconomic factors. My journey had begun.

After a while I had the opportunity to become a PhD-student at the Department of Primary Health Care. I had the honour to work with Cecilia Björkelund, Ann Blomstrand and Tine Högberg within the "Pro-Health" (Hälsolyftet) project. My focus was to study the participants in the "Pro-Health" programme and the importance of socioeconomic factors. During several years we arranged health educations for health care personnel. Many new questions were raised.

Physical activity and its positive effects on health have always been important for me. The Population Study of Women in Gothenburg (PSWG) was started in Gothenburg by Calle Bengtsson, in 1968. This is a world-unique population survey that celebrated its 50 year jubilee last year. Thanks to this survey I had the opportunity to continue to work with research questions related to physical activity, well-being, mental stress and socioeconomic aspects. I feel a tremendous gratitude for having been included in this research group.

Now I am approaching the end of this journey. This thesis contains a description of the prevalence of overweight and obesity among four-year-old children and socioeconomic aspects. It also reports the results concerning the importance of socioeconomic aspects within “Pro-Health” (Hälsolyftet). Finally, I report the results from the Population Study of Women in Gothenburg, regarding physical activity, well-being, mental stress and socioeconomic aspects.

INTRODUCTION

This thesis is about health in a socioeconomic perspective and health promotion work from a primary care perspective. How do we work to create equal health for the entire population? How can health care motivate the individual to make health-promoting choices? It also deals specifically with women's living conditions and the development of healthy lifestyle factors. Socioeconomic aspects of lifestyle will be highlighted.

Health

The WHO definition of health from 1948 is: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (1). In 1978 the Declaration of Alma Ata was adopted at the International Conference of Primary Health Care. This declaration pronounced the need of action by governments, health care workers and the world community to promote health of all people. WHO's goal was "Health For All".

Figure 1 shows the main determinants of health (2). The different levels are:

- **General socioeconomic, cultural and environmental conditions:**

The major structural environment. Changes here require national or international political actions.

- **Living and working conditions:**

These conditions are determined by various sectors such as education, work environment, unemployment, health care and housing. Improvement here occurs through healthy strategies within the framework of each sector. Processes at national, regional or local level are developed.

- **Social and community networks:**

Support from family, friends and neighbours is strengthened. These strategies are developed to strengthen individuals' own defence against health hazards.

- **Individual lifestyle factors:**

The areas where individuals have a choice. The focus would include support aimed at groups with the unhealthiest lifestyles.

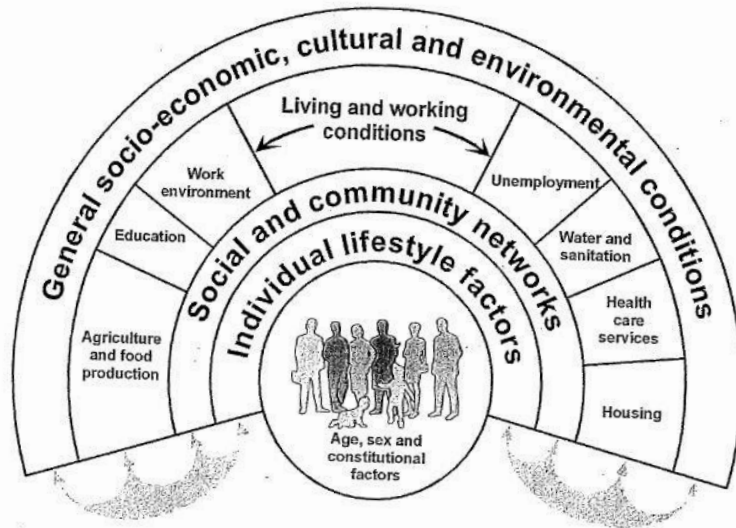


Figure 1. The main determinants of health (2).

A corner-stone in public health work is to reduce the social inequities in health. Efforts at all the above shown levels would be most effective.

Socioeconomic aspects

One of the first to study social determinants of health was Jerry Morris in London (3). He noted in 1949 that sedentary drivers of London's double-decker buses had a higher proportion of cardiovascular diseases (CVD) than conductors who went around selling tickets and climbed the stairs (3).

In the longitudinal Whitehall II study (4), lifestyle factors such as smoking, alcohol consumption, diet and physical activity explained much of social

inequalities in all-cause mortality. The results showed a social gradient in mortality; lower socioeconomic position (SEP) was associated with higher mortality.

In 2008, the report "Closing the gap" from WHO was published with Professor Michael Marmot as chairman of the Commission. Within and between the studied countries, very large health disparities were demonstrated, closely related to social conditions, called social determinants (5-7). The report called for further research regarding the determinants of health and health promotion/prevention initiatives globally (7).

Equal health and care are at the heart of the Health Care Act. In all countries, health and illness follow a social gradient: the lower the socioeconomic position, the worse the health. The following is a quote from the WHO Health Care Act: *"This is about social justice. Social injustice is killing people"* (7).

Noncommunicable diseases (NCDs) such as cardiovascular diseases, cancer, diabetes and pulmonary diseases are the principal causes of death globally (8). NCDs are caused and aggravated, to a great degree, by the following four behavioural factors: tobacco use, unhealthy diet, physical inactivity and alcohol. These factors are responsible for around 80% of cardiovascular diseases and 30% of all cancer (8).

A prerequisite for effective prevention is that preventive actions in health care, mainly primary health care, can reach the most socially vulnerable groups. Socioeconomic status is shown to be an independent predictor of all-cause mortality (9). High socioeconomic status has been shown to be associated with a lower risk of cardiovascular disease (CVD) (10), but not cancer. An association is observed between living in a low socioeconomic status (SES) area and less daily physical activity (PA) and lower fitness (11). The prevalence of obesity and many other lifestyle parameters in children vary among children with different socioeconomic status (12, 13).

There is a strong connection between social factors and unhealthy living habits (14). For example, people with lower education have poorer eating habits and are less physically active than those with higher education. The health gaps based on education grow, while the average health of the population is increasing, also in Sweden (15). Life expectancy is increasing in Sweden, but clear differences remain, and life expectancy coincides with socioeconomic conditions (16).

Social and cultural factors can be obstacles to lifestyle changes. Health care can, to a greater extent, help patients to change their lifestyle if these social and cultural barriers are identified (17).

WHO has called on its member countries to establish a system to systematically monitor health inequalities (7). This is not yet available on a national basis in Sweden, but some regional and local public health reports have been established. The city of Malmö has initiated a commission, i.e. The Commission for a Socially Sustainable Malmö (15). The commission's report contains recommendations for how to reduce social inequalities in health.

Gothenburg as well has produced a report, i.e. Inequality in Living Conditions and Health in Gothenburg 2014 (18). The report shows major differences in health and living conditions in different parts of Gothenburg. Among other findings, there is a large difference in average life expectancy between different areas - 9 years difference for men and 7.5 years difference for women. Many suggestions are presented that, if improved, can together change the image of a segregated city. Intervention in early childhood is recommended. Health should be improved more quickly for those groups who are particularly vulnerable (18).

Socioeconomic definitions

There are several different indicators used to define socioeconomic position (19). The specific research question should determine which one to use. Different definitions are used during different life courses. Education, income/household income, occupation and employment are common socioeconomic position (SEP) indicators (18).

Childhood obesity - Socioeconomic aspects

Definitions

The term childhood is the age span from birth to 18 years of age. The World Health Organization (WHO) has defined obesity as a condition of excessive or

abnormal fat accumulation in adipose tissue, to the extent that health may be impaired (20).

The most used method for classification of overweight and obesity is Body Mass Index (BMI), especially on the population level. The definition is weight in kilograms divided by the square of height in metres (kg/m^2). BMI 25-29.9 is classified as overweight and > 29.9 is obesity, as defined by WHO (20).

In children, BMI changes with age. A workshop organized by the International Obesity Task Force (IOTF) developed age- and sex-specific BMI reference curves for children (21). This was established by Cole et al. in 2000. The background was six large studies from United States, Singapore, the Netherlands, Hong Kong, Great Britain and Brazil (21). Cut off points for children (2-18 years) concerning overweight and obesity were created corresponding to adult BMI at age 18 ($25 \text{ kg}/\text{m}^2$ for overweight and $30 \text{ kg}/\text{m}^2$ for obesity).

Other methods concerning adults, such as waist circumference (WC) and waist-hip ratio (WHR) are valuable and show index of intra-abdominal fat mass (22).

Prevalence

An increase in the prevalence of overweight and obesity among children has occurred since the 1980s in most parts of the world (23-26). In the United States, the prevalence of overweight and obesity from 5 to 17 years was 32% in 2004 (26). A longitudinal study showed that children with low SEP had 3 to 4 times higher odds of obesity than children with higher SEP (27).

The prevalence of childhood overweight and obesity was estimated to more than 40% in countries in southern Europe (28). In northern Europe, the prevalence of overweight and obesity was around 10%. Higher levels were found in populations with lower SEP (28).

Also in Sweden, the prevalence of overweight and obesity has increased in 10-year-old children (29) and was 21% in 2000. Results from a large global study showed that in 2017, 20% of girls and 25% of boys in Sweden had overweight/obesity (30). A low socioeconomic level of residential area seems to be associated with a higher prevalence of obesity (31-33).

Consequences

Regarding the long-term consequences of childhood obesity, there is a marked increased risk of being overweight/obese even in adulthood (34). A child with obesity has an increased risk of developing cardiovascular risk factors such as hypertension, dyslipidaemia and left ventricular dysfunction (35). Other diseases such as diabetes mellitus, liver disease, cancer, sleep apnea and psychosocial problems are associated with obesity as well (35).

Insulin resistance and type 2 diabetes are associated with obesity and are of particular concern because of their role in the pathogenesis of obesity-associated diseases (36). Insulin resistance is present in many children with overweight and obesity (37).

In order to develop effective prevention programmes, we need to gain more knowledge about the determinants of obesity in different population groups. Environmental and socioeconomic factors are important (38). Focusing on the obesogenic environment is a systemic approach that may be best suited for low SES communities.

Ethical aspects

There are great ethical issues concerning lifestyle changes, health promotion activities and community and health care preventive interventions. What is the best way to work with health promotion within the framework provided by our medical ethical rules (39)?

How do we reconcile these two aspects?

A physician has ethical rules as the basis for all work:

Rule 6: The Principles of Autonomy. Treat the patient with empathy, care and respect. The doctor must not infringe on the patient's right to decide on him/herself.

Rule 9: The doctor should not without examination or other sufficient knowledge of the patient give advice or prescriptions.

The Danish philosopher Søren Kierkegaard wrote a poem, published in 1859: "To help is to understand" (40). He described: "In order truly to help someone else, I must understand what he understands. Take Care to Find Him Where He is and Begin There."

The important issue is:

Health care needs to show every individual a respectful treatment. We have to find out where the patient is and start there. We should actively show that we hear, listen to and respect what the person says.

- Listen to and work with summaries and reflections. Confirm how the patient thinks.
- Ask for permission to inform. "Permission to ask".
- Work with motivation, starting from Prochaska DiClemente's wheel of change (Figure 2) (41, 42).

It is very important to have this way of thinking, when working with health promotion! Motivational interviewing is used as a technique for behavioural change and is based on theories of Stages of Changes (43).

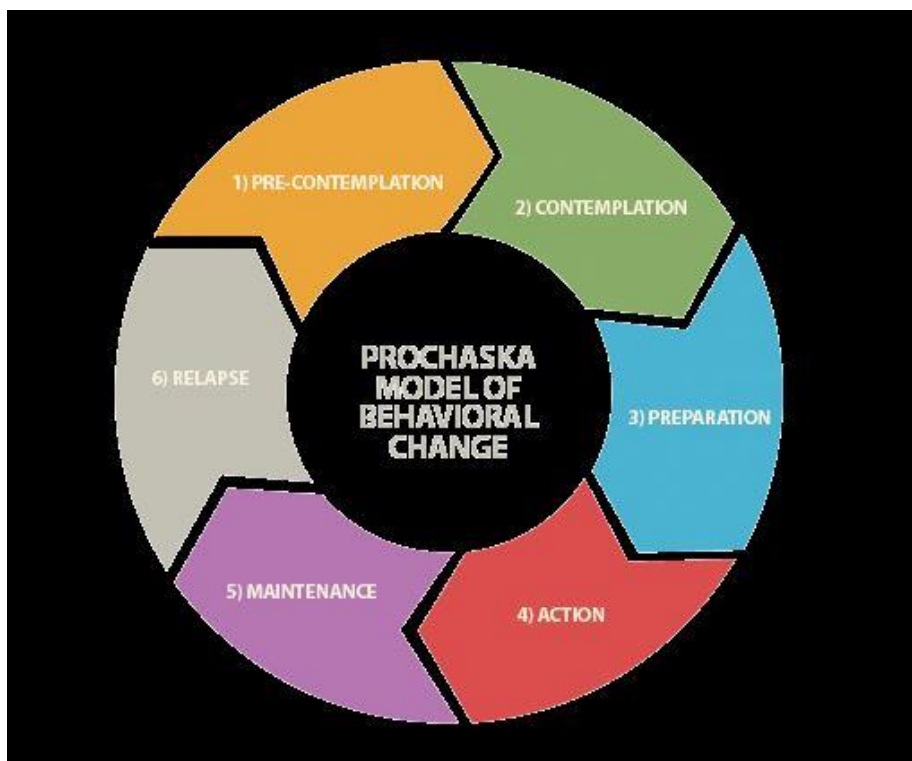


Figure 2. Prochaska di Clemente's, Stages of Change Model (42).

Promotion and prevention

In Sweden, unhealthy living habits, such as tobacco use, physical inactivity, unhealthy diet and hazardous alcohol consumption, contribute most to the overall disease burden (44). According to the Health and Medical Services Act (Swedish Code of Statutes 1982:763 and 2017:30) (45, 46), disease prevention is a part of the health care work. Illness prevention needs therefore to become an integral part of the health care work, and especially in primary care (8).

During the recent decades, the role of primary health care in the medical prevention of chronic diseases has been successful. This applies, for example, to the treatment of hypertension, high blood lipids, chronic obstructive pulmonary disorders and high blood sugar levels. In contrast, the non-pharmacological prevention and health promotion activities have been less

successful. The proportion of people with overweight and obesity is increasing in Sweden (47) and was 51% on the population level in 2018. The same proportion was observed in 18-year-old men (48).

The Cochrane Institute (49) has published a review concerning which groups are best reached for successful lifestyle prevention regarding cardiovascular disease (CVD). Evidence showed that intervention with counselling and education concerning lifestyle changes does not reduce mortality when directed to persons without risk factors as hypertension and diabetes. However, there are significant effects on total mortality and cardiovascular morbidity, when these interventions are directed to people with CVD risk factors. A systematic review of lifestyle interventions in primary care (50) showed the same.

The knowledge that healthy lifestyle can prevent 80 % of all coronary heart disease and stroke and 30 % of all cancer has been present for a long time (44). The major public health problems such as diabetes, CVD including myocardial infarction and stroke, are associated with lifestyle.

The work to develop methods for the support of individuals' lifestyle change has no obvious position in health care. In 2011 and 2018, The National Board of Health and Welfare produced national guidelines for disease prevention methods (44, 51). These guidelines were added as a follow-up to Swedish agency for health technology assessment's compilation of literature on evidence regarding methods of lifestyle changes, concerning PA (52, 53).

These guidelines consist of counselling methods that aim to change the patient's lifestyle. The methods support lifestyle change in patients who smoke, use alcohol hazardously, have insufficient physical activity or have unhealthy eating habits. The base for the preventive work is counselling dialogue. Health promotion dialogue supports the individuals' ability to increase control over their own health and to improve it (52, 54).

Primary care requires advanced research to further develop methods that facilitate individuals' efforts to change unhealthy living habits. This can lead to long-term savings in the form of reduced health care costs for lifestyle-related illnesses (51).

However, these guidelines do not contain recommendations about how or when health care should ask questions about lifestyle (51).

The National Board of Health and Welfare emphasizes in particular the importance of working to change the living habits of the following risk groups:

- adults with special risks, social vulnerability
- adults who will undergo surgery
- children and young people under 18 years
- pregnant women.

Prevention is a broad concept that encompasses all types of measures to prevent ill health. These measures are often divided into the concepts of primary, secondary and tertiary prevention.

The public health definition of primary prevention refers to measures to prevent illness, that is, reduce the incidence. Secondary prevention refers to early diagnosis and treatment of illness, that is, reduce the prevalence. Tertiary prevention is about rehabilitation of disease, reducing complications. In the medical context, primary prevention refers to the treatment of risk factors for disease prevention. Secondary prevention here refers to efforts to reduce the risk of worsening disease (55). Both these definitions are used in primary care.

Primary care

Evidence shows that health care systems organized with primary care as a base provide better health (7).

Collaboration among government, parliament, authorities, municipalities and voluntary organizations is required for effective prevention work. Measures at all levels are necessary. Primary care has for a long time been considered to have a special role in preventive work, as it is the first instance in the meeting with the population. Multidisciplinary teams that are organized to collaborate with social services are required.

The potential importance of prevention for public health is great. In 1972 the North Karelia Project started in Finland (56). Chronic disease prevention and health promotion were established. In Denmark the RCT, Ebeltoft Health Promotion Project (57), showed positive effects on cardiovascular risk scores.

Also in Sweden, there are several examples of structured prevention programmes in primary care (58-67). Most of these target CVD and diabetes.

In Norsjö (58, 59), Sollentuna (60, 61), Strömstad (62, 63), Skaraborg (64, 65), Hisingen (66) and Stockholm (67), prevention programmes have combined individual- and population-oriented work.

Evaluations show that the population welcomes preventative efforts and that preventive work can be carried out without causing undue concern. A large proportion of the population would like the health care staff to ask about their living habits (68). Despite this, only 30 percent of patients who have sought care in the past year report that the staff has done so (68). A large proportion of physicians and nurses feel that they lack expertise in lifestyle counseling (69).

- **Norsjö** (58, 59): VIP, Västerbotten Intervention Program started in Norsjö, in 1985. All inhabitants were/are called to health surveys at the primary care centre at the age of 30, 40, 50 and 60 years. Evaluations have shown very good results, including reduced cholesterol and blood pressure levels.
- **Sollentuna** (60, 61): A prevention programme for cardiovascular disease in the primary care organization was initiated in Sollentuna, in 1988. During 4 years, 5622 persons participated and cholesterol, triglycerides and blood pressure levels were significantly reduced.
- **Strömstad** (62, 63): All women aged 45-64 were invited to health survey in 1985. The main purpose was to reduce risk factors for cardiovascular and cerebrovascular disease. Women who attended were offered a three-month group course (changing dietary and physical exercise patterns). The participants changed their habits and risk factor levels significantly compared to the non-participants. The participants with multiple risk factors reduced their risk most.
- **Skaraborg** (64, 65): An intervention program called “Live for Life” started in Habo, in 1988. It contained a population strategy and individual health examinations. This program resulted in improved dietary habits, reduced smoking and blood pressure levels. Decreased mortality from ischaemic heart disease in 1984-1996 was observed.

- **Hisingen, Pro-Health** (66): A low-budget lifestyle-improvement method was successfully implemented at Hisingen, Gothenburg in 2007. Men and women aged 18-79 visiting any of the eight PCCs were offered health questionnaires and health profiles. Reductions in BMI, WC, WHR, BP and p-glucose were observed at the 1-year follow-up.
- **Stockholm** (67): A structured intervention programme on lifestyle habits and quality of life was initiated in 2008. Individual visits as well as group sessions were offered by inter-professional teams. The one-year follow-up showed improved lifestyle habits and quality of life.

Physical activity - Socioeconomic aspects

A physically active lifestyle shows a positive association with a good health. Physical activity (PA) reduces the risk of cardiovascular diseases, type 2 diabetes, hypertension, breast/colon cancer and depression (70). WHO has stated that physical inactivity is the fourth leading risk factor for mortality (70). Physical inactivity is estimated to be the largest public health problem in the 21st century (71).

Worldwide data shows that most young people and one third of adults do not reach the public health recommended levels of physical activity (72).

Cardiorespiratory fitness (strong predictor of morbidities and mortality) protects against the effects of other health risks on mortality such as smoking and high blood pressure (73). A large cohort study from 1995 to 2017, showed a significant decline in cardiorespiratory fitness, in Swedish adults (74).

It is important to note that all movement is counted (75). Although adults' leisure time physical activity has increased over the past 20-30 years, many studies report a decline in occupational physical activity (72, 76, 77). Therefore, a decreasing trend of total PA is observed (76).

Many studies show that we are increasingly sedentary at the same time as our fitness has generally deteriorated (74, 78). There is a strong link to socioeconomic factors (79, 80). Lower socioeconomic groups have a higher

risk of being less physically active during leisure time. Living in a low SES area is associated with significantly lower mean PA levels (11).

Studies from Denmark and Finland show that leisure time physical activity levels have increased in recent years (81, 82). At the same time, studies from Finland and Norway show that levels of occupational physical activity have decreased in recent years (82, 83).

In Sweden, longitudinal studies show a trend of increasing levels of leisure time physical activity (84-86). At the same time, the 2014 Eurobarometer showed that Sweden was one of the countries with the lowest daily physical activity in Europe (87).

A nationwide study showed that only 7% of Swedes (50 to 64 years) reached the recommended daily physical activity level - 150 minutes/week (moderate- and vigorous intensity PA) (88).

Measuring physical activity

It is difficult to measure physical activity well (52, 53). Questionnaires are often used. More objective measurement methods are pedometers, mobile phones and accelerometers (52, 86). The most evaluated and used bicycle test is Åstrand. It was developed already in the 1950s. A special network has been started for objective motion measurement (89).

Effects of physical activity

A strong association has been confirmed between leisure time PA and well-being in women (90). Many population-based studies show that increased PA is associated with decreased risk of CVD and all-cause mortality (73, 91). The specific mechanisms underlying this association are not entirely clear, but improvement in known cardiovascular risk factors is shown to mediate this effect (92). Some examples of physical activity effects are lowered blood pressure, cholesterol (total and LDL) and inflammatory factors (92). A systematic review shows that regular moderately intense physical activity is associated with a lower risk of type 2 diabetes (93). Higher cardiorespiratory fitness appears to have a protective effect during periods of high stress. One study showed that participants with high perceived stress did not show

increased metabolic risk factors if they had high cardiorespiratory fitness levels (94).

Other salutogenic effects of physical activity are: increased stress tolerance, improved mental health, improved sleep, decreased arteriosclerosis, formation of new brain cells and osteoporosis prevention (95).

Women's health - Socioeconomic aspects

WHO performed a worldwide study, the World Health Survey, in 2004 with over 220 000 women and men from 57 countries. Women from all age groups 18-70 years reported poorer health compared to men (96). Social, cultural, economic and biological factors were considered to be underlying causes of the inequality of health status (96). Also, in the European Quality of Life Survey, major educational differences in self-rated health (SRH) regarding gender and countries were observed (97).

Self-rated health - SRH

Self-rated health (SRH) is the most widely used health measurement and recommended by WHO for health monitoring (98). SRH is a strong and independent predictor of mortality (99, 100). A population-based study showed a significant association between low SRH and higher use of social insurance facilities and health care services (101).

Women's health in Sweden

In Sweden, women's health situation has improved in recent decades (102). Among other aspects, it is reported that the life expectancy of women has increased by 2 years, since 1990 (102). In the National Public Health Report from 2019, it is stated that the self-estimated health of the population (35-74 years) has increased (16). However, it appears that there are differences between different educational groups. Higher educational level is associated with a greater proportion who estimate their health as good or very good (16).

The work situation for women has changed significantly (103). Increasing opportunities for education have affected women's employment possibilities. The employment rate was about 50% in the 1970s. This can be compared to 75% full time ($\geq 35\text{h/week}$) in 2016.

A large increase in perceived mental stress in middle-aged women is reported (104). In the 1960s, 25% reported anxiety and mental stress compared to 75% in 2004 (104). Meanwhile, during the corresponding time period, it was found that perceived stress levels in middle-aged men remained unchanged at a low level, 17% (105).

Perceived health, well-being and mental stress are strongly associated factors (106). Socioeconomic differences are reported, such as that cardiovascular diseases and diabetes are more common among lower educated (14). Social differences in life expectancy increased from 1986 to 2007, mainly in women (14).

AIM OF THE THESIS

General aims

To study the impact of socioeconomic aspects on lifestyle development, lifestyle effects and lifestyle changes in relation to physical activity, well-being and mental stress.

Specific aims

Study I

To assess early growth characteristics and socioeconomic factors in relation to body mass index (BMI) and presence of overweight among 4-year-old children examined at Child Health Centres (CHC).

Study II

To explore whether a primary care lifestyle programme reached and engaged socioeconomically vulnerable groups to the same extent as higher socioeconomic groups.

Study III

To examine trends in physical activity in relation to socioeconomic position in middle-aged women.

Study IV

To monitor trends in well-being and mental stress among middle-aged women and their associations with socioeconomic position.

MATERIAL AND METHODS

Studies I-IV

Table 1. Studies in this thesis

	Study I	Study II	Study III	Study IV
Time	2006 - 2010	2007 - 2008	1980 - 2004	1980 - 2016
Status	Published	Published	Published	Submitted
Design	Retrospective, cross-sectional, comparative study observational	Prospective, comparative study observational	Cohort comparison study, observational	Cohort comparison study, observational
Outcomes	Overweight Socioeconomic factors	Reachability - Pro-Health Engagement - Pro-Health Socioeconomic factors	Physical activity Socioeconomic position	Well-being Mental stress Socioeconomic position
Study sample	309 four-year-olds from primary care	2124 participants (18-79) from Pro-Health	977 women - from Population Study of Women in Gothenburg	1550 women - from Population Study of Women in Gothenburg
Data collection method	Medical records	Self-reported questionnaires	Self-reported questionnaires	Self-reported questionnaires
Data analysis	Descriptive Comparative	Descriptive Comparative	Descriptive Comparative	Descriptive Comparative

Study I Design

Paper I is a retrospective, cross-sectional, comparative study concerning overweight among 4-year-old children and association to socioeconomic factors.

Study population

In Sweden, the participation of children at the Primary Care - Child Health Centre (CHC, in Swedish: BVC) is nearly 100% among children living in a Primary Care Centre (PCC) area. The child health record is established for all newborns and contains growth data from birth and onwards. In the CHC, specialised district nurses are responsible for health check-ups of the children living within a certain area. The children attend health check-ups at specific ages. At four years of age an important check-up is conducted routinely for all the children registered at the CHC.

In the present study two different CHC-cohorts were investigated: District A – CHC and District B – CHC. The data were collected from the child health records. In District A, 234 4-year-old children were invited for the regular check-up and of those 224 (96%) attended. In District B, 90 4-year-old children were invited for the check-up and of those 85 (94%) attended.

Variables

The data were collected from the child health records. Height was measured to the nearest 0.5 cm, with the child in standing position. Weight was measured with the child in light clothing to the nearest 0.1 kilogram on an electronic scale, which was calibrated at regular intervals. Overweight was defined by using the BMI cut-offs established by IOTF (21). The individual BMI values were also converted into a BMI standard deviation score (BMISDS) (107). In addition, information concerning duration of breastfeeding and maternal smoking during pregnancy was collected.

Child Health Centres (CHCs)

Children from two CHCs were analysed in the study: District A CHC and District B CHC. The CHCs were selected in order to provide two populations featuring dissimilar socioeconomic characteristics (108). The demographic characteristics of the two districts are presented in Table 2.

Table 2. Demographic- and socioeconomic characteristics of the populations in the two districts.

	District A (dA)	District B (dB)	P-value
Number of inhabitants	27163	19909	
Inhabitants born abroad, <i>n</i> (%)	2321 (8.5)	929 (4.6)	<.0001
Unemployment, <i>n</i> (%)	1062 (3.9)	534 (2.7)	<.0001
Index for "unhealthy rate"	51.4	23.2	*
Higher education (>12 years), <i>n</i> (%)	2865 (10.5)	4794 (24.1)	<.0001
Income (Mean, Swedish Crowns per year)	177000	256000	*
Inhabitants on sick leave for more than one year, <i>n</i> (%)	2330 (8.6)	768 (3.8)	<.0001

*P-value could not be estimated since only mean values were available and not the distributions.

Socioeconomic factors

We obtained this information from the City Office Gothenburg, Statistics derived from 2004 (108).

In District A (dA), significantly more inhabitants were born abroad and were unemployed compared to district B (dB).

In addition, fewer inhabitants had completed 12 years of school in dA than in dB. Furthermore, in dA, significantly more inhabitants were on sick leave for more than one year.

Study II Design

Paper II is a prospective, comparative, observational study with the aim to examine the impact of socioeconomic factors on the outcome of a person-centred lifestyle intervention programme.

“Pro-Health” intervention programme

The “Pro-Health” intervention programme consists of four parts: **Health questionnaire, health profile, health dialogue** and **health desks**. The “Pro-Health” is a person-centred method that starts off an educational process. If the person is not motivated to take part at one occasion, he/she can always return later on.

Study population

A health-promotion programme, “Pro-Health”, for lifestyle changes in primary health care, was initiated in 2007-2008, at Hisingen, Gothenburg. The demographics of Hisingen are representative of Gothenburg as a whole. There are both high- and low- income populations and high morbidity in some areas.

The study was carried out as follows: All men and women aged 18-79 visiting any of the eight public primary care centres (PCCs) during an eight month period were offered a health questionnaire.

Among all visitors at the PCCs (Figure 3), 7789 individuals were interested in a lifestyle intervention and among these, 3687 participated at baseline in a health dialogue (with health profile). 2121 individuals returned and participated at one-year follow-up.

The 3687 participants at baseline (in the health dialogue) responded to a questionnaire regarding four socioeconomic factors; education, employment, ethnicity and living situation.

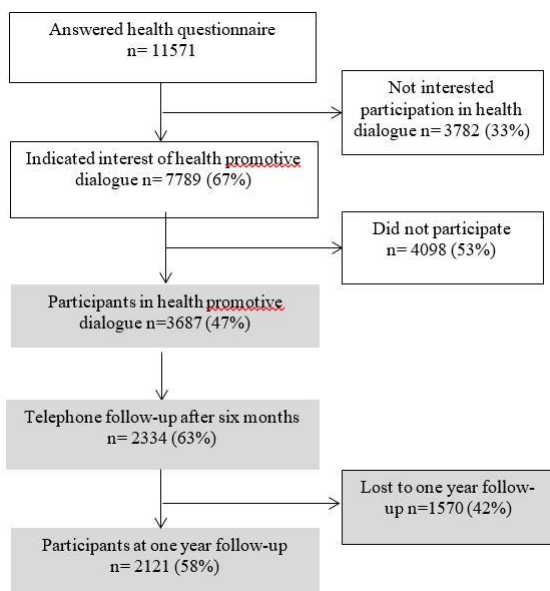


Figure 3. Description of the participants in the “Pro-Health” intervention programme. The present study deals with participants in the health dialogue and participants in the one-year follow-up (grey colour).

Health questionnaire

The health questionnaire (Figure 4) was used as an instrument to initiate reflection about the participant's own lifestyle. The intention was to start a motivational process for lifestyle changes. This questionnaire was distributed at the PCC's reception desk and answered voluntarily and anonymously with “yes”, “no” or “don't know” response options. The health questionnaire consisted of ten questions concerning lifestyle, including physical activity, smoking, alcohol intake, mental stress and dietary habits, among others. One question was about readiness/motivation to start lifestyle change. After the final question, the patient could continue and ask for a health profile and health dialogue (with blood pressure and blood sugar check) or refrain from further participation.



Engelska

Questions about your lifestyle

Circle your answer

Are you not physically active enough? Yes..... No..... Don't know

Do you smoke or use snuff? Yes..... No

Do you experience stress at work several times per week?..... Yes..... No..... Don't know

Do you experience stress during your leisure time
several times per week?..... Yes..... No..... Don't know

Have you felt that you should cut down
on your alcohol consumption? Yes..... No..... Don't know

Do you have problems with sleep?..... Yes..... No..... Don't know

Do you consider yourself overweight?..... Yes..... No..... Don't know

Do you eat too much fat? Yes..... No..... Don't know

Do you not eat enough fibre? Yes..... No..... Don't know

Do you eat/drink sweet products too much?..... Yes..... No..... Don't know

Do any of your parents and/or siblings have diabetes or high blood pressure or have they had a
heart attack, stroke or vascular cramps in their legs?
..... Yes..... No..... Don't know

How much can you engage in changing your lifestyle now based on your current life situation (family,
work, leisure, etc.)?

Mark your respons in the boxes below:

Not at all	Very little	Neither a little nor a lot	Quite a lot	A lot
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Created by General Practitioner Ann Blomstrand.

Figure 4. Description of the health questionnaire in “Pro-Health” intervention programme.

Health profile

The health profile was self-administered. The participant carried out the health profile at home and the duration was around 60 minutes (of reflection). The only things that were needed were a pencil and measuring tape. The health profile consisted of eight separate folders concerning lifestyle. The answers from each folder were converted into self-instructive health profile measures. These measures were classified as “good”, “less good” or “risk” corresponding to green, yellow or red fields (109-111).

The folders represented: physical activity, smoking, alcohol intake, mental stress, dietary habits, living conditions (one for employed and one for job seekers), waist-hip ratio (WHR) and well-being. Each folder ended with simple information concerning how to change to better habits.

Health dialogue

The health dialogue was conducted by a nurse and lasted for about 30-60 minutes, after the participant had completed a health profile. The health profile was the starting point of the health dialogue. Biological variables, i.e. systolic and diastolic blood pressure, capillary non-fasting p-glucose, weight, waist circumference (WC) and waist-hip ratio (WHR), were measured at baseline and at the one-year follow-up. These parameters were included in the method. The participants were informed that they would receive a telephone follow-up by the same nurse after 6 months and that they were expected to attend the one-year follow-up (with another health profile).

Health desks

After the health dialogue, the participants could choose either activities on their own, or help within the PCC or contact with municipality health desks. Within the PCC, participants were offered, for example, stop-smoking groups, overweight groups and individual help for those with hazardous drinking. The municipality health desks offered, for example, physical training groups and anti-stress groups.

Socioeconomic factors

The 3687 participants at baseline (in the health dialogue) responded to a questionnaire regarding four socioeconomic factors, i.e. education, employment, ethnicity and living situation. Socioeconomic vulnerability was determined as having three or more out of four of the following socioeconomic vulnerability factors: 1. low education (\leq nine years in primary school), 2. unemployed or being on sick-leave at the time of health dialogue, 3. born outside Scandinavia and 4. living alone (112, 113)

Reachability

The socioeconomic factors among the participants in “Pro-Health” were studied. The distribution of socioeconomic factors in the population of Hisingen was also documented (Table 6).

These two were compared.

Reachability was determined as follows: proportion of those participating in “Pro-Health” study compared to municipality level and- examined by comparing the distribution of socioeconomic factors to Hisingen population statistics in 2007.

Engagement

Engagement was determined as follows: change in risk factors and lifestyle after participation in “Pro-Health” 2007-2008. The degree of change in variables (biological and health profile) one year after baseline examination was examined in relation to socioeconomic factors. Different vulnerability groups were compared (Table 8).

Study III Design

Papers III and IV are based on the Population Study of Women in Gothenburg (PSWG). Paper III is a cohort comparison study with the aim to study secular trends in physical activity in relation to socioeconomic position in middle-aged women.

Study population

A population-based study started in Gothenburg in 1968. This was one of the few epidemiological studies at that time that was based entirely on women. The sample of participants was identified from the Revenue Office Register. The sampling method was based on date of birth. Women born on day 6,12,18,24 or 30 of each month of year 1908, 1914, 1918, 1922, and 1930 were invited.

All participants would be almost exactly the same age at the time of the examination. The examinations were performed at the time of the women's age + 6 months: thus the examination period started in the autumn of the examination year and extended to late spring of the following year. For simplification purposes, examination year 1968-69 is in this thesis indicated 1968 and 1980-81 is indicated as 1980, 2004-05 as 2004, etc.

The survey was performed during a ~12-month period and 1462 women participated (participation rate 90%). This sample of women was a representative cohort of women in Gothenburg at the time. Follow-up examinations have been carried out in 1974, 1980, 1992, 2000, 2004 and 2016, using the same procedure.

The investigations were carried out as follows: An invitation to a health examination was sent out to the selected population. Those women who responded and accepted to participate were sent a general questionnaire regarding medical and social information. The participants arrived fasting in the morning and were interviewed and examined at different examination stations following a special schedule. Physical examinations were performed at the different stations by a nurse, a dentist and a physician. Electrocardiogram (ECG), blood pressure, blood and urine sampling were obtained together with questionnaires that included social, behavioural, diet and medical questions among others. The dental surveys included a radiographic survey. Each participant spent around 4 hours (including breakfast) at the examinations.

Women in the study who were identified as in need of further care were referred to a general practitioner or another specialist.

For the present study, we retrieved data on randomized samples of 38- and 50-year-old women who were examined in 1980 and in 2004 (Figure 5). The participation rate was 84% in 1980 and 59% in 2004.

Due to large changes in the Swedish educational system and women’s employment patterns between the 1960s and 1980s, it was not meaningful to include earlier-born cohorts.

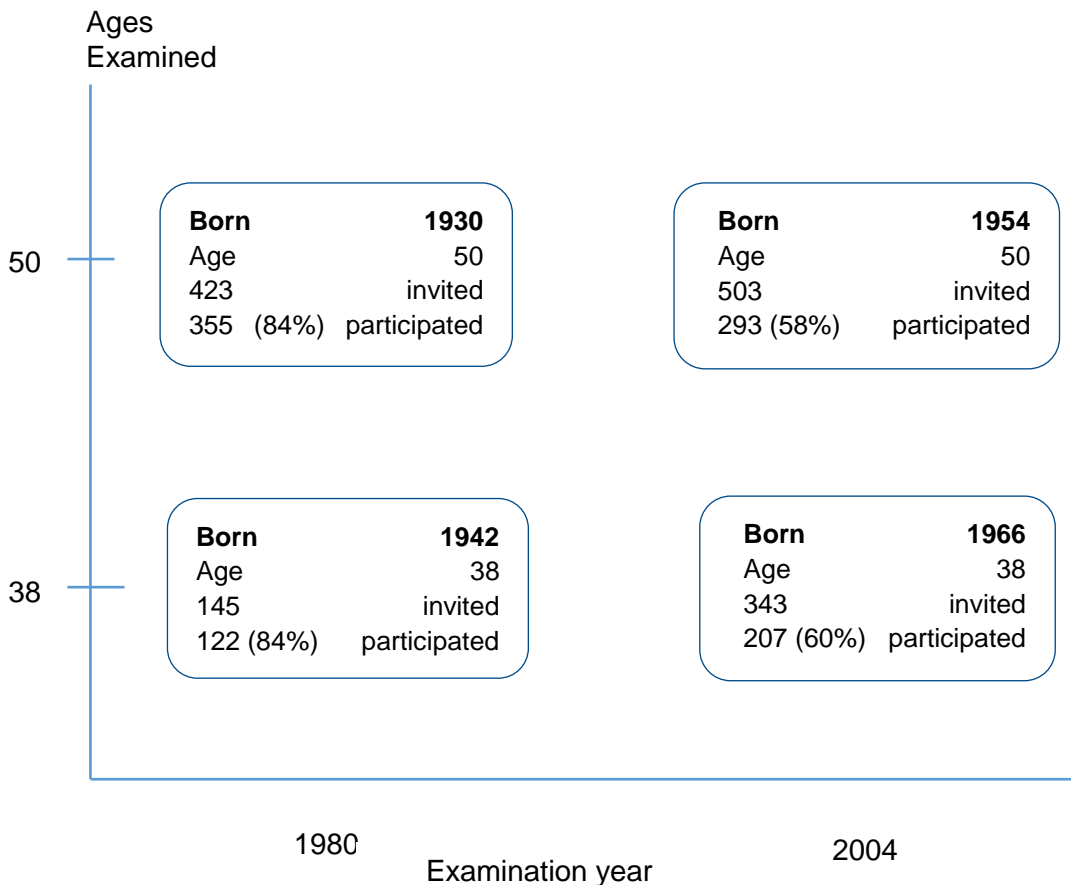


Figure 5. Description of the 38- and 50-year-old age groups of women examined in the Population Study of Women in 1980 and 2004.

The study population in 1980 was $n = 477$; the 38-year-old women were born in 1942 ($n = 122$) and the 50-year-old women were born in 1930 ($n = 355$). The study population in 2004 was $n = 500$; the 38-year-old women were born in 1966 ($n = 207$) and the 50-year-old women were born in 1954 ($n = 293$).

Physical activity indicator

The physical activity questionnaire was developed to describe physical activity during leisure time and at work in population studies in Gothenburg. This was based on the method described by Saltin and Grimby in 1968 (114). The questionnaire has been evaluated and found to discriminate activity levels correct as compared with maximal oxygen uptake (115). Participants were interviewed by a physician and classified by this method into physical activity groups.

Four activity groups were classified with respect to physical activity – during leisure time: (I) low physical activity, being almost totally inactive, (II) intermediate, indicating some physical activity for at least 4 hours per week, e.g. walking or bicycling, (III) high, meaning regular physical activity e.g. gymnastics, gardening, tennis or golf, (IV) very high, regular hard physical activity and competition, e.g. running or swimming several times a week.

Four activity groups were classified with respect to physical activity – at work: (I) light office work and no domestic work, (II) shop work, light industrial work or domestic work including the care of one child, (III) hospital work or domestic work including the care of two or more children, (IV) heavy work together with domestic work, or just domestic work including the care of two or more children. Changing occupation frequency in the generations of women, resulted in that unemployment or long-term sickness absence was classified as physical activity at work (daytime).

Socioeconomic position

Socioeconomic position (SEP) was determined in terms of the social and economic factors that influence the positions that women hold within the structure of the society (19). For the present study we used socio-occupational group and level of education to define socioeconomic position, as described below.

Socio-occupational group

The participants reported their occupations, and this information was used to classify them into low, medium and high occupational groups, according to Carlson's standard occupations grouping system (116). The group classification was performed according to the Swedish socioeconomic index (117), a generally accepted socio-occupational classification method.

Educational group

The participants reported years of education; this information was converted into a dichotomous variable: low and high education. In 1980, the category low education corresponded to women with primary school or less (<7 years of education). Low education in 2004 corresponded to women who had completed 12 years of education or less.

Study IV Design

Papers III and IV are based on the Population Study of Women in Gothenburg (PSWG). Paper IV is a cohort comparison study with the aim to monitor trends in well-being and mental stress and their associations with socioeconomic position in middle-aged women.

Study population

For detailed information about the PSWG, see above, Paper III.

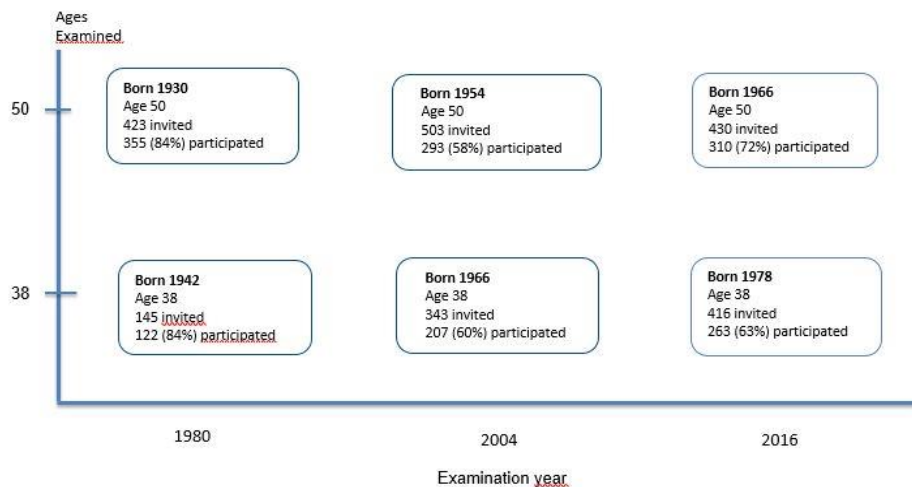


Figure 6. Description of the six 38- and 50-year-old cohorts examined in the Population Study of Women examinations in 1980, 2004 and 2016, respectively. Year of birth, number of invited women, and number of women who participated in the respective examinations.

For the present study, we retrieved data on randomized samples of 38- and 50-year-old women who were examined in 1980, 2004 and in 2016 (Figure 6). The participation rate was 84% in 1980, 59% in 2004 and 68% in 2016.

The study population in 1980 was $n = 477$, comprising 38-year-old women born in 1942 ($n = 122$) and 50-year-old women born in 1930 ($n = 355$). The

study population in 2004 was $n = 500$, comprising 38-year-old women born in 1966 ($n = 207$) and 50-year-old women born in 1954 ($n = 293$). The study population in 2016 was $n = 573$, comprising 38-year-old women born in 1978 ($n = 263$) and 50-year-old women born in 1966 ($n = 310$).

Well-being indicator

The question used (exactly the same in 1980, 2004 and 2016) regarding well-being was: “How do you experience your health situation (well-being)?”. The answers were denoted on a Likert-type scale from 1 to 7. Answer 1 corresponded to “excellent, couldn’t be better” and answer 7 corresponded to “very poor”. Well-being was dichotomised as good (scores 1-3) and poor (scores 4-7).

The question was derived from the Gothenburg Quality of Life Instrument (GQL instrument) (118) composed in the 1960s, based on WHO definition of health (1). This question was evaluated in a study (119) that confirmed high reliability. Self-estimated well-being reflected both physical and mental well-being (119).

Mental stress indicator

The participants were asked to identify their level of perceived mental stress from a questionnaire, given by the examining study physician. This question was evaluated in a study that confirmed high reliability (120). The six possible answers were: “never experienced any period of stress”, “experienced a period of stress”, “experienced a period of stress during the last 5 years”, “experienced several periods of stress during the last 5 years”, “living under constant stress during the last year” and “living under constant stress during the last 5 years”. Degree of mental stress was dichotomised as low mental stress (answers 1-3) and moderate/high (answers 4-6).

Socioeconomic position

Socioeconomic position (SEP) was determined in terms of the social and economic factors that impact the positions that participants hold within the

structure of the society (19). For the present study we used socio-occupational group to define socioeconomic position, as described below.

Socio-occupational group

The participants reported their occupations, and this information was used to categorise them into low, medium and high occupational groups, according to Carlson's standard occupations grouping system (116). The group classification was performed according to the Swedish socioeconomic index (117), a widely accepted socio-occupational classification method. This method includes the number of years that a person has worked in an occupation in combination with an individual's educational level.

Statistical analysis, Papers I-IV

Paper I

Prevalence data were analysed with descriptive statistics. The two different CHC-districts were compared, see Table 2. Fisher's exact test was used to analyse categorical dichotomous variables. Two sample t-tests were used for normally distributed variables and Mann-Whitney tests for non-normally distributed variables.

To study the relation between BMISDS (at 4-years) and predictor variables, Pearson correlation analyses were conducted. Multiple regression analysis was conducted to estimate the predictors for BMISDS (at 4-years).

Logistic regression was used and outcomes were presented as odds ratios (OR) with 95% confidence intervals (CI). The dependent variable was overweight (including the obese) at 4-years and the predictors were CHC-district (socioeconomic factor), median-birth weight, median-birth length and median-BMI at birth. Statistically significant differences were estimated at $p < 0.05$.

Paper II

Logistic regression analyses were conducted to explore odds for change/improvement (biological and health profile variables) between baseline and the one-year follow-up. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. Differences were considered statistically significant at $p < 0.05$. T-test was used for analysis of continuous variables and chi-square test for categorical variables.

To compare the change/improvement from baseline to one-year follow-up between the various socioeconomic groups, logistic regression analyses were conducted with adjustment for age and gender. Each variable was dichotomised as negative change or unchanged/positive change, and the desirable direction of each variable was identified. OR and 95% CI for direction of change (decrease or increase) was calculated.

Paper III

The association between low and high physical activity at work/leisure time and socio-occupational group/education was analysed cross-sectionally at 1980 and 2004 with Pearson Chi-Square test and reported as ORs. Logistic regression analyses were conducted to explore odds for improvement between 1980 and 2004, in terms of ORs with 95% CIs. Four levels of physical activity (I-IV), were the dependent variables.

Differences in physical activity between the two 38-year-old samples and the two 50-year-old samples were analysed, adjusted separately for socio-occupational group and educational group. Differences were considered statistically significant at $p < 0.05$. Test of interactions between time and socioeconomic position were conducted.

Paper IV

Logistic regression were conducted with outcome variables poor well-being and high mental stress, to test for association with exposure factors (predictors) time, age and SEP. Results were presented as odds ratios (OR) with 95% confidence intervals (CI). Associations were considered statistically

significant at $p < 0.05$. Interactions were tested between age and time to see if the time trends for well-being and mental stress differed by age groups.

Next step was to investigate the importance of SEP. Interactions were tested between SEP and time to see if the time trends in well-being and mental stress differed by SEP.

RESULTS

Studies I-IV

Study I: Overweight among four-year-old children in relation to early growth characteristics and socioeconomic factors

Our results showed that the prevalence of overweight and obesity in the total sample of 4-year-old children (n=309) from the two CHCs was 17.1% and 3.2%, respectively.

The socioeconomic characteristics in the different CHCs did have a modifying effect, as a significantly higher proportion of children with overweight and obesity was present in CHC-A compared to CHC-B ($p = 0.03$).

The participants from the CHC-A showed a significantly higher BMISDS at 4 years of age, compared to the children from CHC-B. This variable BMISDS at 4 years of age correlated with weight, length and BMI at birth. Therefore an analysis (linear multiple regression) was conducted using these variables as covariates. The determinants for BMISDS at 4 years of age were studied in this model (Table 3).

Table 3. Linear multiple regression analysis of continuous variables as predictors for body mass index standard deviation score (BMISDS).

	BMISDS		
	Univariate = R-value	P-value	Beta-value at linear multiple regression analysis
CHC	0.12*	.03	0.35
Birth weight	0.24*	<.001	Ns
Birth length	---	.08	—
Birth BMI	0.27*	<.001	0.18
Smoking rate of mothers during pregnancy	—	Ns	
Duration of breastfeeding	---	Ns	
Gender	—	Ns	

*included in multiple linear regression model

We found that CHC-district ($p = 0.03$), birth weight ($p = <0.001$) and birth BMI ($p = < 0.001$) were significant independent determinants for BMISDS at 4 years of age.

In the next step, we did a stepwise logistic model (Table 4).

Table 4. Results from a stepwise multiple logistic regression analysis of categorical variables as predictors for overweight and obese at 4 years of age, (dichotomised CHC and birth BMI).

Overweight (including the obese)			
Stepwise logistic regression analysis			
	OR	95% CI	P-value
CHC-dA = 2 CHC-dB = 1	2.6	1.2–5.8	.02
Birth weight	—	—	—
Birth length	—	—	—
Birth BMI**	1.9	1.1–3.6	.03
			—
			—
			—

*included in multiple linear regression model OR: Odds Ratio
CI: Confidence Intervals **Birth BMI: Dichotomised at the median
(13.6 kg/m²)

We found that CHC-district ($p = 0.02$) and birth BMI ($p = 0.03$) were significant independent determinants for overweight (including the obese) at 4 years of age.

Furthermore, we found a non-significant tendency ($p = 0.07$) for a higher proportion of maternal smoking during pregnancy in CHC-A compared to CHC-B. The breastfeeding duration did not differ between the two CHCs.

Study II: A primary care lifestyle programme suitable for socioeconomically vulnerable groups – an observational study.

The results were based on data from the primary health care health promotion programme “Pro-Health”. After completing health questionnaires, a final sample of 3687 men and women participated at baseline with health profile and health dialogue. The age groups and gender of the participants are presented in Table 5.

Table 5. Distribution of age -groups and gender of the participants in the “Pro-Health” at baseline, n = 3687.

Age (years)	Men, n (%)	Women, n (%)	Total, n (%)
18-29	95 (30)	225 (70)	320 (9)
30-39	185 (34)	365 (66)	550 (15)
40-49	196 (31)	445 (69)	641 (17)
50-59	241 (34)	470 (66)	711 (19)
60-69	363 (39)	579 (61)	942 (26)
70-79	203 (39)	320 (61)	523 (14)
Total	1283 (35)	2404 (65)	3687 (100)

Health questionnaires from participants and non-participants in the health dialogue were compared. Those who participated showed significantly higher readiness to initiate lifestyle change and indications of worse lifestyle, compared to non-participants.

After one year, 2121 (58%) returned and participated in the one-year follow-up.

Table 6 shows data concerning socioeconomic vulnerability factors of the participants in the “Pro-Health” at baseline and at the one-year follow-up. The population of Hisingen (130 000 inhabitants) was used as comparison.

The prevalence of socioeconomic vulnerability factors among the participants corresponded well to the community level.

Table 6. Distribution (%) of vulnerability factors among the participants in the "Pro-Health" at baseline and at one-year follow-up. Hisingen population as comparison.

	Low education (max 9 years) age 18-79	Unemployed/on sick-leave age 18-65	Born outside Scandinavia age 18-79
Pro-Health (n=3687)	27%	18%	16%
One year follow-up (n=2121)	30%	19%	11%
Hisingen population	23% ¹	22% ²	22%

¹age 16-74

²age 16-64

Table 7 presents descriptive variables at baseline for participants, stratified by socioeconomic factors, i.e. living situation, education, employment and ethnicity. There were statistically significant differences for many variables concerning the different socioeconomic vulnerability groups. Some results will be mentioned here.

The group of married/cohabiting participants had significantly higher WHR and p-glucose compared to singletons. Singletons rated their view of life presently and concerning the future significantly poorer than the married/cohabiting participants. Singletons smoked significantly more and perceived more stress than the married/cohabiting participants.

Participants in the low education group had significantly higher BMI, WHR, waist circumference, p-glucose, systolic and diastolic blood pressure compared to the participants with higher education. On the other hand, the participants with higher education perceived more mental stress.

Participants who were unemployed or on sick leave had a significantly higher BMI, poorer view of life presently and concerning the future, higher proportion of smokers, were more physically inactive and had more stress compared to the employed.

Participants born outside Scandinavia had a significantly higher BMI, WHR, systolic and diastolic blood pressure, a poorer view of life presently and

Table 7. Descriptive variables at baseline; body mass index (BMI), waist hip ratio (WHR), waist circumference, p-glucose, p-glucose ≥ 7 , systolic and diastolic blood pressure, view of life present and future, smoking, physical activity, stress, alcohol, diet, stratified for socioeconomic factors, i.e. living situation, education, employment and ethnicity, n=3687.

	Living situation				Education				Employment				Ethnicity			
	Singleton		Married/cohabit		Primary school		High school/ university		Unemployed/sick leave		Employed		Born outside Scandinavia		Born in Scandinavia	
	n = 1235 mean	(SD)	n = 2408 mean	(SD)	n = 976 mean	(SD)	n = 2670 mean	(SD)	n = 455 mean	(SD)	n = 1998 mean	(SD)	n = 568 mean	(SD)	n = 3081 mean	(SD)
BMI (kg/m ²), n = 3660	27.3	(5.26)	27.3	(4.59)	28.0*	(4.74)	27.0	(4.86)	27.9*	(5.20)	27.0	(4.96)	27.91*	(4.62)	27.2	(4.87)
WHR, n = 3594	0.89	(0.09)	0.90*	(0.08)	0.91*	(0.08)	0.89	(0.08)	0.89	(0.08)	0.89	(0.08)	0.89*	(0.08)	0.90	(0.08)
Waist circumference, n = 1109 (cm)	94.9	(14.3)	94.8	(12.5)	96.9*	(12.8)	94.0	(13.1)	95.3	(13.5)	93.4	(13.4)	93.3	(11.5)	95.0	(13.25)
Cap p-glucose (mmol/L), n = 3528	6.3	(1.48)	6.4*	(1.49)	6.6*	(1.67)	6.3	(1.41)	6.3	(1.56)	6.2	(1.30)	6.45	(1.67)	6.36	(1.45)
Cap p-glucose (mmol/L) ≥ 7 , n = 821	8.39	(1.86)	8.37	(1.67)	8.50	(1.92)	8.30	(1.62)	8.41	(1.86)	8.16	(1.53)	8.44	(1.83)	8.35	(1.70)
Systolic BP (mmHg), n = 3659	127	(19.0)	127	(18.7)	133*	(18.05)	125	(18.57)	123	(17.6)	123	(17.1)	121*	(18.8)	128	(18.6)
Diastolic BP (mmHg), n = 3658	77	(11.2)	78	(10.9)	79*	(10.48)	77	(11.11)	77	(11.3)	77	(11.3)	76*	(11.2)	78	(10.9)
View of life present, n = 3596	5.75*	(2.02)	6.56	(1.87)	6.56	(2.01)	6.18*	(1.92)	4.80*	(1.94)	6.23	(1.76)	5.68*	(2.08)	6.39	(1.91)
View of life future, n = 3560	7.08*	(1.93)	7.62	(1.64)	7.50	(1.87)	7.42	(1.71)	6.57*	(2.07)	7.64	(1.56)	7.05*	(2.02)	7.51	(1.70)
	At risk	(%)	At risk	(%)	At risk	(%)	At risk	(%)	At risk	(%)	At risk	(%)	At risk	(%)	At risk	(%)
Smoking, n = 3691	344*	(27.7)	452	(18.7)	216	(22.1)	580	(21.7)	138*	(30.4)	485	(24.3)	136	(24.2)	663	(21.4)
Physical activity, n = 3691	248	(20.1)	440	(18.2)	175	(18.0)	510	(19.2)	114*	(25.1)	408	(20.5)	134*	(24.0)	555	(18.0)
Stress, n = 3691	947*	(76.6)	1743	(71.9)	589	(60.7)	2096*	(78.7)	403*	(88.8)	1661	(83.2)	473*	(84.9)	2217	(71.9)
Alcohol, n = 3691	158	(12.8)	291	(12.1)	114	(11.7)	335	(12.6)	61	(13.5)	259	(13.0)	35	(6.3)	414*	(13.4)
Diet, n = 3691	740	(59.8)	1393	(57.9)	556	(57.1)	1577	(59.2)	278	(61.2)	1249	(62.6)	270	(48.2)	1865*	(60.4)

*Significant difference between means/number at risk at 0.05 level, describes the group with most risk, higher or lower mean.

concerning the future, were more physically inactive and perceived more stress compared to Scandinavian born participants. On the other hand, Scandinavian born participants showed significantly higher alcohol consumption and more unhealthy diet than the participants born outside Scandinavia.

Change after one year - engagement

Table 8 presents the 2077 out of 2121 participants in the one-year follow-up. When comparing the different SEP -groups concerning the participants' change from baseline to the one-year follow-up, we obtained the following results. Four different SEP -groups were identified. 780 (37%) participants had no socioeconomic vulnerability factors, 886 (43%) had one socioeconomic vulnerability factor, 347 (17%) had two socioeconomic vulnerability factors and 64 (3%) had ≥ 3 vulnerability socioeconomic factors.

Reduction of risk factors and increase in healthy behaviour were defined as improvement. Biological mean values and behavioural improvement defined as one or two steps of change in the health profile were studied.

The SEP -groups with 1, 2 and ≥ 3 socioeconomic vulnerability factors did not differ substantially concerning positive lifestyle improvements during one year compared to the participants with no vulnerability factors. In other words, the engagement in the "Pro-Health" during one year was almost equal for the participants from the different SEP -groups. One exception was that the group with one and two socioeconomic vulnerability factors had significantly lower odds for improvement concerning physical activity compared to the group with no vulnerability factors.

Table 8. Comparison of change from baseline to one-year follow-up between the groups with 0, 1, 2 and ≥ 3 socioeconomic factors. Logistic regression analysis; age and gender included in the analysis. Dichotomisation by undesired change + no change; desired change. Reduction of risk factor/increase in healthy behaviour indicated as improvement. The group with no socioeconomic factor as reference group (OR=1.0). Statistically significant difference indicated with bold figure, n = 2077 (out of 2121 due to missing data).

	No socioeconomic factor, n = 780		1 socioeconomic factor, n = 886			2 socioeconomic factors, n = 347			≥ 3 socioeconomic factors, n = 64		
	Improved, n (%)	OR	Improved (1), n (%)	OR	CI 95%	Improved, n (%)	OR	CI 95%	Improved, n (%)	OR	CI 95%
BMI ^a	368 (47)	1.0	398 (45)	0.89	0.73–1.08	150 (43)	0.80	0.62–1.04	27 (42)	0.79	0.47–1.33
WHR ^a	364 (48)	1.0	423 (49)	1.04	0.85–1.26	143 (42)	0.79	0.61–1.02	28 (43)	0.80	0.48–1.34
p-glucose ^a	392 (53)	1.0	451 (53)	0.99	0.81–1.21	184 (55)	1.08	0.83–1.40	34 (56)	1.11	0.65–1.88
Systolic BP ^a	338 (43)	1.0	399 (45)	1.08	0.89–1.31	142 (40)	0.89	0.69–1.15	29 (45)	1.11	0.66–1.85
Diastolic BP ^a	314 (40)	1.0	407 (46)	1.27	1.05–1.55	154 (44)	1.17	0.91–1.51	23 (36)	0.85	0.50–1.45
View of life present ^b	279 (36)	1.0	352 (41)	1.25	1.02–1.53	137 (40)	1.24	0.95–1.62	23 (36)	0.99	0.58–1.70
View of life future ^b	239 (32)	1.0	284 (34)	1.12	0.91–1.39	116 (35)	1.21	0.92–1.59	22 (36)	1.19	0.69–2.05
Smoking ^a	33 (4)	1.0	37 (4)	1.03	0.64–1.67	16 (5)	1.18	0.64–2.19	6 (9)	2.54	1.02–6.35
Physical activity ^b	228 (29)	1.0	215 (24)	0.79	0.64–0.99	71 (21)	0.65	0.48–0.89	19 (30)	1.00	0.57–1.76
Stress ^a	71 (9)	1.0	108 (12)	1.44	1.04–1.98	57 (16)	2.13	1.46–3.11	11 (17)	2.02	1.00–4.06
Alcohol ^a	46 (6)	1.0	69 (8)	1.44	0.98–2.13	25 (7)	1.38	0.83–2.29	4 (6)	1.21	0.42–3.51
Diet ^a	239 (30)	1.0	277 (31)	1.04	0.85–1.29	122 (35)	1.26	0.97–1.65	19 (29)	0.95	0.54–1.65

^aDecrease.

^bIncrease.

Study III: Socioeconomic disparities in physical activity among Swedish women and trends over time – the Population Study of Women in Gothenburg

The two cohorts of 38- and 50-year-old women were stratified into two groups, those examined in 1980-81 and those in 2004-05. Table 9 shows descriptive data.

Table 9. Characteristics of 38- and 50-year-old women in the Population Study of Women in Gothenburg regarding the assessments performed in 1980-81 and 2004-05, respectively.

Variables/age	1980-81		2004-05	
	38 years N = 122 n (%)	50 years N = 355 n (%)	38 years N = 207 n (%)	50 years N = 293 n (%)
Marital status				
Married n (%)	79 (65)	261 (73)	90 (44)	154 (53)
Smoking	46 (38)	139 (39)	23 (11)	67 (23)
Employment status				
Full time = 35 h/w	48 (40)	112 (32)	126 (61)	179 (61)
Part time = 1-34 h/w	56 (46)	180 (51)	51 (25)	62 (21)
Unemployment	17 (14)	62 (18)	26 (13)	49 (17)
Physical activity – work				
I Low	22 (18)	96 (27)	26 (13)	50 (17)
II Intermediate	62 (51)	180 (51)	69 (34)	138 (48)
III High	33 (27)	69 (19)	97 (48)	93 (32)
IV Very high	5 (4)	10 (3)	11 (5)	6 (2)
Physical activity – leisure time				
I Low	42 (34)	114 (32)	46 (23)	48 (17)
II Intermediate	51 (42)	161 (45)	74 (36)	128 (44)
III High	28 (23)	76 (21)	72 (35)	104 (36)
IV Very high	1 (1)	4 (1)	12 (6)	9 (3)
Socio-occupational level				
Low	51 (43)	143 (47)	50 (25)	84 (29)
Medium	57 (48)	129 (43)	98 (50)	145 (51)
High	11 (9)	30 (10)	49 (25)	57 (20)
Educational level				
Low	43 (35)	228 (65)	89 (44)	143 (49)
High	79 (65)	127 (35)	114 (56)	150 (51)

¹Unemployment: Early retirement, students, housewives, unemployed.

We retrieved data from the Population Study of Women in Gothenburg. Table 9 shows descriptive data: participation rates, marital status, smoking, employment status, physical activity at work and leisure time, socio-occupational level and educational level.

Physical activity and association with socioeconomic position

Table 10a and b shows the associations between physical activity levels (outcome) and socioeconomic level (exposure).

Physical activity at work

The main results were several significant associations between high physical activity at work and low socio-occupational level and low educational level, in 1980 as well as in 2004 (Table 10a and b). The odds ratio (OR) for having high physical activity (III and IV) in the group with low socio-occupation was 5.39 (95% CI 2.31-12.58) concerning 38-year-old women in 1980. The odds ratio (OR) for having high physical activity (III and IV) in the group with low socio-occupation was 3.03 (95% CI 1.78-5.17) concerning 50-year-old women in 2004.

Physical activity – leisure time

There were no statistically significant associations between low and high leisure time physical activity and different socioeconomic groups (Table 10 a and b).

Table 10a and b. The association between: (a), low (I) vs. high (II, III, IV) physical activity (outcome) at work/leisure time, (b), high (III, IV) vs. low (I, II) physical activity (outcome) at work/leisure time and low/high socio-occupational group and low/high education group, respectively, defined as the exposed group. Odds ratios (OR) with 95% confidence intervals (CI).

	Low physical activity – at work				Low physical activity – leisure time			
	1980–81		2004–05		1980–81		2004–05	
	OR (CI)	<i>p</i>	OR (CI)	<i>p</i>	OR (CI)	<i>p</i>	OR (CI)	<i>p</i>
Low socio-occupational Group								
38 years	0.47 (0.17–1.32)	0.15	0.49 (0.16–1.51)	0.21	2.12 (0.99–4.55)	0.053	1.53 (0.73–3.21)	0.26
50 years	0.55 (0.32–0.93)	0.03	0.88 (0.44–1.77)	0.73	1.45 (0.89–2.37)	0.14	1.02 (0.51–2.03)	0.95
Low education								
38 years	0.64 (0.23–1.78)	0.39	0.63 (0.27–1.49)	0.29	1.21 (0.56–2.63)	0.63	1.29 (0.66–2.51)	0.45
50 years	0.67 (0.41–1.08)	0.10	1.89 (1.01–3.53)	0.045	1.20 (0.74–1.93)	0.46	1.21 (0.64–2.26)	0.56
High socio-occupational Group								
38 years	2.13 (0.78–5.88)	0.15	2.04 (0.66–6.25)	0.21	0.47 (0.22–1.01)	0.053	0.65 (0.31–1.37)	0.26
50 years	1.82 (1.08–3.13)	0.03	1.14 (0.56–2.27)	0.73	0.69 (0.42–1.12)	0.14	0.98 (0.49–1.96)	0.95
High education								
38 years	1.56 (0.56–4.35)	0.39	1.59 (0.67–3.70)	0.29	0.83 (0.38–1.79)	0.63	0.78 (0.40–1.52)	0.45
50 years	1.49 (0.93–2.44)	0.10	0.53 (0.28–0.99)	0.045	0.83 (0.52–1.35)	0.46	0.83 (0.44–1.56)	0.56

	High physical activity – at work				High physical activity – leisure time			
	1980–81		2004–05		1980–81		2004–05	
	OR (CI)	<i>p</i>	OR (CI)	<i>p</i>	OR (CI)	<i>p</i>	OR (CI)	<i>p</i>
Low socio-occupational Group								
38 years	5.39 (2.31–12.58)	<0.001	3.85 (1.86–7.99)	<0.001	0.51 (0.21–1.25)	0.14	0.98 (0.51–1.89)	0.95
50 years	2.50 (1.43–4.38)	<0.001	3.03 (1.78–5.17)	<0.001	0.77 (0.45–1.31)	0.34	0.71 (0.42–1.22)	0.21
Low education								
38 years	1.81 (0.82–3.98)	0.14	1.72 (0.98–3.03)	0.06	0.63 (0.25–1.58)	0.32	1.45 (0.82–2.56)	0.20
50 years	2.30 (1.28–4.15)	0.005	1.31 (0.80–2.14)	0.28	0.94 (0.56–1.59)	0.83	0.74 (0.46–1.19)	0.21
High socio-occupational group								
38 years	0.19 (0.08–0.43)	<0.001	0.26 (0.13–0.54)	<0.001	1.96 (0.80–4.76)	0.14	1.02 (0.53–1.96)	0.95
50 years	0.40 (0.23–0.70)	<0.001	0.33 (0.19–0.56)	<0.001	1.30 (0.76–2.22)	0.34	1.41 (0.82–2.38)	0.21
High education								
38 years	0.55 (0.25–1.22)	0.14	0.58 (0.33–1.02)	0.06	1.59 (0.63–4.00)	0.32	0.69 (0.39–1.22)	0.20
50 years	0.43 (0.24–0.78)	0.005	0.76 (0.47–1.25)	0.28	1.06 (0.63–1.79)	0.83	1.35 (0.84–2.17)	0.21

Bold figures: Statistically significant differences between the cohorts.

Increase in mean physical activity 1980 to 2004

Physical activity at work

Odds of increase in mean physical activity for 38- and 50-year-old women over time (1980 to 2004) were statistically significant both when controlled for socio-occupational group as well as for level of education (Table 11).

Table 11. Odds for increase over time (1980 to 2004) in mean physical activity at work and leisure time for 38- and 50-year-old cohorts, adjusted for socio-occupational level and education group, respectively. Odds ratios (OR) with 95% confidence intervals (CI). Bold figures: Statistically significant differences between the cohorts in increase in mean physical activity levels in 1980 and 2004. There was no interaction between the effect of socio-occupational group and education.

	Adjusted for Socio-occupational group 1980–2004 OR (CI)	Adjusted for Educational level 1980–2004 OR (CI)
Physical activity at work		
38-year-olds	2.59 (1.65–4.07)	2.29 (1.40–3.75)
50-year-olds	2.09 (1.52–2.88)	2.01 (1.35–2.98)
Physical activity leisure time		
38-year-olds	1.93 (1.25–2.98)	1.67 (1.04–2.70)
50-year-olds	2.04 (1.49–2.79)	2.27 (1.54–3.34)

Odds for belonging to a higher level of physical activity were twice as high in 2004 compared to 1980, see Table 11.

Physical activity – leisure time

Odds for increase in mean physical activity for 38- and 50-year-old women over time (1980 to 2004) were statistically significant both when controlled for socio-occupational group as well as for level of education, see Table 11. Test of interactions between socioeconomic position and time showed no interaction for either socio-occupational group or level of education.

Study IV: Well-being and mental stress in the Population Study of Women in Gothenburg, Sweden: 36-year trends and socioeconomic disparities

Table 12. Characteristics of 38- and 50-year-old women in the Population Study of Women in Gothenburg regarding the assessments performed in 1980, 2004 and 2016, respectively. P values for trends over time.

	1980		2004		2016		P 38 years	P 50 years
	38 years 122 n (%)	50 years 355 n (%)	38 years 207 n (%)	50 years 293 n (%)	38 years 263 n (%)	50 years 310 n (%)		
Well-being poor (4-7)	46 (38)	161 (46)	48 (24)	101 (35)	92 (35)	109 (36)		
Well-being good (1-3)	76 (62)	193 (54)	152 (76)	188 (65)	168 (65)	197 (64)	0.69	<0.01
Mental stress								
Low	95 (78)	293 (83)	109 (55)	134 (47)	94 (36)	157 (51)		
Medium-high	27 (22)	62 (17)	90 (45)	154 (53)	167 (64)	152 (49)	<0.01	<0.01
Socio-occupation								
Low	51 (43)	143 (47)	52 (26)	84 (29)	41 (17)	73 (24)		
Medium	57 (48)	129 (43)	100 (49)	145 (51)	118 (48)	145 (48)		
High	11 (9)	30 (10)	52 (25)	57 (20)	85 (35)	82 (27)	<0.01	<0.01
Smoking								
Yes	46 (38)	139 (39)	23 (11)	67 (23)	23 (9)	37 (12)		
No	76 (62)	216 (61)	181 (89)	224 (77)	240 (91)	273 (88)	<0.01	<0.01
BMI								
< 25	100 (83)	209 (59)	136 (69)	173 (62)	179 (68)	177 (58)		
≥ 25	21 (17)	146 (41)	60 (31)	108 (38)	83 (32)	131 (42)	0.01	0.77
Leisure time								
physical activity								
Low (1)	42 (34)	114 (32)	46 (22)	48 (17)	18 (7)	31 (10)		
High (2-4)	80 (66)	241 (68)	158 (78)	241 (83)	244 (93)	278 (90)	<0.01	<0.01

Descriptive data

The three different cohorts of 38- and 50-year-old women examined in 1980, 2004 and 2016 are presented in Table 12, regarding number of participants, well-being (poor/good), perceived mental stress level (low/medium-high), socio-occupational level (low/medium-high), smoking (yes/no), BMI ($< 25/ \geq 25$) and leisure time physical activity (low/high). P values refer to trends over time between the three cohorts.

Trends in well-being

In the 38-year-old women, no significant differences were seen between the three cohorts regarding well-being ($p=0.69$) (Table 12). In the 50-year-old women, significant differences were seen between the three cohorts, where the trend showed an increased proportion of women who perceived their well-being as good ($p<0.01$) (Table 12).

Table 13. Time, age and socio-economic position as separate predictors for poor well-being and high mental stress in all 38- and 50-year-old women (dependent variable). Logistic regression. Odds ratios (OR) with 95% confidence intervals (CI).

	Poor well-being OR (CI)	p	High stress OR (CI)	p
Time	0.91 (0.73 – 1.13)	0.41	2.38 (1.89 – 3.00)	0.00
Age	1.45 (0.90 - 1.49)	0.05	0.80 (0.61 - 1.05)	0.11
SEP	2.00 (1.31 – 3.04)	0.00	1.02 (0.76 – 1.37)	0.89

Table 13 shows results from a fully adjusted model (all women) with time, age and SEP as separate predictors. Significant differences were found ($p<0.05$), where the lower socio-occupational group had a higher proportion of poor well-being.

Trends in mental stress

Concerning perceived mental stress, a significant trend of increased high mental stress ($p < 0.01$) was seen for both 38- and 50-year-old groups of women (Table 12). Table 13 shows that this was the trend for all women irrespective of age and SEP.

Importance of SEP

Does SEP modify the association between time and well-being and time and stress?

Table 14 shows tests of interactions in all women, examining whether the “risk factor” low socio-occupational group affected the development of well-being over time and of stress over time. No significant interactions were found ($p = 0.30$ and 0.32). The different SEP groups showed the same development over time concerning well-being and mental stress.

Table 14. Interaction test of SEP. Low socio-occupational group in relation to time and well-being, and to time and mental stress with all 38- and 50-year-old women included. Odds ratios (OR) with 95% confidence intervals (CI).

		Time and well-being		Time and stress	
		OR (CI)	p	OR (CI)	p
Low socio-occupational group		0.78 (0.48 – 1.26)	0.30	1.21 (0.83 – 1.77)	0.32

Association between well-being/mental stress and socioeconomic position

Table 15 shows associations between poor well-being (outcome variable) and low SEP in 1980, 2004 and 2016. In 1980 and 2004 there were significant associations ($p = 0.05$ and $p = 0.00$) between poor well-being and low SEP but not in 2016. Low socio-occupation as a “risk factor” for poor well-being was greatly attenuated from 1980 to 2016.

Table 15. Test of the association between poor well-being (scale 4-7) (outcome)/ high mental stress (outcome), and low socio-occupational group, defined as the exposed group, 1980, 2004 and 2016. Logistic regression. Odds ratios (OR) with 95% confidence intervals (CI).

	Low socio-occupational group					
	1980		2004		2016	
	OR (CI)	p	OR (CI)	p	OR (CI)	p
Poor well-being scale 4-7						
38- and 50- year-olds	1.48 (1.00-2.19)	0.05	2.14 (1.41-3.24)	0.00	1.19 (0.76-1.86)	0.46
High mental stress						
38- and 50- year-olds	0.96 (0.58-1.58)	0.87	1.00 (0.68-1.49)	0.99	1.00 (0.64-1.56)	0.99

Table 15 also shows associations between high mental stress (outcome variable) and low SEP, in 1980, 2004 and 2016. No significant associations were found.

DISCUSSION

One of the main findings of this thesis was that a significantly higher proportion of children with overweight/obesity was found in a district with lower socioeconomic status compared to a district with higher socioeconomic status. This indicates that preventive actions conducted in primary care should be implemented also with a socioeconomic perspective. We could show that socioeconomically vulnerable groups can be reached and engaged in a health promotion programme, i.e. Pro-Health, with long lasting results also after one year. On the population level, we found increased physical activity levels at work and leisure time among 38- and 50-year-old women compared to earlier generations with no significant differences between the socioeconomic groups. We also found increased perception of good well-being in 50-year-old women 1980 to 2016, and in women with low socioeconomic position a comparable level of well-being in 2016. However, perceived high mental stress increased from 1980 to 2016 concerning all women independent of socioeconomic position.

Study I

The main findings of this study were that a significant association was seen between the CHC-districts' socioeconomic status, BMI at birth and overweight among 4-year-old children. We found a significantly higher proportion of children with overweight and obesity in the district with lower socioeconomic status.

The strengths of this study were the participation rate at the 4-year control, 94% in CHC-A and 96% in CHC-B. Therefore, we perceived that the surveyed participant group was representative of 4-year-olds in each district.

A limitation of this study was one part of the method. We compared the two different CHC-district socioeconomically at group level. This was done as we did not have any individual information regarding educational level, employment rate etc. It would have been better and more specific if we had been able to compare at the individual level instead. However, this was done in one study and the results were consistent with ours (121).

The association between low socioeconomic status and overweight/obesity at the age of 4 in our study is in accordance with many previous studies (26, 31, 121, 122). For instance, in Canada, a population-based study – Quebec

Longitudinal Study of Child Development showed that the largest predictors of the development of obesity in 4-year-olds were low socioeconomic status, maternal smoking during pregnancy and parental overweight/obesity (122).

Studies have shown that the important factor for preventing children from developing obesity is an environment that stimulates increased physical activity and reduced sedentary behaviour (123).

The effects of sedentary time on children's health are under-researched (124). In Australia, there are recommendations for children and youths (5-18 years) regarding screen time, i.e. maximally 2 hours/day. There is no equivalent in Sweden (124). In a study from 122 countries, decreased physical activity levels in children are reported (72). In Sweden, this reduction of physical activity levels applies especially to 11-12 -year-old boys (125). Living in a deprived neighbourhood and parental low education are associated with increased childhood obesity (126).

Study II

The main findings of this study were that socioeconomically vulnerable groups could be reached and engaged in the primary health care health promotion program Pro-Health to the same extent as higher socioeconomic groups. The various socioeconomic groups did not differ regarding the odds of improving lifestyle from baseline to the one-year follow-up.

The strengths of this study were the high participation rate and the unselected starting group. Another advantage was that the eight primary care centres together were representative for Swedish primary care as a whole. There were both urban and rural areas. Another advantage was the methodology in Pro-Health. If a person lacked motivation for lifestyle change, there was an opportunity to return at a later date.

A limitation of this study was the lack of control group. Since this study was conducted in the context of regular primary care, it was not possible for ethical and practical reasons to have a control group as well. However, in studies similar to this on the population level, many disadvantages with RCTs have been shown (127).

Our results concerning Pro-Health as a suitable lifestyle programme also for socioeconomically vulnerable groups is in accordance with previous studies

(64, 128). In a Finnish study the influence of socioeconomic status was examined concerning the impact of health counselling on risk factors (128). The results showed that lifestyle was positively influenced by counselling in all socioeconomic groups.

In a primary care study from Denmark, the patient's and GP's communication about lifestyle was studied. In similarity to the methodology of Pro-Health, health care in the Danish study was recommended to focus on the patient's own starting point (129). In Sweden, the Norsjö's prevention program also showed that lifestyle changes such as lowering blood pressure and lowering cholesterol were also significant for those with lower education (130).

A systematic review shows that it is important to identify positive components in the prevention work. To achieve effective prevention programmes, further long-term follow-up is required (131).

Study III

The main findings of this study were that 38- and 50-year-old women in the Population Study of Women in Gothenburg from all socioeconomic groups had increased their physical activity at leisure time and at work from 1980 to 2004. There was an association between high physical activity at work and low SEP. Concerning leisure time PA and SEP, no significant association was found.

The strengths of this study were the long follow-up period of the PSWG, here 24 years, as well as the equivalence in methodology at each survey opportunity. Identical interview procedures with the same questionnaire were performed by physicians at each examination. This allowed us to compare physical activity levels over time. Another strength of this study was that physical activity was studied both during leisure time and working hours, thus providing a more overall picture.

A limitation of this study was the decreasing participation rate from 84% in 1980 to 59% in 2004. To study this in more detail, a dropout analysis was performed in 2004 (132). Participants and non-participants were compared at group level. Non-participants generally belonged to a lower socioeconomic group but there were no differences in place of birth, marital status or hospital care-rates. However, we found that a participation rate around 60% was acceptable and similar to previous population studies (133).

Another weakness of this study was that physical activity was reported by the participants themselves, albeit noted in the questionnaires by the physician at the interview. Studies show that such questionnaires, with fixed response alternatives/activity groups, are the most credible (134) and useful in health care (135). In addition to questionnaires, objective measuring instruments (physical activity) such as accelerometers are often used today (134).

The main findings in this study showed that physical activity levels (leisure and work) increased from 1980 to 2004, for all socioeconomic groups. These results were equivalent to those from Danish and Finnish studies concerning leisure –time -physical activity (81, 136). A Danish study showed that the physical activity trend from 1987 to 2005 had increased for all socioeconomic groups. A Finnish study also showed that the physical activity trend from 1978 to 2002 had increased for all socioeconomic groups.

Our results concerning the relation between high PA at work and low socioeconomic position was in accordance with an English study, where occupational PA increased with decreasing occupational status (137). An Australian study showed that belonging to a higher SEP was associated with higher total sitting time (138). The same was shown in SCAPIS (88).

Contrary to our results, other studies in Sweden, SALLS and VIP, have shown worrying results (84, 85). In both these longitudinal studies, leisure time physical activity levels (1980-2004 and 1990-2007) increased mainly among those with higher education. This resulted in increased health disparities in different groups. Thus, it is very important to direct health prevention efforts to the most vulnerable groups.

Our results are somewhat surprising in so far as studies have shown at the same time that only 7% of adult Swedes reach the recommendation of 150 minutes of physical activity per week (88).

Study IV

The main findings in this study showed an increasing proportion of 50-year-old women who perceived good well-being from 1980 to 2016. No significant differences were found among 38-year-old women and perceived well-being over time. The proportion of women who experienced high mental stress increased between 1980 and 2016, among all SEP groups. Belonging to a low SEP group was in 1980 associated with poor perceived well-being, but not in 2016.

The strengths of this study were the long follow-up period of 36 years and the use of identical study protocols. Due to the fact that identical questionnaires were used on all survey occasions, we were able to compare the cohorts. Also, the circumstances surrounding the investigations were similar each time. Another strength of this study was that analysis was done to evaluate the well-being indicator. The well-being indicator and SF-36 showed high relative validity, coefficient of 0.69.

A limitation of this study was that the participation rate declined from 84% in 1980 to 68% in 2016. To study this in more detail, a dropout analysis was performed, see above study III (132).

We have thus studied perceived well-being over time in middle-aged women. Many other studies have shown that subjective self-rated health is a good measure of use of health care/mortality (139), myocardial infarction (140) and metabolic health (141).

This study's results regarding well-being are similar to those from a large longitudinal study, SALLS (Swedish Annual Level of Living Survey) (142). This study from southern Sweden showed improved self-rated health in women and men > 48 years of age during the period 1980 to 2004. At the same time, deteriorated or unchanged self-rated health was shown in the younger 16-47 years (142).

Contrary to our results, a study from northern Sweden, the MONICA study, showed that women's self-rated health deteriorated in the years 1990 to 2014 (143). A French study showed the same deterioration in women's self-rated health from 1995 to 2016 (144). A Finnish longitudinal study showed that the socioeconomic differences in self-rated health had widened in 2012 compared to 2000 (145). The Whitehall II study showed that social inequalities increased and were reflected in negative self-rated health development from 1985 to 2004 (146).

General Discussion

Finally, what are the implications of these findings?

It is important that primary care is active in reaching the entire population, and that we also incorporate a socioeconomic perspective, both in prevention and health promotion. We reach the children through the parents, and there are positive trends concerning lifestyle that we can support in primary care. However, it is worrying that young and middle aged-women - unlike 50 -year-old men – experience mental stress to such an extent. Society needs to improve strategies for collaboration at all levels - Child Health Centres, primary health care and public health. It is not just the individual who carries responsibility, but also the community, both within and outside the health care system, as well as the society. On a societal level, most health promotion activities are carried out by public health and community authorities, but primary care should also be very active.

1. Physical activity, taxing unhealthy food, health literacy

In a major review conducted by the Public Health Agency of Canada, physical activity recommendations for children were stated as follows: preschool children 4-6 years, at least 10,000 steps/day; girls 6-11 years, 11,000 steps/day; boys 6-11 years, 13,000 steps/day (147).

WHO has reported on various methods to stop the development of obesity in the population. In Norway and France, food with health risks such as sweets and soft drinks is taxed. WHO notes that these taxes have the potential to reduce health inequalities and improve health of socioeconomically vulnerable groups. Taxing unhealthy food is thus an effective tool for obesity -prevention (148).

Low health literacy is a barrier for reaching disadvantaged socioeconomic environments. Health literacy is often described as having an impact on self-efficacy and empowerment (149). Parental level of education seems to be a protective factor against childhood obesity. Prevention programmes should take health literacy into account, so that parents can make good health choices (149). Future health is largely determined by factors in childhood, and inequality is one of them.

2. *Motivation, multi-professional team, context of primary care*

Other studies also emphasize the importance of working with the individual's motivation, which is the core of Pro-Health (150). The importance of working in multi-professional teams concerning health prevention (as Pro-Health) is emphasized in many other studies (150, 151).

Thus, we have extensive knowledge about the impact of lifestyle on health (152). We have effective prevention programmes adapted to the context of primary care (66, 153, 154). Decision -makers should work on this in their efforts to promote equal health for the entire population.

3. *Increased opportunities for daily physical activity*

Decision -makers should work for a society with increased opportunities for daily physical activity during leisure time as well as during working time. There are many good examples, such as neighbourhood walkability (155), stair use instead of elevators (156), active workstations (157), and breaking up periods of sitting (158).

Finally, it is very important that the society and the health care work together for increased opportunities for PA, not least because physical activity protects against harmful stress (94). To reduce unequal health, multilevel targeted prevention programmes are needed in the future (80). The health promotion programme Pro-Health could be a possible piece in the puzzle.

4. *Collaboration at all levels of the society – Primary care*

Our results showed that an increasing proportion of women experienced high mental stress in 2016 compared with 1980. This is consistent with previous studies (16). Studies have shown that a high occupational stress in women is associated with an increased risk of developing obesity (159). Mental stress is a major risk factor for many diseases and also associated with sick -leave (160). Many factors exist that may improve self-rated health, such as total physical activity (161). Finally, it has been investigated how high physical activity levels could compensate for the association between low SEP and poor self-

rated health (162). The study showed that high physical activity levels could offset the negative association between low SEP and poor self-rated health.

Health promotion and preventive activities must include respect for the individual and the individual's life situation and approach the individual with respect - i.e. ask for permission and motivation. One of the advantages of primary care is that it is always there, continually over the life course. Primary care meets the population and the individual at all ages and many times during the life-course. If a person at one visit to the primary care centre lacks the motivation for changing lifestyle because of e.g. worrying circumstances, there will always be a new occasion and opportunity for motivation at the next visit. This is why it is so important for primary care to continually be active in both prevention and health promotion, and to be active in research and implementation of methods that are effective and at the same time pay respect to the individual and the individual's socioeconomic and life situation. Let us continue the work with health disparities such that primary care can contribute together with other parts of society.

Ethical considerations

Prior to the start of the study, the health promotion programme Pro-Health was granted an ethical permit by the regional Ethic Review Board in Gothenburg, Sweden (Dnr 007-07). All men and women at the eight health care centers who chose to participate in the study were given written information about the study's background, aim and arrangement. Participants were also informed that they could choose to leave the study at any time, with no consequences whatsoever. All participants were also informed that all personal data were kept confidential. Each participant was coded with a specific participant number. Only the research coordinator at each health care center had the knowledge of the link between participant numbers and personal data.

The Prospective Population Study of Women in Gothenburg was approved by the ethical committee of University of Gothenburg (Dnr 65-80; Ö564-03; 258-16). The study was in accordance with the Declaration of Helsinki. Women in the study were invited to a free health examination, through a letter. The women were informed that the participation was completely voluntary and that they could choose to leave the study at any time without any consequences. They also received information that total confidentiality prevailed regarding

their personal data. After the surveys, the participants received a letter home, regarding the results from their surveys. If the participant wished, this information was also sent to the responsible physician at their health care centre.

CONCLUSION

General conclusion

Primary health care - reaching the entire population - needs a socioeconomic perspective. It is urgent to improve the conditions for preventive work to reduce health disparities.

Specific conclusions

1. Low socioeconomic status at the district level was an independent determinant of overweight and high BMI at four years of age, at the CHC.
2. Socioeconomically vulnerable groups can be reached and engaged in a health promotion programme, i.e. Pro-Health, to the same extent as higher socioeconomic groups.
3. Middle-aged women in different socioeconomic groups improved their physical activity to the same extent from 1980 to 2004.
4. Middle-aged women have generally high perceptions of well-being but nevertheless they perceive high mental stress irrespective of socioeconomic position.

FUTURE PERSPECTIVES

The Swedish Government's objective from 2015 is that the unequal health gaps in the population should be closed within a generation. This requires efforts at all levels of society. For the primary health care, there are good tools to use. It has been found that multi-professional teams, collaboration and work structure are very important in health promotion work. The health promotion programme Pro-Health has much to offer at a population level. There is now an e-version of Pro-Health that needs to be tested before large scale implementation. Thus, this is an example of health care approaching the patients in a respectful and ethically appropriate way. It is urgent to improve the conditions for preventive work to reduce health disparities.

ACKNOWLEDGEMENT

Först och främst vill jag tacka alla deltagare som deltagit i studierna och all personal som arbetat med dem. Utan Er hade inte denna avhandling varit möjlig.

Jag vill tacka alla som har hjälpt mig under dessa år:

Cecilia Björkelund, min fantastiska huvud-handledare och Stora förebild! Mitt varmaste Tack för allt stöd, engagemang och all ovärderlig hjälp. Det har verkligen varit roligt att få arbeta med dig!

Ann Blomstrand, min mentor och bi-handledare. Tack vare Dig, fick jag komma till Allmän-medicin och arbeta inom Hälsolyftet. Tack för all hjälp, alla givande diskussioner, glada skratt och din varma omtanke!

Tack till övriga bi-handledare: **Lauren Lissner**, **Dominique Hange** och **Jörgen Thorn** för all Fin hjälp. Tack för att Ni har delat med Er av all Er Stora kunskap!

Stort tack till övriga med-författare för de olika arbetena: **Maria Johansson**, **Staffan Mårild** och **Tine Högberg** för gott samarbete!

Tack **Nashmil Ariai** och **Valter Sundh** för all värdefull, fin hjälp kring statistiken.

Tack **Lolo Humble** och **Eva Deutch** för all hjälp med att få ihop den här avhandlingen. Tack för Er värme och godhet.

Tack Nationella Forskarskolan i Allmänmedicin, **Maria Boström** och **Lars-Hjalmar Lindholm**. Tack till alla i Grupp 5! Jag är så tacksam över att få vara med i det här enastående forskar- nätverket!

Stort Tack till alla underbara vänner och medarbetare på Allmän-medicin. Jag vill särskilt tacka TYK-medarbetare: **Helen Borgkvist**, **Marie Walther**, **Jessica Liljeblad**, **Bernhard von Below**, **Helena Ödesjö** och **Dominique Hange** (igen!). Tack för alla era goda råd, Er stora Godhet och alla skratt!

Stort Tack även till övriga vid Allmän-medicin, för all Fantastisk hjälp: **Lilian Weman**, **Lena Beijer**, **Gunilla Hellquist**, **Annika Olsson**, **Birgitta**

Malmhage, Carl Wikberg, Maria Eriksson, Stefan Bergman, Maria Åberg och Ulf Lindblad!

Jag vill även tacka våra kära grannar **Ingegerd** och **Lennart Östblom** för att Ni är så snälla och tar hand om Honey.

Tack mina svär-föräldrar **Gunilla** och **Bengt Waller** för att Ni alltid finns där för oss!

Tack mina föräldrar **Marianne** och **Ingemar Thorén** för all värme, kärlek och barnvakts/läx- hjälp!

Tillsist, Stort Tack till min älskade make **Erik** och våra barn **Louise, Oscar** och **Sigrid!** Ni är mitt allt! ❤️

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