

Experiences of counselling on
physical activity during pregnancy
Gestational diabetes mellitus -
screening and pregnancy outcomes

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To my family with endless love

Ja visst gör det ont

*Ja visst gör det ont när knoppar brister.
Varför skulle annars våren tveka?
Varför skulle all vår beta längtan
bindas i det frusna bitterbleka?
Höljet var ju knoppen hela vintern.
Vad är det för nytt, som tär och spränger?
Ja visst gör det ont när knoppar brister,
ont för det som växer
och det som stänger.*

*Ja nog är det svårt när droppar faller.
Skälvande av ängslan tungt de hänger,
klamrar sig vid kvisten, sväller, glider -
tyngden drar dem neråt, hur de klänger.
Svårt att vara oviss, rädd och delad,
svårt att känna djupet dra och kalla,
ändå sitta kvar och bara darra -
svårt att vilja stanna
och vilja falla.*

*Då, när det är värst och inget hjälper,
Brister som i jubel trädets knoppar.
Då, när ingen rädsla längre håller,
faller i ett glitter kvistens droppar
glömmer att de skrämdes av det nya
glömmer att de ängslades för färden -
känner en sekund sin största trygghet,
vilar i den tillit
som skapar världen.*

Karin Boye, 1935

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ABSTRACT

Background

Overweight and obesity are global health problems with several adverse health effects that threaten public health. In Sweden, almost four of ten pregnant women are overweight or obese, conditions that are associated with adverse pregnancy outcomes, including gestational diabetes mellitus (GDM), a metabolic disorder that complicates pregnancy. Globally, physical inactivity is the fourth leading risk factor for mortality. The recommendation for physical activity (i.e., ≥ 150 minutes/week) issued by the Professional Associations for Physical Activity and the Swedish National Board of Health and Welfare is in line with the recommendations by the WHO. Physical activity during pregnancy is generally safe and beneficial for both the pregnant woman and her fetus and can maintain or improve fitness and may further improve pregnancy outcomes. However, pregnant women tend to lower their physical activity when entering pregnancy. Midwives working in antenatal care (ANC) in Sweden play a prominent role in promoting a healthy lifestyle through counselling pregnant women on lifestyle, including physical activity during pregnancy. Individual counselling on physical activity encourages pregnant women to maintain their pre-pregnant leisure time physical activity throughout their pregnancy.

Aims

This thesis has three main aims. First, this thesis investigated guidelines for screening of GDM, risk factors, and pregnancy outcomes in relation to GDM. Second, it investigated physical activity during pregnancy and pregnancy outcomes. Third, it explored midwives' and pregnant women's experiences with counselling that addressed physical activity during pregnancy.

Methods

Study I and III are cross-sectional studies using data from the Maternal Health Care Register and the Salut Register. A total of 184,183 pregnant women were included in Study I (2011-2012) and 3,868 in Study III (2011-2012). Several statistical analyses were used: two-independent samples t-test, Pearson's Chi-Square test, and univariate and multivariate logistic regression analyses. Study II and IV are qualitative studies applying qualitative content analysis. Study II included 41 midwives who were interviewed in eight focus group discussions (FGD). Study IV included 14 pregnant women who participated in individual in-depth interviews.

Main findings

There was no consensus in Sweden regarding clinical guidelines for screening regimes or 2-hour cut-off value for diagnosis of GDM from 2011 through 2012. Four screening regimes were applied in Sweden during this time period: A) universal screening with a 2-hour cut-off value of 10.0 mmol/L; B) selective screening with a 2-hour cut-off value of 8.9 mmol/L; C) selective screening with a 2-hour cut-off value of 10.0 mmol/L; and D) selective screening with a 2-hour cut-off value of 12.2 mmol/L. The highest prevalence of GDM was found where selective screening was applied with a 2-hour cut-off value of 8.9 mmol/L. Unemployment, low educational level, and non-Nordic origin were all risk factors for GDM, and a BMI ≥ 30 kg/m² almost four-doubled the risk for GDM compared to pregnant women with BMI < 30 kg/m². Increasing OGTT-values were associated with increasing risk of adverse pregnancy outcomes (Paper I). Midwives in antenatal care perceived counselling as both challenging and as an opportunity to promote a healthy lifestyle for pregnant women. As the theme "An on-going individual adjustment" revealed, the midwives tried to adjust their counselling to each pregnant woman's individual needs. Counselling pregnant women on physical activity was seen as complex and ambiguous with a risk of being rejected by the women if the advice was delivered too straightforward. Instead, the midwives were "tiptoeing" around the sensitive topics (Paper II). Almost half of pregnant women reported that they achieved the recommended level of physical activity during

pregnancy (i.e., ≥ 150 minutes/week). These pregnant women were characterized by lower BMI, higher educational level, and very good or good self-rated health (SRH) compared to the pregnant women who did not achieve the recommended level (Paper III). Pregnant women reported a desire for individual counselling on physical activity during pregnancy. The theme that emerged was “Longing for fulfilment of individual needs and expectations”, which reflected the wish that midwives’ counselling on physical activity should be based on pregnant women’s individual needs instead of merely providing general advice. Some participants reported receiving encouragement and support, but others believed they were provided insufficient counselling on physical activity and that the midwife had her own agenda focusing mostly on medical surveillance (Paper IV).

Conclusions

No consensus regarding clinical guidelines and diagnostic criterion for GDM existed in Sweden during 2011 to 2012. Obesity was a strong risk factor for development of GDM, and low socio-economic status and non-Nordic origin were also demonstrated as significant risk factors. Positively, almost half of the pregnant women reached the recommended level of physical activity during pregnancy. Participants fulfilling the recommendation were characterized by lower BMI, higher education, and very good or good self-rated health. Midwives strived to adjust and individualize their counselling on physical activity; however, some of the pregnant women could experience the counselling on physical activity being too general. Clearly, healthcare professionals should encourage fertile and pregnant women to be physically active, especially overweight and obese pregnant women who report low levels of physical activity, in order to improve overall health in this population.

Key words

Gestational diabetes mellitus, screening, pregnancy outcomes, physical activity, pregnancy, counselling, health promotion, midwife

SAMMANFATTNING PÅ SVENSKA

Bakgrund

Övervikt och fetma är ett stort hälsoproblem globalt med flera negativa hälsoeffekter som utgör ett hot mot folkhälsan. Nästan 40% av de gravida i Sverige har övervikt eller fetma vilket är associerat med flera negativa graviditetsutfall där graviditetsdiabetes (GDM) är en metabolisk sjukdom som komplicerar graviditeten. Fysisk inaktivitet är den fjärde ledande riskfaktorn för dödlighet i ett globalt perspektiv. Att vara fysiskt aktiv förbättrar välbefinnandet och livskvaliteten, främjar stabil vikt, insulinkänslighet och normalt blodtryck. Vidare sänker fysisk aktivitet risken för diabetes mellitus typ 2, fetma och hjärt-och kärlsjukdomar. Fysisk aktivitet under en okomplicerad graviditet är generellt att betrakta som utan risk och ökar välbefinnandet för både kvinnan och fostret. Fysisk aktivitet bidrar till att bibehålla eller förbättra fysisk kondition och kan förbättra graviditetsutfall. Trots dessa fördelar tenderar gravida att sänka sin fysiska aktivitet under graviditeten. De svenska rekommendationerna följer de internationella riktlinjerna som innebär ≥ 150 minuter/vecka av måttlig fysisk aktivitet alternativt 75 minuter/vecka av intensiv fysisk aktivitet eller en kombination av dessa. Svenska barnmorskor som arbetar inom mödrahälsovården i Sverige har en central, rådgivande roll gentemot gravida kvinnor när det gäller att verka för en hälsosam livsstil inkluderande fysisk aktivitet. Individuell rådgivning i fysisk aktivitet kan uppmuntra och stödja gravida kvinnor att fortsätta vara fysiskt aktiva under hela graviditeten.

Syfte

Att kartlägga riktlinjer för graviditetsdiabetes i Sverige samt riskfaktorer och graviditetsutfall i relation till GDM. Vidare att undersöka fysisk aktivitet under graviditeten samt associationer till graviditetsutfall och slutligen att utforska barnmorskor och gravida kvinnors upplevelser av rådgivning i fysisk aktivitet.

Metod

Studie I och III var tvärsnittsstudier där data från Mödrahälsovårdsregistret och Salutregistret nyttjades. Totalt 184,183 gravida kvinnor inkluderades i Studie I och 3,868 inkluderades i Studie III (tidsperiod 2011-2012). Statistiska analyser som genomfördes var t-test, Pearson's Chi-2-test och univariat samt multivariat logistisk regressionsanalys. Studie II och IV var kvalitativa studier där intervjuerna analyserades med manifest och latent kvalitativ innehållsanalys. Studie II inkluderade 41 barnmorskor i åtta fokusgrupper och 14 gravida omföderns djupintervjuades individuellt i Studie IV.

Resultat

Under perioden 2011-2012 förelåg inte någon enighet gällande riktlinjer för screening och gränsvärde för diagnosen GDM i Sveriges 43 mödrahälsovårdsområden. Fyra olika screeningregimer identifierades; A) generell screening och 2-timmar gränsvärde på 10,0 mmol/L i plasmaglukos, B) selektiv screening och 2-timmar gränsvärde på 8,9 mmol/L i plasmaglukos, C) selektiv screening och 2-timmar gränsvärde på 10,0 mmol/L i plasmaglukos och D) selektiv screening och 2-timmar gränsvärde på 12,2 mmol/L i plasmaglukos. Den högsta prevalensen av GDM återfanns i det område som hade 8,9 mmol/L som gränsvärde och den lägsta där 12,2 mmol/L var gränsvärdet för GDM. Arbetslöshet, låg utbildningsnivå och ett utom-nordiskt ursprung utgjorde alla riskfaktorer för utveckling av GDM. Fetma, BMI ≥ 30 kg/m², utgjorde den riskfaktor med högst risk för att utveckla GDM under graviditet med en nästan fyrdubblad risk jämfört med en kvinna med BMI < 30 kg/m². Ökande 2-timmarsvärden av blodglukos var associerat med ökande negativa graviditetsutfall såsom kejsarsnitt och instrumentell vaginal förlossning (Artikel I). Barnmorskorna i mödrahälsovården upplevde rådgivningen i fysisk aktivitet som å ena sidan utmanande men å andra sidan som en möjlighet att verka för en hälsosam livsstil hos de gravida kvinnorna. Temat "En ständigt pågående anpassning" visar barnmorskornas försök att anpassa sin rådgivning efter varje enskild gravid kvinnas behov och situation. Rådgivningen i fysisk aktivitet till gravida upplevdes som komplex och mångfacetterad. Det uttrycktes en oro för att bli avvisad av den gravida kvinnan om de givna råden förmedlades för uppriktigt. Detta ledde ibland till att barnmorskorna

”trippade på tå” och försiktigt närmade sig känsliga ämnen såsom övervikt och råd om fysisk aktivitet. Barnmorskorna försökte även finna individuella lösningar och anpassa råden utifrån varje enskild gravid kvinnas möjligheter. Detta var särskilt tydligt i mötet med kvinnor som immigrerat till Sverige, där barnmorskorna upplevde att en del av rådgivningen bestod i att slå hål på myter om fysisk aktivitet såsom något riskfyllt samt att informera om de positiva hälsoeffekterna med fysisk aktivitet under graviditeten (Artikel II). Nästan hälften av de gravida kvinnorna uppnådde Socialstyrelsens rekommendationer avseende fysisk aktivitet under graviditet och dessa kvinnor karakteriserades av lägre BMI, högre utbildningsnivå samt mycket bra/bra självskattad hälsa jämfört med de gravida som inte uppnådde rekommendationerna (Artikel III). Temat som framkom i Artikel IV var ”Längtan efter tillfredsställelse av individuella behov och förväntningar” och speglar de gravidas önskan att erhålla en individuellt anpassad rådgivning i fysisk aktivitet av barnmorskorna istället för en generell rådgivning avsedd för alla. Några gravida hade erfarenheter av barnmorskan som stöttande och uppmuntrande i sin rådgivning i fysisk aktivitet. Andra kunde uppleva rådgivningen som otillräcklig, att barnmorskan exempelvis inte hade tillräckligt med kunskap i fysisk aktivitet samt att barnmorskan hade en egen agenda för deras möten som i huvudsak fokuserade på den medicinska övervakningen av graviditeten.

Slutsats

Under perioden 2011-2012 förelåg ingen consensus angående de nationella riktlinjerna och diagnostiska värdet för GDM i Sverige. Fetma var den riskfaktor med högst risk för utvecklande av GDM och låg socio-ekonomi, maternell ålder >35 år samt utom-nordiskt ursprung utgjorde även riskfaktorer för GDM. Positivt var att nästan hälften av de gravida uppnådde Socialstyrelsens rekommendationer för fysisk aktivitet under graviditeten och dessa karakteriserades av signifikant lägre BMI, högre utbildningsnivå samt mycket god/god självskattad hälsa. Trots att barnmorskorna beskrev hur de strävade efter att anpassa rådgivningen i fysisk aktivitet till varje enskild kvinna, kunde de gravida kvinnorna uppleva att rådgivningen var otillräcklig, för generell och främst fokuserad på den medicinska övervakningen. Det är av största vikt att hälso- och sjukvårdspersonal som möter fertila och gravida kvinnor verkar för en hälsosam livsstil, särskilt

avseende kvinnor med en inaktiv livsstil och de som har övervikt eller fetma för att på så sätt förbättra hälsan hos denna del av befolkningen. För att uppnå detta krävs resurser gällande personal, tidsutrymme samt fortbildning inom hälsa och rådgivning för barnmorskor och annan hälso- och sjukvårdspersonal som möter dessa kvinnor. Slutligen, för att möjliggöra rådgivning som avser att stödja fysisk aktivitet för de kvinnor som immigrerat till Sverige behövs mer kunskap och utbildning i mötet med dessa kvinnor.

ORIGINAL PAPERS

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No consensus on gestational diabetes mellitus screening regimes in Sweden: pregnancy outcomes in relation to different screening regimes 2011 to 2012, a cross-sectional study. *BMC Pregnancy Childbirth*. 2014 May 31;14:185.
- II. **Lindqvist M**, Mogren I, Eurenus E, Edvardsson K, Persson M.
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Leisure time physical activity among pregnant women and its associations with maternal characteristics and pregnancy outcomes. Accepted, *Sexual & Reproductive Healthcare*.
- IV. **Lindqvist M**, Persson M, Mogren I.
“Longing for individual recognition” - pregnant women’s experiences of midwives’ counselling on physical activity during pregnancy. Submitted.

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Paper I BMC Pregnancy & Childbirth

Paper II BMC Pregnancy & Childbirth

DEFINITIONS AND GLOSSARY

Bias	Every effect on the study that results in a systematic deviation of the results from reality. Defined as design bias, gender bias, instrumental bias, observation bias, and publication bias. In some cases, bias may cause an association to appear to be present when it is not (false positive; type 1 error) or for an association to appear absent when an effect is truly present (false negative; type 2 error).
Confidence interval	An interval that, with a specified grade of confidence of (e.g., 95%), includes the true value of the target variable in the population (when the value has been calculated on a representative sample of this population).
Confounding	A confounding factor is one that is associated with the studied exposure while at the same time being a risk factor for the measured dependent outcome variable.
Cross-sectional study	A study that examines the relationship between diseases or other health-related characteristics and other variables of interest as they exist in a defined population at one particular time.
Epidemiology	The study of the distribution and determinants of health-related states or even in specified populations, and the application of this study to control the problems.
Focus group discussions	A method of data collection in a special composed group generating qualitative data and to use the group interaction to explore people's own experiences.

Logistic regression	A regression analysis where the dependent variable is binary and where the association between two or more variables is a function of the included determinants. A logistic regression is based on an equation modelling the logarithmic odds as a linear function of determinants.
Member check	To bring back the results to the members of the studied group with the purpose of strengthen the credibility of the results.
Odds ratio	The ratio between two odds. The odds of a particular exposure among persons with specific characteristics divided by the corresponding odds of exposure among persons without the characteristics of interest. In logistic regression, the parameter estimates are transformed to odds ratios.
Power estimation	The estimation of the power of the pre-requisites of the study (including the sample size) to be able to reject the null hypothesis when it is false.
Population attributable proportion	The proportion of cases in the population that should not have occurred if the exposed had had the incidence of the unexposed.
Purposive sampling	Non-random procedure used mainly for qualitative analysis. Each participant is selected deliberately aiming for a great variation of his or her characteristics, with the expectation that they, on a theoretical basis, will represent the phenomena under study.
Qualitative in-depth interviews	Open-ended and conversational interviews for the purpose of exploring specific themes or phenomena under study.

Reliability	The extent to which a study is free from errors of measurements. Careful testing of the instruments is required. In qualitative studies this refers to the ability of the researcher to account for changing conditions. To allow other researchers to follow the decision trail is one way to increase reliability.
Risk factor	Characteristics of individuals that on the basis of epidemiologic evidence is known to be associated with health-related conditions considered important to prevent.
Saturation	The stage in the research process when an additional interview or observation is not expected to add new information. This is the stage where, in qualitative studies, you ideally should stop data collection.
Triangulation	A technique of using different data collection methods, data sources, informants, analytical approaches, or investigators in a study of a joint problem to enhance the trustworthiness.
Trustworthiness	Trustworthiness usually includes the following terms: credibility, transferability, dependability, and confirmability. These terms can be compared with internal validity, external validity, reliability, and objectivity in quantitative research.
Validity	The ability of the quantitative study to capture what was stated in the aims. <i>Internal validity</i> refers to the performance of the study. For statistical analysis, validity refers to selection criteria and other types of bias. The <i>external validity</i> refers to the possibility to transfer or generalise the results to other populations or settings. For qualitative analysis, triangulation, prolonged engagement and member checks are important.

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ABBREVIATIONS

AGA	Appropriate for Gestational Age
ANC	Antenatal care
BMI	Body Mass Index
CI	Confidence Interval
CS	Caesarean section
DM2	Diabetes Mellitus type 2
FGD	Focus Group Discussions
GDM	Gestational Diabetes Mellitus
HAPO	Hyperglycemia and Adverse Pregnancy Outcome
IADPSG	International Association of Diabetes and Pregnancy Study Group
ICF	International Classification of Functioning
LGA	Large for Gestational Age
LTPA	Leisure-time physical activity
MBR	Medical Birth Register
MHCA	Maternal Health Care Areas
MHCR	The Swedish Maternal Health Care Register
MHCR-VB	The Swedish Maternal Health Care Register in Västerbotten
NBHW	The Swedish National Board of Health and Welfare
OGTT	Oral Glucose Tolerance Test
OR	Odds Ratio
PAP	Population attributable proportion
SALUT-R	The Salut Register
SGA	Small for Gestational Age
SRH	Self-Rated Health
WHO	World Health Organization

INTRODUCTION

Overweight and obesity during pregnancy

“The health of women and children is critically important to almost every area of human development and progress...research has conclusively demonstrated that the health of women and children is the cornerstone of public health. Healthy women and children create healthy societies. Healthy societies, in turn, are the foundation upon which nations build successful economies and create prosperity for their people.” Global Strategy for Women’s and Children’ Health. United Nations Secretary-General Ban Ki- moon, Geneva, 2010.

The epidemic of overweight and obesity is an increasing health problem internationally as well as nationally, with implications for health care and health prevention within all areas (1-7). Globally, Swedish pregnant women and their offspring are healthy (8). However, 38% of Swedish pregnant women are overweight or obese (8), a number that has almost doubled in the last 20 years (7). This is a threat not only to public health and the Swedish population in general, but also to maternal and fetal health outcomes per se (3, 9). Being overweight or obese are strongly related to several adverse maternal outcomes such as gestational diabetes mellitus, hypertensive disorders including preeclampsia, premature delivery, instrumental delivery, and caesarean section (3, 5). Furthermore, these complications during pregnancy and delivery are associated with adverse fetal outcomes such as small for gestational age, large for gestational age, fetal stress, and perinatal mortality and morbidity (5). For many women, obesity often starts in pregnancy due to excessive weight gain during pregnancy or the inability to lose weight postpartum (10). More than 40% of women in Sweden gain more weight than recommended during pregnancy (11). Obesity in itself is a risk factor for excessive weight gain during pregnancy, which adds to the risks for complications during pregnancy and delivery and makes weight retention postpartum more likely (10). Inter-pregnancy weight increase may increase perinatal complications even though the pregnant woman does not become overweight by definition (12).

Gestational diabetes mellitus

Definition, prevalence, and pathophysiology

The definition of gestational diabetes mellitus (GDM) has varied throughout the years and the current definition is diabetes diagnosed in the second or third trimester of pregnancy that is not clearly overt diabetes (13). A recent study investigating the global prevalence of GDM (36 countries included) demonstrates large variations of the prevalence due to different screening methods, diagnostic criteria, and population characteristics. The highest prevalence of GDM is found in Middle East and North Africa with a median prevalence of 12.9% (range 8.4%-24.5%) and the lowest in Europe with a median prevalence of 5.8% (range 1.8%-22.3%) (14). In this perspective, Sweden is considered a low risk country for GDM with an annual prevalence of 1% to 2.6% (15, 16). For a non-pregnant woman as well as for a pregnant woman, glucose levels are controlled by insulin. The β -cells in the pancreas are responsible for the regulation of insulin, increasing or decreasing the levels (17). Insulin resistance is explained by decreased insulin-stimulated glucose uptake and metabolism in the tissues of the body (e.g., adipose tissue) due to an impaired suppression of glucose output from the liver. This is called hepatic gluconeogenesis (18). Different conditions can initiate insulin resistance such as hormonal and metabolic changes that normally occur during pregnancy (19), but insulin resistance can also be the result of unhealthy conditions, such as being overweight or obese (20). The insulin resistance caused by pregnancy can be compensated with normal β -cell function. Hence, the development of GDM is usually due to the inability of the β -cells to respond to the required insulin level within the tissue (21, 22).

Risk factors and adverse outcomes associated with GDM

GDM is strongly related to being overweight or obese, and the risk of developing GDM is doubled for pregnant women who are overweight (Body Mass Index, BMI 25.0-29.9 kg/m²) and the risk increases by more than six-fold for pregnant women who are obese (BMI \geq 30.0 kg/m²) (23). Other significant risk factors for developing GDM are having a family history of diabetes mellitus type 2, unexplained intrauterine fetal death, maternal age \geq 35 years, immigrant status (24-26), and a previous child birth with weight exceeding 4500 grams (27). Other risk factors

related to GDM diagnosis are elevated fasting or randomly measured plasma glucose (28), accelerated fetal growth (29, 30), and increased amount of amniotic fluid (i.e., polyhydramnios) (30, 31). Women with GDM have an increased risk of adverse outcomes of pregnancy and childbirth, such as hypertensive conditions (32-34), including a three-fold risk of preterm development of preeclampsia (35), induction of labour (15, 33), and an increased risk of DM2 later in life (36). The results from the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study show that higher maternal glucose levels are associated with increased risk of macrosomia, caesarean sections, induction of labour (15, 33) as well as a premature delivery (37, 38) and neonatal hypoglycemia (39). Furthermore, the offspring of women with GDM during pregnancy have increased risk of obesity, glucose intolerance, and diabetes mellitus in puberty or early adulthood, all conditions included in the metabolic syndrome (40, 41). This increase in risk is believed to be due to fetal programming – the gene transcription and modulation in the immature organs of the fetus affected by the intrauterine environment (42).

Screening for GDM – international aspects

The diagnosis of GDM is based on the result from the oral glucose tolerance test (OGTT), but there are several screening methods described (43). In 1979 and 1980, the U.S. Diabetes Data Group (NDDG) established that a 3-hour 100-g oral glucose tolerance test should be used as a diagnostic test for GDM in the USA (44). The American Diabetes Association (ADA) and many more associations all over the world adopted these recommendations for OGTT. However, in 1980 the WHO adopted the 75-g oral glucose tolerance test (45), and in 1999 they established the following diagnostic cut-offs: fasting ≥ 7 mmol/L or 2-hour plasma glucose ≥ 7.8 mmol/L. These recommendations have been maintained throughout the years (46). In 2011, the International Association of Diabetes and Pregnancy Study Group (IADPSG) presented their recommendations for thresholds for GDM diagnosis based on the epidemiological HAPO study (47), and these recommendations have also been adopted by the WHO (48). Their proposed criteria for GDM diagnosis when using a 75-g OGTT include fasting plasma glucose of 5.1-6.9 mmol/L (92-125 mg/dL) or a 1-hour plasma glucose of 10.0 mmol/L (180 mg/dL) or a 2-hour plasma glucose of 8.5 mmol/L (153 mg/dL) (47). There is, however, no international consensus regarding how pregnant women should be

screened for GDM, whether screening should be undertaken universally, or whether women who present risk factors should undergo screening (i.e., selective screening) (49).

Screening for GDM in Sweden

In Sweden, no national guidelines have previously been available regarding diagnosis and screening for GDM (50, 51). As a result of this lack of national consensus, there are various cut-offs applied for plasma glucose levels after OGTT, so GDM diagnosis is inconsistent across Maternal Health Care Areas (MHCA) in Sweden. Before 2015, there were two national approaches for screening for GDM in Sweden: 1) a universal screening approach where all pregnant women are offered an OGTT and 2) a selective screening approach based on maternal risk factors specified in the local guidelines. The risk factors that indicate a need for screening for GDM include family history of diabetes mellitus type 2 (DM2), GDM, macrosomic infant (defined as 4500 grams or more or large for gestational age), stillbirth in previous pregnancy, BMI ≥ 30 kg/m², and non-European nationality. The risk factors for OGTT during pregnancy indicating an OGTT are accelerating fetal growth, polyhydramnios, and elevated random capillary plasma glucose. Both universal and selective screening regimes for the diagnostic procedures stipulate the use of a 75-g glucose load and the 2-hour value of the capillary plasma glucose. In June 2015, the National Board of Health and Welfare (NBHW) issued their national recommendations for diagnosis of GDM. NBHW has decided to embrace the recommendations for GDM diagnosis issued by WHO (48) and IADPSG (47). The proposed diagnostic criteria for GDM when using a 75-g OGTT include fasting plasma glucose of ≥ 5.1 mmol/L or a 1-hour plasma glucose of ≥ 10.0 mmol/L or a 2-hour plasma glucose of ≥ 8.5 mmol/L based on plasma glucose samples (52). Internationally, the recommendations are based on venous glucose levels, although Sweden uses capillary plasma glucose levels for diagnostics (53). Several studies have not found any differences between venous and capillary glucose in the fasting state, but these studies did find that after glucose intake the glucose capillary levels were higher than the glucose venous levels. However, a study in 2011 reported that the capillary glucose levels are higher than the venous glucose levels at all time points of the OGTT (53). In summary, the NBHW has concluded that there are no differences in plasma glucose level during the fasting state, but that there are higher capillary glucose levels

compared to venous the glucose value after the load of glucose (52). A national randomized-controlled study is planned to start during 2016 in Sweden to further investigate the implementation of the new guidelines (personal message).

Physical activity

The definition of physical activity is “any bodily movement produced by skeletal muscles which results in energy expenditure” (54). Physical activity has a major positive health effect, and physical inactivity has been identified as the fourth leading risk factor for global mortality (6% of deaths globally) and a threat to public health (55-57). Strong evidence shows that physical inactivity increases the risk of many adverse health conditions such as coronary heart disease, high blood pressure, stroke, metabolic syndrome, type 2 diabetes, depression, osteoporosis, and breast and colon cancers (58). A study of 4,634 women and men concludes that life span is prolonged by more than three years if the subjects maintain normal weight and stay physically active (59). According to estimates by the WHO, the disease burden in the European Region as a result of unhealthy eating habits and physical inactivity is at least the same as the disease burden caused by smoking or excessive alcohol consumption. Prevention against obesity should be of the same calibre and scale, including the reduction of social inequalities in health, which is a major goal in public health policy (60).

Physical activity during pregnancy

Physical activity during uncomplicated pregnancies is generally safe and beneficial for both the pregnant woman and her fetus and does not in general increase the risk of adverse pregnancy outcomes (61). Physical exercise during pregnancy may maintain or improve fitness and may further reduce the risk of pregnancy complications such as pre-eclampsia, preterm birth, and excessive maternal gestational weight gain (61-66). Physical activity is associated with very good or excellent self-rated health (67) and well-being. Women who are physically active before pregnancy seem to continue their physically active lifestyle into pregnancy (68). There is, however, insufficient evidence to conclude that physical exercise prevents pregnancy glucose intolerance or gestational diabetes mellitus (GDM) (69).

Measurement of physical activity

In epidemiological studies of large populations, questionnaires are the only feasible method for collecting data on physical activity (70, 71) and questionnaires offer easy access to a large sample at a low cost. However, there are some disadvantages. For example, respondents tend to overestimate their physical activity, so a validation of the instrument is crucial (72). Although measuring physical activity in representative populations with absolute precision is impossible, several methods can be used to assess physical activity. If the sample is small, accelerometers, heart rate recorders, and oxygen consumption meters are convenient ways to assess physical activity.

Guidelines for physical activity

The WHO's recommended levels of physical activity for the ages 18-64 years are at least 150 minutes (performed in bouts of at least 10 minutes) of moderate-intensity aerobic physical activity per week, or at least 75 minutes of vigorous-intensity aerobic physical activity per week, or a combination of these. Pregnant women should seek medical advice before striving to achieve these recommendations (58). These recommendations are also adapted and translated into Swedish by the Professional Associations for Physical Activity (61). Furthermore, these recommendations are in line with guidelines on health promotion developed by the Swedish National Board of Health and Welfare (NBHW) (2011).

The Swedish National Board of Health and Welfare is also responsible for developing evidence-based national guidelines in the health sector. These guidelines focus on good health care for common conditions and for patients with serious diseases where health care requires significant resources. In 2011, NBHW issued national guidelines for health promotion related to counselling on lifestyle involving tobacco, alcohol, physical activity, and eating habits. For the implementation of the guidelines, the NBHW has pointed out the importance of health professionals using a health promotion approach. As advocates for healthy lifestyles, health professionals primarily provide patients with information, tools, and support. Counselling should be designed as a supportive dialogue based on the patient's own experiences and lifestyle and takes into account the patient's motivation to change (73).

Self-rated health

Self-rated health is defined as self-assessment of overall health status. Self-rated health has increasingly attracted interest in its relation to different health outcomes and can be used to predict morbidity, mortality, and use of healthcare resources (40-43). Studies have tried to understand the role of self-rated health as a predictor for future disease. In Sweden, self-rated health has also proved to be a reliable predictor for mortality (74). Good self-rated health is progressively declining during pregnancy (44, 45), and health problems originating during pregnancy may also influence self-rated health postpartum (46).

Counselling

Counselling is about verbal and non-verbal communication between individuals. Body language cues (including eye contact, posture, and facial expressions) are all different expressions of non-verbal communication. To give advice is seen as a practical recommendation for action. Counselling, however, is weighty and serious advice given after careful deliberation. Counselling as a term means to listen, support, advise, or provide professional recommendations on social problems. In 2014, The American Counselling Association (ACA) reached a consensus regarding the definition of counselling: "Counselling is a professional relationship that empowers diverse individuals, families, and groups to accomplish mental health, wellness, education, and career goals" (75). Counselling is designed to make a person confident enough to take a particular course of action (76). During counselling, the importance of the non-equal relationship between the caregiver and the patient is emphasized. The caregiver is allowed to ask the most intimate questions, but the patient does not have that option. Counselling comprises verbal communication, non-verbal communication, as well as educational aids such as written information sheets, pamphlets, and brochures. Clear, honest, and adequate information should be given to patients as required (77). It is estimated that a person is only able to recall half of what is heard after a counselling session and remembers best the information from the first third and the last quarter of the session. This underlines the importance of just providing verbally key information, and supplementing it with written information to take home. Goal setting helps patients focus on mobilising efforts and motivates them to search for strategies for action (78).

Motivational interviewing (MI), a common method used in antenatal care in Sweden for behavioural change during pregnancy, is recommended by the Swedish National Board of Health and Welfare. MI is defined as “a directive, client-centred counselling style for eliciting behaviour change by helping clients to explore and resolve ambivalence” (79). The four general principles are expressing empathy, developing discrepancy, rolling with resistance, and supporting self-efficacy (80). The method has been modified to fit different contexts and areas of application (81). The main goal is to consider and help the client to act upon their ambivalence in order to facilitate a change in behaviour. The effect on behavioural change, using MI as an intervention programme in primary care, is still unclear due to the different approaches and mixed methods used when applying MI as an intervention (82). However, a meta-analysis concludes that MI cannot be disregarded as an important component in changing sedentary behaviour (83). The Swedish National Board of Health and Welfare suggests that counselling on lifestyle changes, such as increasing physical activity, should usually be performed in 10 to 15 minutes and for more challenging cases in 30 minutes (84).

Midwives' counselling during pregnancy

Midwives working in ANC provide medical support for all fertile women as well as medical surveillance during pregnancy. The supporting role of the midwife is prominent, related both to sexual and reproductive health as well as promotion of a healthy lifestyle. Furthermore, pregnancy is an ideal opportunity to promote change of lifestyle that may benefit both the pregnant woman and her fetus (85). The content and quality of the relationship established between the midwife and the pregnant woman is central for successful health care. Effective communication not only increases the quality of maternity care, but also ensures clinical safety (86-89). In addition, trust and confidence are significant components with respect to the relationship between caregivers and patients (90). Swedish midwives apply different strategies to promote healthy behaviour and to protect the relationship when advising the pregnant woman and her partner. These strategies depend on whether the pregnancy is normal or complicated (89, 91). Care providers perceive the topic of excessive weight gain during pregnancy as a sensitive topic during pregnancy (92). A patient-centred and individualized care where the pregnant woman and her midwife are seen as partners is preferable (93).

Pregnant women's experiences of counselling

Experiences by pregnant women on conflicting information from health care providers and other professionals concerning physical activity during pregnancy have been described (94). During antenatal care, pregnant women often experience a lack of information and advice on physical exercise during pregnancy and perceive the caregiver's knowledge as limited (95). As reported by pregnant women, barriers to performing physical activity during pregnancy include lack of time and motivation, increased body size, pain, and other physical barriers (94, 96). The wellbeing of the fetus can motivate pregnant women to perform physical activity and strive for a healthy lifestyle (94, 97). One qualitative study concludes that pregnant women need unambiguous advice regarding healthy lifestyle, diet, and exercise during pregnancy (98). As a result of these findings, healthcare providers are demanding specific evidence-based guidelines on physical activity for pregnant women (94).

Lifestyle

According to the WHO's International Classification of Functioning, lifestyle includes personal factors such as "particular background of an individual's life and living" (99). The ability to change lifestyle depends on the motivation to change. Before providing counselling, caregivers should assess a patient's level of agreement and motivation to change lifestyle (100). At the beginning of the 20th century, science viewed people as passive beings, only reacting to stimuli that affected behaviour (101). However, this view has changed; from the 1960s, it has been understood that people interact with their environment (102). To further understand the predictors for our behaviour, Ajzen's model of Theory of Planned Behaviour can shed some light on this concern. Briefly, the theory is based on three considerations: behavioural beliefs (beliefs of presumable consequences of the behaviour), normative beliefs (beliefs of normative expectations of others), and control beliefs (beliefs about facilitators or barriers to perform the behaviour). An explanation of the non-impact of "increasing the knowledge campaigns" on behavioural change is probably due to the effort of using only knowledge as the tool to change behaviour. According to Ajzen, a successful behavioural change is achieved by addressing attitudes, norms, and beliefs (103).

Pregnancy is an ideal opportunity to promote a change in lifestyle, which may benefit both the pregnant woman and her fetus, as the pregnant woman may be more motivated to change her unhealthy behaviours (85). There are several interventions in antenatal care that promote physical activity during pregnancy. However, a recent review of nine interventions for physical activity concluded that very few interventions significantly influence physical activity during pregnancy. In part, this conclusion reflected the fact that these studies were poorly designed (i.e., they had poor validity). Furthermore, the authors of the review emphasized the importance of interventions grounded in a theoretical framework of behavioural change. The environment of the individual (i.e., family, friends, and social networks) as well as the community and policy levels should be considered when developing future intervention strategies (104). In addition, several studies (68, 96, 105, 106) have focused on barriers and facilitators for physical activity during pregnancy, and for later intervention they point out the importance of including the role of environment (107).

Information on pregnancy-related issues

Pregnant women tend to seek advice and support regarding pregnancy-related issues not only from their midwife and other healthcare professionals (108) but also from magazines, books, the Internet, family, friends, and work colleagues (108, 109). A study concludes that 97% of pregnant women use Internet search engines (e.g., Google and Yahoo) to find information (110, 111), and 94% of the women use the Internet as a complement to the advice provided by healthcare professionals (110). It is more common to use the Internet to confirm the advice or information healthcare professionals provide than to confirm the information found on the Internet with the information the midwife or healthcare professionals provide (111, 112). A study exploring the Internet's impact on decision-making during pregnancy concludes that one of the reasons pregnant women seek information on the Internet is they do not feel the number of their antenatal care visits is sufficient (113). Furthermore, pregnant women often believe information on physical activity is vague and often the advice they receive is contradictory (108). Healthcare professionals should encourage and inform pregnant women on the importance of being critical about information on the Internet, to check with their midwife or appointed

healthcare professional, and to choose reliable professionals in the field of pregnancy and childbirth (111, 113).

Scientific methods

Quantitative research has been the dominating research method since the late 19th century through the mid 20th century. In the second half of the 20th century, qualitative methods were more common. Later, mixed methods were initiated. There are some important differences between quantitative and qualitative research. Choosing the method for a research project depends on the researchers' philosophical assumptions and their strategies (e.g., how they collect the data) (114). In this thesis, we have used both quantitative and qualitative methods depending on the research questions under study.

Quantitative methods

Quantitative methods are based in the positivistic paradigm (115). The aim is to act on causal relationships between an exposure and an outcome and further generalize the results to the whole population. When doing quantitative research, a deductive approach is applied with an experimental or observational design (114, 115) and a test of the hypothesis to investigate the representativity of the results (116). Data are analysed through statistical methods.

Epidemiology

Epidemiology is the study of the distribution of health-related states or events in specified human populations including the determinants influencing such states and the application of this knowledge to control health problems (117). The distribution is about time, place, and person and the determinants are factors that affect health (i.e., chemical, physical, social, culture, economical, genetic, or behavioural factors). Health-related states are defined as diseases and causes of death, as well as the positive aspects of health and reactions to preventive methods used in health care. Studies are usually observational studies rather than experimental studies (118). Furthermore, an epidemiological study focuses on a well-defined population, such as a population in a specified geographical area at a specific time. Epidemiological research aims to identify different risk factors for diseases in the population (e.g., lifestyle habits, alcohol habits, and tobacco habits) as well as to improve and

restore public health (117). Furthermore, epidemiological studies are typically used to investigate public health – i.e., efforts organised by society to protect, promote, and restore people’s health. It is the combination of sciences, skills, and beliefs that is directed to the maintenance and improvement of the health of all the people through collective or social actions (119). Public health science is a multidisciplinary field that studies the significance of the healthcare system, social fabric, working life, and the environment with respect to the health of the population (120).

Qualitative methods

Qualitative research is “an inquiry process of understanding based on distinct methodological traditions of inquiry that explore holistic picture, analyses words, report detailed views of informants, and conducts the study in a natural setting” (121).

In qualitative research, the paradigm is naturalistic (115). Performing qualitative research aims to explore and understand individual experiences with a topic or an unknown concept. The qualitative method focuses on the “how” and “why”. The researcher often collects the data through an inductive method, aiming to discover new findings by interacting with the participant (116). The most common data collection method is through interviews in different forms such as in-depth interviews and focus group discussions (FGD) conducted in the participant’s work or home. The researcher often uses purposive sampling when conducting the study: the researcher tries to achieve as great a variation as possible of the characteristics of the participants (122, 123).

Qualitative content analysis

More than 60 years old, content analysis initially was a quantitative method, a way to systematically and objectively describe the manifest content in written communicated materials (116). The method has developed through the years and is currently characterized by two approaches: 1) a quantitative approach similar to the original and 2) a qualitative approach that includes an interpretation of the manifest as well as the latent content (124). Qualitative content analysis can further be divided into two methods of analysis depending on the way that the categories are derived from the text – the inductive content analysis or

conventional content analysis where the analysis (i.e., codes and categories) depends solely on the text, the deductive content analysis, or *directed content analysis* where the analysis starts from a theory (125, 126). The qualitative content analysis has a systemically step-by-step approach. After reading the text several times, the text is divided into meaning units (i.e., the constellation of words or statements that relate to the same central meaning) (124). Thereafter, the meaning units become condensed meaning units with a higher abstraction level through codes, sub-categories, and categories. At the end of the analysis process, the underlying meanings – the latent content – in the categories are linked together as an emerging theme (124).

Validity in quantitative research

Typically, validity relates to the “the degree to which a measurement or a study reaches a correct conclusion” (118); that is, validity refers to how accurately the study measures what it claims to measure in the study population. There are two main types of validity: 1) external validity refers to how well the results of the study apply to other populations i.e., representativity, and 2) internal validity refers to how well the results reflect the true situation in the study population and the degree the study is free from systematic errors. Systematic errors are errors (or biases) that can lead to a distortion of the results. Random errors can be avoided through a larger study sample (118). In observational studies this is highly important to take into consideration, due to the non-existing randomization of the material that may lead to differences in the characteristics of the study groups. Furthermore, bias can lead to stronger or weaker associations than the real situation. Bias can be divided into three types; selection bias, information bias and confounders (118). Selection bias is due to systematic differences in the characteristics between the recruitment of two study groups, making the comparisons between the two groups invalid. Information bias, such as recall bias, is a misclassification of the exposure or outcome of the data. A confounding factor is one that is associated with the studied exposure while at the same time being a risk factor for the measured dependent outcome variable. (118, 119).

Trustworthiness in qualitative research

To ensure validity in qualitative research, the concept of trustworthiness is often applied. Trustworthiness usually includes the following terms: *credibility*, *transferability*, *dependability*, and *confirmability*. These terms can be compared with internal validity, external validity, reliability, and objectivity in quantitative research (123). *Credibility* refers to the “true value” and deals with how well we have understood and described the participants’ reality in the study. It includes the description of the recruitment process as well as how well the presentation of results covers the data through categories, sub-categories, and themes (124). Member checks where the participants have the opportunity to assess the results, and triangulation where for example different researchers evaluate the data, can be useful methods of evaluation. How applicable the results are in relation to other contexts is described as *transferability*. However, qualitative research does not aim to achieve statistical generalisation. Instead, it aims for analytical generalisation of the research question by securing as much variation as possible among the participants’ characteristics. Furthermore, the aim is to strengthen the transferability, therefore the data collection continues until saturation in data. Transferability is further achieved through the researchers detailed description of the study’s sampling, setting, data collection, the analysis process and the participants’ characteristics, (124, 126). *Dependability* refers to the consistency or reliability and the possibility for others to follow the researchers’ “decision trail”. Dependability can be strengthened through detailed field notes of the data collection process and analysis. In addition, dependability is further strengthened when the data collection is performed over a short period. Finally, *confirmability* deals with the neutrality of the data more than the neutrality of the researcher. Although objectivity is often the goal of research, the researcher and the study participants in qualitative research unavoidably interact, so true objective is impossible (123). Thorough discussions in the research group including researchers with different backgrounds can strengthen objectivity in data.

THE SETTING

Antenatal care in Sweden

The Swedish antenatal care, inspired by maternal healthcare in England, was organised during the 1930s to focus on medical and social aspects for the good health of the new born child. At first, the pregnant women were offered two visits, one to a midwife and one to a doctor. The visits focused on hygiene childcare education and how to measure of blood pressure and albumin in urine. Gradually, the number of visits increased and the midwives went from being the doctor's assistant to a central role in supporting the pregnant woman and acting as a counsellor in reproductive health. Today, the midwife is responsible for the surveillance of pregnancy, primarily managing uncomplicated pregnancies. The national guidelines of surveillance during pregnancy in antenatal care were created by the professional associations of obstetricians and midwives (127); however, different local Maternal Health Care Areas (MHCA) may have their own guidelines (50, 127). The national guidelines recommend eight to ten antenatal care (ANC) visits for uncomplicated pregnancies. The ANC surveillance programme aims to identify risk factors during pregnancy that could result in complications for the mother or the fetus. These examinations include for example measuring blood pressure, other biomarkers, symphysis-fundus, and maternal weight. Counselling on healthy lifestyle – including alcohol and nicotine use, diet, and psychosocial active – is provided.

ANC in Sweden is free and is currently organized in 43 areas (i.e., the MHCA) that roughly correspond to the Swedish counties. A consultant obstetrician and a consultant midwife are responsible for the guidelines regarding maternal and fetal surveillance and medical management within each MHCA. The overall aim of antenatal care in Sweden is to achieve “good sexual and reproductive health for the whole population”, a goal that is similar to the WHO's guidelines for sexual and reproductive health. Furthermore, Swedish antenatal care aims to *i)* provide health care during pregnancy and postpartum period, *ii)* support expecting parents in their preparation of parenthood, *iii)* provide individual family planning, *iv)* prevent unwanted pregnancies and STDs, *v)* screen for cervical cancer, and *vi)* promote healthy lifestyle and improve public health (127).

The role of the midwife in Swedish antenatal care

Midwives working in ANC focus on different aspects of reproductive and sexual health in an attempt to support the woman throughout her whole life cycle. The midwife's main responsibility is to survey a normal pregnancy, to provide follow-up care, and to identify complications or abnormalities during pregnancy (128). Further duties are parental support, cervical cancer screening, and counselling on family planning methods, including prescribing contraception and attending to psychosocial illness and health promotion such as counselling on lifestyle. In summary, the midwife has a central role in antenatal care and can be seen as "the spider in the net" with a prominent coordinating role. Over the last few decades, the role of the midwife has changed due to increased psychosocial illness in the population, increased immigration, and increased duties such as provision and logistics of supplies (127). Almost 20% of the pregnant women in antenatal care are of non-Nordic origin (51), resulting among other things a need for a translator, an interaction that often requires a significant amount of time.

Swedish health registers and quality registers

In the Nordic countries, there is a unique opportunity to use population-based national health registers for research. The national registers offer unique possibilities and are a valuable source of information and matrix for clinical trials (129).

The Swedish Maternal Health Care Register

Since 1999, midwives in antenatal care have collected data for a national health quality register, the Swedish Maternal Health Care Register (MHCR) (130). Between 2007 to 2009, the MHCR revised its variables, resulting in a new version of the register that was launched in 1 January 2010 (130). The MHCR presents data in several areas related to pregnancy and delivery and includes information on socio-economic factors and lifestyle. In 2013, the MHCR monitored around 89% of all pregnant women in Sweden (131). MHCR demonstrates satisfactory internal validity for the majority of its variables (130). MHCR data are collected on two occasions: during the pregnant woman's first visit at ANC and during her postpartum visit within the first 16 weeks. In accordance to the Swedish Patient Data Law, the pregnant women are informed of the purpose of the MHCR (91). The major part of data in

the MHCR is retrieved from medical records and manually registered by a midwife. Some of the questions are posed directly to the pregnant woman, for example, questions regarding self-rated health.

The Salut Register

The Salut Child Health Promoting Intervention Programme (Salut Programme) is headed by the County Council of Västerbotten. It is a multi-sector programme with collaboration between ANC, child healthcare, and dental care and coordinates with the municipalities' pre-schools and primary and secondary schools (97). The Salut Programme has been developed in a step-wise progression since 2005 and data have been collected on a regular basis since 2008. The national public health goals (i.e., to secure favourable conditions during childhood and adolescence) have increased physical activity and improved eating habits. The programme starts by inviting the pregnant woman and her partner before their first visit to ANC, and continues with support until the child reaches 19 years of age (132). The Salut Programme Register (SALUT-R) is built up by data collected from early pregnancy (around gestational week 10) from the pregnant woman and her partner respectively, and then at certain ages throughout the child's growing up. The Salut questionnaire contains questions on obstetric and medical history, living conditions and lifestyle.

AIMS

The overall aim of this thesis was to study different aspects of GDM, both as an exposure and as an outcome, and physical activity patterns and their relation to pregnancy outcomes. Further, to explore among Swedish midwives, their experiences and views on counselling pregnant women on physical activity during pregnancy; and among pregnant women their experiences of midwives' counselling on physical activity during pregnancy.

The specific aims of the four papers included in the thesis were:

To investigate for the period of 2011-2012 in Sweden: *i)* Guidelines for screening of GDM, *ii)* background and risk factors for GDM and selection to OGTT; and *iii)* pregnancy outcomes in relation to GDM, screening regimes and levels of OGTT 2 hour glucose values. (Paper I)

To explore how Swedish midwives experience counselling pregnant women on physical activity, specifically focusing on facilitators and barriers during pregnancy. Whether the midwives perceive that their own lifestyle and body shape may influence the content of the counselling they provide. (Paper II)

To investigate for the period of 2011-2012 in Sweden: *i)* prevalence of self-reported physical activity during leisure-time in early pregnancy *ii)* associations between pre-pregnancy and early pregnancy physical activity during leisure-time and to investigate maternal background characteristics, mode of delivery, birth weight, prevalence of gestational diabetes mellitus and self-rated health. (Paper III)

To explore the experiences of parous, pregnant women on: *i)* The significance of lifestyle counselling provided by a midwife in antenatal care, addressing health promotion with special focus on physical activity during pregnancy, *ii)* Factors influencing the trustworthiness of counselling conducted by a midwife. (Paper IV)

MATERIALS AND METHODS

Table 1. Overview of Papers I-IV in the thesis

Papers	Study design	Participants	Method	Setting	Data source/materials
I	Quantitative study: Cross-sectional study	184,183 pregnant women	Epidemiological and biostatistical methods	National sample, Sweden	The Swedish Maternal Health Care Register
II	Qualitative study: Focus group discussions	41 midwives in antenatal care	Qualitative content analysis	Sweden	Focus groups discussions
III	Quantitative study: Cross-sectional study	3,868 pregnant women	Epidemiological and biostatistical methods	Västerbotten county, Sweden	The Swedish Maternal Health Care Register and the Salut-Register Västerbotten, Sweden
IV	Qualitative study: Individual interviews	14 pregnant women	Qualitative content analysis	Umeå catchment area, Sweden	Individual in-depths interviews

Paper I

This is a cross-sectional population based study with a national sample where data were retrieved for 2011 and 2012 from the Maternal Health Care register and local guidelines from each Maternal Health Care Area in Sweden. The study included all women who gave birth between 2011 and 2012 with registered data in the MHCR (a total of 184,183 deliveries – 88,140 in 2011 and 96,043 in 2012). The guidelines used for screening of GDM in all MHCA in Sweden were retrieved from each MHCA with the assistance from the appointed consultant midwife in each MHCA (N=43). The retrieved variables from the MHCR were as follows: country of origin, maternal age, parity, maternal height, maternal weight, body mass index, smoking, level of education, self-rated health, number of visits to antenatal care, use of professional interpreter at visits in ANC, treatment for psychological ill-health during pregnancy, GDM, OGTT, gestational age, delivery mode, birth weight, small for gestational age (SGA), appropriate for gestational age (AGA), and large for gestational age (LGA). All local guidelines for 2011-2012 were requested by sending e-mail to each appointed consultant midwife in each MHCA. During September 2012, the majority of the guidelines were received and by late October, after a telephone call, the remaining guidelines were collected.

Two-independent samples t-test was used to test differences of parametric data. Pearson's Chi-Squared test was used to test differences between categorical variables and univariate and multivariate logistic regression analyses were performed and were presented with odds ratios (OR) and their 95% confidence intervals (CI). Different multivariate models were demonstrated. The population attributable proportion (PAP) was calculated for specified exposures using the formula $PAP = \frac{p(RR-1)}{1 + p(RR-1)}$, where PAP is the proportion of cases in the population that should not have occurred if the exposed had the incidence of the unexposed. RR was estimated with OR. Statistical analysis was done using SPSS version 19.

Paper II

A thematic interview guide was created based on the literature and on the authors' work experiences. A pilot FGD was performed in northern Sweden where seven midwives working in ANC participated and shared their experiences. The pilot FGD resulted in minor revisions of the interview guide and the pilot material was later included in the materials due to its richness including important information. The topics of the interview guide were as follows: counselling on physical activity in general, barriers and facilitators for physical activity, counselling of native Swedish women, counselling of immigrant women, the significance of midwife's own body shape, and the significance of the midwife's lifestyle.

This qualitative study was conducted with midwives in eight antenatal care units, from northern Sweden to southern Sweden - Gällivare, Skellefteå, Gävle, Stockholm (two units), Jönköping, Göteborg, and Malmö. The selection of antenatal care centres aimed for a variation in size, socio-economy, demography, and geography (coastland and inland). All of the eight focus group discussions were performed in antenatal care units in each of the visited areas. The inclusion criterion was that the eligible participants (i.e., midwives) were currently and exclusively working in ANC. Furthermore, we used purposive sampling to achieve as great a variation as possible in relation to age, work experience, and number of years of employment in ANC. We aimed for six to eight participants in each FGD, but in the most rural areas this was impossible because very few midwives worked in ANC in these areas.

The consultant midwife in the target MHCA was contacted by author ML and was asked to provide a list of available participants in the specific MHCA area that fulfilled the inclusion criterion. Each of the appropriate participants was approached by ML and provided with the information about the study. Before the FGD was conducted, all of the midwives received oral and written information about the study and gave their written consent. None of the eligible participants declined to participate in the study. Due to unexpected work obligations, three of the participants dropped out shortly before the performance of one of the FGD. A total of 41 midwives participated in the study and their characteristics are presented in Table 2.

Shortly after the performance of each FGD, ML transcribed the interviews and read the transcripts several times together with the author MP. The interviews were analysed through qualitative manifest and latent content analysis, which means that a systematic approach was used and the analysis included both the obvious content in the transcribed text (i.e., the manifest content) as well as the underlying meanings (i.e., the latent content). The transcripts were read several times to achieve a sense of the whole. Furthermore, meaning units were identified and later condensed and coded. ML and MP compared and discussed the codes to identify similarities and differences. During this process, with input of author IM, sub-categories and categories were identified. The transcripts were then re-read by ML to make sure that none of the significant information had been neglected. At the end of the analysis process, all the authors discussed the findings and in this phase a theme emerged.

Table 2. Characteristics of participants (N=41) attending the focus group discussions (FGD)

FGD	(n)	Mean age years	Work experience as midwife mean years (range)	Work experience in ANC mean years (range)
Northern Sweden				
FGD 1	2	49.5	17.5 (10-25)	9.5 (4-15)
FGD 2	7	53.2	23.7 (5-35)	12.7 (5-27)
FGD 3	6	52.5	26.7 (2-35)	16.7 (8-27)
Mid Sweden				
FGD 4	5	36.5	7.0 (2-9)	2.3 (1-5)
FGD 5	5	58.3	23.0 (5-26)	16.5 (4-24)
FGD 6	9	42.1	16.1 (8-19)	11.9 (3-17)
Southern Sweden				
FGD 7	5	48.8	13.8 (2-22)	12.8 (2-18)
FGD 8	2	47.5	17.5 (15-20)	7.5 (2-13)

Paper III

Paper III is a population-based cross-sectional study based on combined data from the MHCR and the SALUT-R from 2011 to 2012. From Study I, we had access to a large dataset (184,183 pregnant women) from the MHCR. The target variable physical activity was not available in the MHCR but could be extracted from the SALUT-R. The two datasets were combined to a sub-set of data consisting of the women who participated in the both registers, a total of 3,868 women. All pregnancies were included in the study irrespective of single or multiple births. Individuals who could not be identified in both registers were excluded from the study (n=979) (Figure 1).

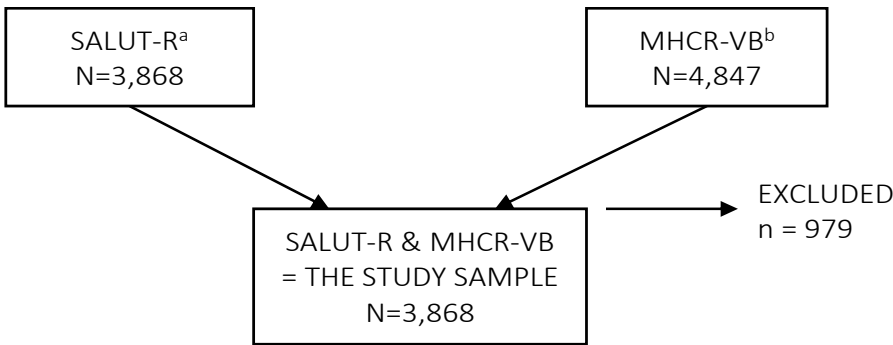


Figure 1. The study sample

^a The Salut Register (SALUT-R)

^b The Maternal Health Care Register in Västerbotten (MHCR-VB)

The variables retrieved from the MHCR-VB were country of origin, maternal age, parity, maternal height, maternal weight, body mass index at first visit in ANC, smoking, level of education, self-rated health, GDM, oral glucose tolerance test (OGTT), gestational age, mode of delivery, and birth weight. The variables from the SALUT-R were self-reported data on pre-pregnancy and early pregnancy physical activity during leisure time.

Two-independent samples t-test and the one-way ANOVA test was used to test differences of parametric data. Pearson’s Chi-Squared test was used to test differences between categorical variables. Univariate and

multivariate logistic regression analyses were performed and presented with odds ratios (OR) and their 95% confidence intervals (CI). Statistical analysis was done using SPSS version 22.

Paper IV

A thematic interview guide was created based on the literature and on the authors' work experiences. Some of the topics mirrored Paper II where midwives were interviewed on their experiences counselling pregnant women on physical activity. The topics in the interview guide for Paper IV included pregnant women's experiences of midwives' counselling on lifestyle habits and lifestyle change in general and physical activity in particular, the significance of lifestyle counselling in general, and the trustworthiness of the midwife in relation to the content of the counselling and her personal characteristics. After the pilot interview, minor changes were made to the interview guide.

Pregnant women were approached and asked to participate in the study at the routine ultrasound examination (18 to 20 weeks of gestation). Purposive sampling was applied for healthy parous women, aiming for a variation in age, country of birth, and BMI (i.e., normal weight, overweight, and obesity). Pregnant women visiting the Specialist Maternal Health Care Centre (SMHC) at Umeå University Hospital for their routine ultrasound were consecutively approached by the appointed midwife and briefly informed about the study and asked if they were interested in being contacted by telephone by ML. The first eight eligible participants agreed to participate in the study, but the ninth eligible participant declined participation in the study. Thereafter, ML contacted the eight women and the place and time for the interviews were agreed upon.

During the course of the data collection, it was recognized that there was a need to recruit more immigrants and overweight or obese women in order to achieve variation in the desired background characteristics. Accordingly, six more participants were recruited, aiming for overweight, obese, and immigrant women. This last process resulted in a total of 14 participants included in the study. Most of the participants were born in Sweden and their BMI varied between 20.1 kg/m² and 38.5 kg/m². Half of the participants reported university level and the other half reported high school level as their highest educational level (Table 3).

The in-depth interviews were performed during 35-36 weeks of gestation in order to gain as much information and experiences as possible of the research questions under study. Author ML conducted all 14 interviews and the majority of the interviews took place at the participant's home, but some of the interviews were conducted in a venue at the hospital. Before the interview, all participants gave their written consent to participate in the study and received the information that they at any time during the study could withdraw their participation without providing any specific reason for their withdrawal. The interviews were digitally recorded and lasted around 45 to 80 minutes (mean time: 50 minutes). Shortly after each interview, ML transcribed the recorded materials. Qualitative content analysis was applied in the analysis, inspired by Graneheim and Lundman (124). The transcribed data were read thoroughly several times by ML and IM to get a sense of the whole. ML identified meaning units that were condensed and identified building up codes, preliminary subcategories and categories. ML, IM, and MP discussed similarities and differences in the codes, sub-categories, and categories and finally consensus was achieved. The transcripts were then re-read by ML to identify whether any important material or information had been neglected. At the end of the analysis, all three authors discussed the underlying meaning in the transcripts and a theme emerged.

Table 3. Background characteristics of the participants in study IV

Variables	n (%)
No of participants	14
Age (years)	
Mean	31.5
Min-Max	23-38
BMI (kg/m ²)	
<25	6
25.0-29.9	2
≥30	6
Marital status	
Cohabiting	14(100)
Educational level	
University	7 (50.0)
High school	7 (50.0)
Compulsory school	
Country of birth	
Sweden	11 (78.6)
Other countries	3 (21.4)

Ethical considerations Study I-IV

All four studies were granted ethical approval by the Ethical Review Board in Umeå (Dno 2012-407-3IM and Dno 2014-22-31M). Study I was based on data retrieved from the Maternal Health Care Register (MHCR) and Study III on data from MHCR combined with the Salut Register. All Swedish quality registers (including MHCR) comply with rules and procedures stated by Swedish Association of Local Authorities and Regions, SALAR (Sveriges Kommuner och Landsting, SKL) and Swedish Patient Data Law (Patientdatalagen). The participation in MHCR is voluntarily. The midwives working in the antenatal care inform the pregnant women about the MHCR in different forums and explain how data is documented in the medical files and in the quality register. These information forums are advertised in the waiting room at the antenatal care unit, at registration in antenatal care, and orally from the midwife. In a majority of the healthcare regions in Sweden, a pregnant woman is requested to complete a form on health issues before her registration in ANC. Typically, information on MHCR is also provided in this form. The Salut Register has received ethical clearance for collection of data from pregnant women and their partners (Dno 2010-63-31), and the data are collected through questionnaires, which are sent to the pregnant woman and her partner before their first visit to the ANC. The participation is voluntary and consent is assumed if a pregnant woman (and/or her partner) returns a completed questionnaire. In Study II, the participants were midwives currently working in ANC in Sweden. Most research questions were exploring opinions and perspectives that were presumed not being sensitive. However, some questions in Study II (e.g., significance of own lifestyle) may have been perceived as sensitive by some of the participants. The research team was well aware of this aspect, so informants were only requested to reveal perspectives that were perceived comfortable. In Study IV, the participants were pregnant women who received counselling on lifestyle during pregnancy. Most of the research questions explored the experiences of pregnant women on lifestyle counselling performed by healthcare professionals during pregnancy, and most of these research questions were considered unproblematic and non-sensitive based on our previous experiences (62). For Study I and III, quantitative results were presented on an aggregated level and no subject was possible to identify. For studies II and IV, findings were presented

on a categorized level and quotations were not characterized in a way that the information may have resulted in identification of a participant.

Statistical analyses

In this thesis, different statistical methods were used. Two-independent samples t-tests and One-way ANOVA were used to test differences in parametric data, and non-parametric two-independent samples test (Pearson's Chi-Squared test) was used to test the difference between categorical variables. Univariate and multivariate logistic regression analyses were performed and presented with odds ratios (OR) and their 95% confidence intervals (CI). The population attributable proportion (PAP) was calculated for specified exposures using the formula $PAP = p(RR-1)/[1 + p(RR-1)]$, where PAP is the proportion of cases in the population that should not have occurred if the exposed had had the incidence of the unexposed. RR was estimated with OR. SPSS version 19 and version 22 were used for all analyses.

RESULTS

PAPER I: No consensus on gestational diabetes mellitus screening regimes in Sweden: pregnancy outcomes in relation to different screening regimes 2011 to 2012, a cross-sectional study.

In this cross-sectional population-based study no consensus was found regarding cut-off glucose value for diagnosis or screening regime for gestational diabetes mellitus (GDM). When comparing the guidelines in the 43 Maternal Health Care Areas (MHCA) in Sweden, we found four different screening regimes: A) universal screening with a 2-hour cut-off capillary glucose value of 10.0 mmol/L; B) selective screening with a 2-hour cut-off capillary glucose value of 8.9 mmol/L; C) selective screening with a 2-hour cut-off capillary glucose value of 10.0 mmol/L; and D) selective screening with a 2-hour cut-off capillary glucose value of 12.2 mmol/L.

The highest prevalence of GDM (2.9%) was found with a 2-hour cut-off value of 8.9 mmol/L when selective screening was applied. Most pregnant women (56.8%) underwent selective screening with 10.0 mmol/L as a 2-hour cut-off glucose value for GDM. Fewer pregnant women (11.3%) were exposed to universal screening with the same cut-off value (Table 4).

Among the background factors for selective screening (based on risk factors), family history of diabetes mellitus type 2, previous macrosomic infant (≥ 4.5 kg), and BMI >30 kg/m² were the most common risk factors (81%). Only four of the MHCA had immigrant status as a risk factor. The most prevalent risk indicator for OGTT was elevated random plasma glucose (≥ 8.0 -9.0 mmol/L), which was presented in all the MHCA using selective screening.

Table 4. Maternal characteristics and specific outcomes in relation to four screening regimes for gestational diabetes mellitus (GDM) in Sweden between 2011 and 2012

Variables	All n (%)	MA ^a (yrs) Mean Min-max	Height (cm) Mean Min-max	BMI ^b Mean Min-max	BMI ^b ≥30 n (%)	OGTT ^c n (%)	GDM n (%)
A. Universal screening 10.0 mmol/L ^d	20822 (11.3)	30.0 15-49	166.4 140-190	25.04 13.63-55.98	2784 (14.1)	19294 (93.6)	456 (2.2)
B. Selective screening 8.9 mmol/L ^d	8634 (4.7)	29.8 15-49	166.4 135-190	24.99 13.82-56.65	1110 (13.4)	1674 (19.6)	252 (2.9)
C. Selective screening 10.0 mmol/L ^d	104688 (56.8)	29.8 13-54	166.2 113-195	25.04 13.90-62.06	14523 (14.2)	13934 (13.4)	1494 (1.4)
D. Selective screening 12.2 mmol/L ^d	50039 (27.2)	31.4 14-57	166.2 123-196	24.11 13.97-56.40)	4631 (9.6)	3403 (6.8)	377 (0.8)

^a Maternal age (MA)^b Body mass index (BMI) kg/m²^c Oral glucose tolerance test (OGTT)^d Cut-off value

We found that adverse pregnancy outcomes such as instrumental vaginal delivery, caesarean section (CS) (elective as well as emergency), and large for gestational age (LGA) was increasing with increasing OGTT-values (Table 5).

Table 5. Oral glucose tolerance test (OGTT) 2-hour values in categories in relation to specified pregnancy outcomes between 2011 and 2012

OGTT values in categories (mmol/L)	All n (%)	Birth weight (grams) Mean Min-Max	LGA ^a n (%)	SGA ^b n (%)	Vaginal non instrumental delivery n (%)	Vaginal instrumental delivery n (%)	CS ^d n (%)	Elective CS n (%)	Emergency CS n (%)
≤7.5	26307 (71.6)	3594 300-5890	1445 (5.7)	590 (2.4)	20082 (76.5)	1781 (6.8)	4388 (16.7)	1928 (7.3)	2455 (9.3)
7.5-8.0	3644 (9.9)	3663 345-5940	316 (9.0)	68 (2.1)	2646 (72.7)	264 (7.2)	732 (20.1)	302 (8.3)	430 (11.8)
8.1-8.9	3576 (9.7)	3682 990-6020	355 (10.3)	64 (2.0)	2537 (71.1)	262 (7.3)	770 (21.6)	315 (8.8)	455 (12.7)
9.01-9.9	1504 (4.1)	3640 491-6270	177 (12.2)	31 (2.4)	1024 (68.4)	105 (7.0)	369 (24.1)	157 (10.4)	211 (14.1)
10.0-12.1	1411 (3.8)	3620 512-5955	198 (14.8)	30 (2.5)	917 (65.2)	101 (7.2)	388 (27.6)	174 (12.4)	214 (15.4)
≥12.20	310 (0.8)	3619 1103-5540	46 (15.6)	7 (2.7)	188 (60.8)	24 (7.8)	97 (31.4)	44 (12.7)	57 (17.8)

^a Large for gestational age (LGA)^b Small for gestational age (SGA)

In univariate logistic regression analysis of the outcome GDM in relation to non-GDM for background factors, BMI ≥ 30 kg/m² was the strongest association for developing GDM, and maternal age ≥ 35 years, non-Nordic origin, unemployment status, and educational level less than university level showed moderately increased risk for developing GDM. From the analysis of the univariate and multivariate logistic regression analyses for the outcome GDM in relation to non-GDM for different maternal background variables, we concluded the following: obesity (≥ 30 kg/m²) was strongly related to GDM OR 4.14 (95% CI 3.81-4.50) and the OR was moderately changed when adjusting for age, country of birth, employment status, and educational level (OR 3.66; 95% CI 3.31-4.01) (Table 6). When performing the same analyses for LGA, LGA was strongly associated with BMI ≥ 30 kg/m² (OR 2.44; 95% CI 2.31-2.58). When adjusting for the same background variables as in the model for GDM, the OR was modestly changed (OR 2.37; 95% CI 2.23-2.52).

Table 6. Univariate and multivariate logistic regression analysis for gestational diabetes mellitus (GDM) in relation to non-GDM for specified variables between 2011 and 2012

Variables	Crude OR ^a	Model 1 ^b (n=178038)	Model 2 ^b (n=178038)	Model 3 ^b (n=176145)	Model 4 ^b (n=148610)
BMI ^c <30.00	1	1	1	1	1
BMI ≥ 30.00	4.14 (3.81-4.50)	4.10 (3.74-4.42)	4.00 (3.68-4.35)	3.93 (3.62-4.28)	3.66 (3.31-4.01)
Age <35	1	1	1	1	1
Age ≥ 35	1.79 (1.15-1.95)	1.72 (1.58-1.87)	1.71 (1.57-1.86)	1.71 (1.57-1.86)	1.60 (1.59-1.93)
Nordic countries ^d	1	1	1	1	1
Non Nordic countries	2.24 (2.06-2.43)		2.18 (2.01-2.37)	2.10 (1.92-2.28)	2.10 (1.87-2.28)
Employed ^e	1			1	1
Unemployed ^f	1.74 (1.57-1.93)			1.27 (1.14-1.42)	1.20 (1.10-1.36)
University level ^g	1				1
<University level	1.62 (1.48-1.77)				1.34 (1.21-1.47)

^a Crude odds ratio

^b Adjusted odds ratio and their 95% confidence intervals

^c Body mass index (BMI) kg/m²

^d Norway, Finland, Denmark, and Iceland

^e Employed includes employed, student, and parental leave

^f Unemployed includes unemployed, sick leave, and other

^g Elementary school/high school

PAPER II: “An on-going individual adjustment”: a qualitative study of midwives’ experiences counselling pregnant women on physical activity in Sweden.

The theme “An on-going individual adjustment” reflects the midwives’ efforts to adjust their counselling on physical activity to each pregnant woman’s individual needs. This was experienced by the midwives as a challenge as well as an opportunity to prevent an unhealthy lifestyle. The following three categories and their sub-categories described the multifaceted challenge (including facilitators and barriers) of promoting physical activity during pregnancy (Table 7).

Table 7. Theme, categories and their sub-categories

Theme	Category	Sub-category
An on-going individual adjustment	Counselling as a challenge	– Fighting lack of resources
		– Responding to high-achieving women
		– Responding to perceived barriers to physical activity in pregnant women
		– Responding to the cultural tug-of-war
	Counselling as walking the thin ice	– Fearing no success
		– Guarding the relationship
		– Acting upon individual needs
	Counselling as an opportunity	– Navigating within cultural traditions
		– Identifying women’s individual facilitators

The first category “Counselling as a challenge” reflects the different challenges midwives experienced when counselling pregnant women on physical activity during pregnancy. The participants perceived challenges as a result of economic cutbacks in ANC and the increased number of pregnant women resulting in a heavy workload. Furthermore, this resulted in work stress due to not being able to deliver the best care possible. The category also included the participants’ experience with trying to convince high-achieving pregnant women to slow down. These high-achieving women were depicted by the midwives as highly educated pregnant women with high demands on themselves as well as for the encounters. The participating midwives reported several barriers to physical activity among pregnant women. They reported physical barriers such as tiredness and different kinds of pain as well as psychological barriers such as lack of knowledge of the impact of physical activity on pregnancy and a fear of failing at exercises. When counselling immigrant women on physical activity, the participants perceived a situation that

could be considered a culture tug-of-war regarding beliefs about rest versus beliefs about physical activity. The challenges included contradictions between the advice conveyed by the participant and the opinions expressed by the pregnant women and their relatives. As a result, the participants often adjusted their recommendations of physical activity to an achievable level for the immigrant pregnant woman. Examples of complicating factors for being physically active were described by the participants as not having appropriate clothes or shoes for different kinds of weather. When the alternatives for physical activity ran out, walking was recommended as a suitable physical activity.

The second category “Counselling as walking the thin ice” addressed how the participants experienced counselling as such. The encounters were seen as golden opportunities to promote a healthy lifestyle. However, the goal of successful counselling leading to a healthier lifestyle for the pregnant woman could lead to an increased stress for the participants if they felt they were unable to achieve this goal. They could perceive high expectations from the expectant parents and colleagues as well as from themselves and a fear of failure due to not being able to provide successful counselling. The participants guarded the relationship to the pregnant woman in a way that the encounters were held in a positive atmosphere. Furthermore, this could lead to a tiptoeing approach from the participants in order to gradually and carefully adjust their counselling on physical activity with respect to each individual woman’s situation. Overweight and obesity were seen as sensitive topics by the participants, resulting in different strategies. Some participants preferred to be straightforward on this issue, whereas others had a more restrained attitude.

The third and last category “Counselling as an opportunity” described midwives’ experiences and strategies to navigate through cultural concerns and to identify the facilitators for counselling on physical activity during pregnancy. The participants tried to adjust and overcome the challenges in counselling due to cultural traditions. In addition to finding culturally accepted forms for physical activity, the participants’ counselling consisted of informing these pregnant women on the significance of physical activity and its safety and benefits. Furthermore, the category reflects the participants’ efforts to find the motivational factors in each woman. The participants reported that improving maternal health, avoiding gestational weight gain, and maintaining a healthy fetus were some of these factors. In addition, the participants experienced that it was easier to motivate those who had been physically active before their pregnancy compared to those who were not.

PAPER III: Leisure time physical activity among pregnant women and its associations with maternal characteristics and pregnancy outcomes.

In this cross-sectional study, 47% of the pregnant women reported that they achieved the recommended levels of physical activity (i.e., ≥ 150 activity minutes/week) proposed by the NBHW in Sweden. A significantly higher proportion of these women who reached the recommended level of physical activity reported their health as very good or good and there was less common with very good health when the leisure time physical activity was low (Figure 2).

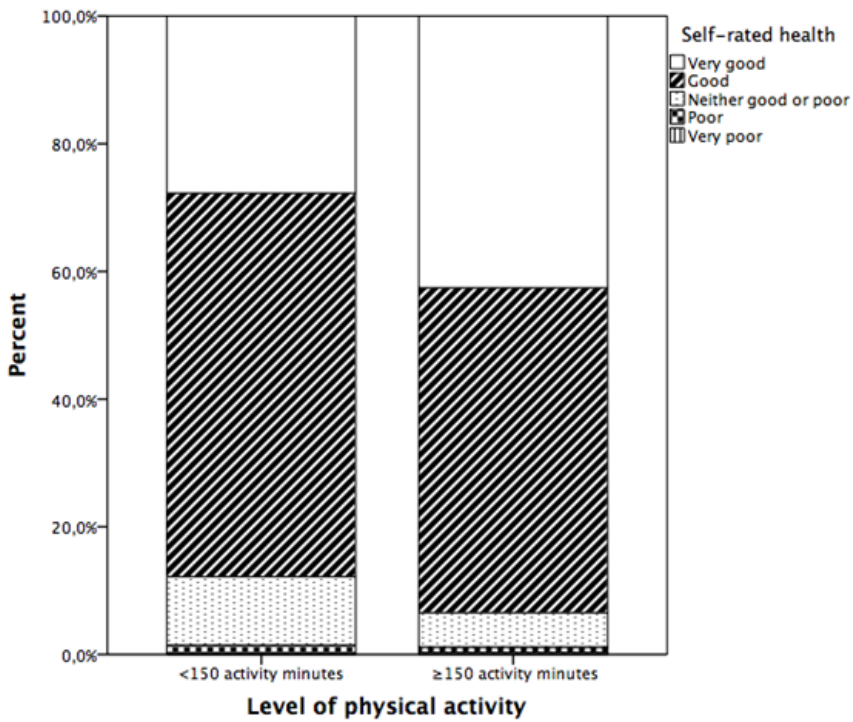


Figure 2. Distribution of self-rated health in relation to two different levels of reported physical activity

Pregnant women who did not reach the recommended level of physical activity had a significantly higher BMI ≥ 30 kg/m² and lower educational level and were of non-Nordic origin compared to the pregnant women who reached the recommended level (Table 8).

In univariate analysis and in the multivariate logistic regression model, pregnant women who achieved the recommended level of physical activity were half as likely to report poor or very poor self-rated health compared to the women who did not. When adjusting for age, parity, body mass index, educational level, employment status, country of origin, and smoking, the odds ratios were almost unchanged (Table 9).

Table 8. Leisure time physical activity levels in relation to maternal background characteristics (N=3868) and test of difference of specified categories

Variables ^a	All n (%)	<150 PA min ^b n (%)	≥150 PA min ^b n (%)	p-value ^c
Maternal age ^d	3762 (97.3)	1989	1773	
Mean; SD		30.0; 5.0	29.4; 4.8	<0.001
Min-Max		19-44	16-46	
Maternal age ^d				
≤19		26 (1.3)	16 (0.9)	<0.001
20-24		256 (12.9)	280 (15.8)	
25-29		638 (32.1)	637 (35.9)	
30-34		689 (34.6)	570 (32.1)	
35-39		325 (16.3)	239 (13.5)	
≥40		55 (2.8)	31 (1.7)	
Parity	3762 (97.3)	1992	1770	0.005
Mean; SD		1.80; 0.81	1.79; 0.79	
Min-Max		1-9	1-6	
Parity				
1		754 (37.9)	904 (51.1)	<0.001
2		860 (43.2)	592 (33.4)	
3		272 (13.7)	212 (12.0)	
≥4		106 (5.3)	62 (3.5)	
Gest age	3715 (96.0)	1962	1753	0.343
Mean; SD		281.4; 6.4	281.5; 6.5	
Min-Max				
Gest age ^{e,f}				
Preterm		100 (5.1)	73 (4.2)	0.250
Term		1680 (85.6)	1499 (85.5)	
Post-term		182 (9.3)	181 (10.3)	
Weight (kg)	3739 (96.7)	1976	1763	
Mean; SD		71.1; 14.0	68.5; 14.0	0.034
Min-Max		48-113	39-156	
Height (cm)	3756 (97.1)	1984	1772	
Mean; SD		165.1; 6.5	166.4; 6.3	0.007
Min-Max		150-183	141-186	
BMI (kg/m ²) ^g	3731 (96.5)	1969	1762	
Mean; SD		24.8; 4.8	24.3; 4.2	0.001
Min-max		18.4-42.0	15.1-50.9	
BMI early pregnancy ^g		1969	1762	
<18.5		54 (2.7)	31 (1.8)	<0.001
18.5-24.99		1180 (59.9)	1180 (67.0)	
25-29.99		476 (24.2)	377 (21.4)	
30-34.99		166 (8.4)	126 (7.2)	
35-39.99		76 (3.9)	37 (2.1)	
≥40		17 (0.9)	11 (0.6)	
Educational level	3653 (94.4)	1922	1731	
Elementary school		94 (4.9)	57 (3.3)	0.002
High school		809 (42.1)	669 (38.6)	
University		1019 (53.0)	1005 (58.1)	

Employment status	3742 (96.7)	1983	1759	
Employed		1546 (78.0)	1384 (78.7)	0.025
Student		187 (9.4)	202 (11.5)	
Parental leave		104 (5.2)	71 (4.0)	
Unemployed		101 (5.1)	65 (3.7)	
Sickness leave		25 (1.3)	26 (1.5)	
Other status		20 (1.0)	11 (0.6)	
Country of origin	3768 (97.4)	1995	1773	
Sweden		1784 (89.4)	1627 (91.8)	0.043
Nordic countries ^h		14 (0.7)	12 (0.7)	
Other countries		197 (9.9)	134 (7.6)	
SRH ⁱ	3390 (87.6)	1782	1608	
Very good		495 (27.8)	685 (42.6)	<0.001
Good		1070 (60.0)	818 (50.9)	
Neither good/poor		191 (10.7)	87 (5.4)	
Poor		23 (1.3)	13 (0.8)	
Very poor		3 (0.2)	5 (0.3)	
Smoking 3 months ^j	3768 (97.4)	1995	1773	0.017
No smoking		1841 (92.3)	1663 (93.8)	
Smoking		152 (6.6)	109 (2.9)	

^a For each specified variable, n and % are presented

^b <150 Physical Activity minutes at leisure time (52.9%) and ≥150 Physical Activity minutes at leisure time (47.1%)

^c Test of difference, t-test for continuous variables and Chi-squared test for categorical variables

^d Maternal age in years

^e Gestational age calculated using the WHO's guidelines

^f Pre-term=22+0-36+6, Term=37+0-41+6, Post-term=42+0-43+6 (weeks)

^g Body mass index (BMI)

^h Norway, Denmark, Finland, and Iceland

ⁱ Self-rated health (SRH)

^j Smoking three months before pregnancy

Table 9. Maternal and fetal outcomes in relation to specified physical activity level. Univariate and multivariate logistic regression, OR, and their 95% confidence intervals

Dependent Variables	All n (%)	<150 PA min ^a n (%)	≥150 PA min ^a n (%)	Crude OR (95% CI)	Adjusted ^b OR (95% CI)
BMI early pregnancy ^c	3731 (96.5)				
<30		1710 (86.6)	1588 (90.1)	Ref.	Ref.
≥30		259 (13.2)	174 (9.9)	0.72 (0.59-0.88)	0.74 (0.61-0.91)
SRH ^d	3390 (87.6)				
Very good/Good		1565 (87.8)	1503 (93.5)	Ref.	Ref.
Neither good/poor or poor/very poor		217 (12.2)	105 (6.5)	0.50 (0.40-0.64)	0.52 (0.48-0.71)
GDM ^e	3735 (96.9)				
Yes		23 (1.2)	13 (0.7)	0.63 (0.32-1.26)	
No		1956 (98.8)	1743 (99.3)	Ref.	
Mode of delivery	3767 (97.4)				
Vag. non instr.		1588 (79.6)	1418 (80.0)	Ref.	
Vag. instr. ^f /CS ^g		406 (20.4)	355 (20.0)	0.98 (0.84-1.15)	
Birth weight ^h	3757 (97.1)				
Mean; SD		3555.8; 534.9	3551.5; 518.3		
Min-Max		803-5524	521-5340		

^a <150 Physical Activity minutes at leisure time (52.9%) and ≥ 150 Physical Activity minutes at leisure time (47.1%)^b Adjusted for age, parity, body mass index, self-rated health, educational level, employment status, country of origin, and smoking^c Body mass index (BMI) (kg/m²)^d Self-rated health (SRH)^e Gestational diabetes mellitus (GDM)^f Vacuum extraction or forceps^g Caesarean section (CS)^h Birth weight of the child^h Birth weight of the child

Furthermore, the probability of reaching the recommended level for physical activity increased if the pregnant woman had a university level (OR 1.44; 95% CI 1.22-2.03).

PAPER IV: “Longing for individual recognition” - pregnant women's experiences of midwives' counselling on physical activity during pregnancy

The theme “Longing for fulfilment of individual needs and expectations” addressed the participants' strong desire for individual counselling. Three categories and their sub-categories reflected the experiences by the participants regarding their wish of counselling based on their individual needs instead of general advice, the midwives' lack of knowledge on physical activity and the experience of the midwife as having her own agenda. However, some participants perceived encouragement and support (Table 10).

Table 10. Theme, categories and their sub-categories

Theme	Category	Sub-category
Longing for fulfilment of individual needs and expectations	Being exposed to insufficient counselling	– Discovering the absence
		– Seeking answers
		– Recognizing midwife's own agenda
		– Sensing hesitation
		– Facing lack of support and trustworthiness
	Appreciating supportive and trustworthy counselling	– Meeting the body of knowledge
		– Being seen and heard
		– Sensing encouragement and trustworthiness
	Wrestling with different cultures	– Dealing with conflicting advice
		– Going my own way
		– Striving for independence
	Dealing with physical activity in daily life	– Being aware of the body
		– The own mind as an obstacle
		– Environmental support
		– Finding a driving force

The first category “Being exposed to insufficient counselling” deals with the participants’ experiences of the midwives’ insufficient or absent counselling on physical activity, and the midwives’ limited knowledge. This could be about safety in different kinds of exercises where the answers were perceived as ambiguous and delivered in a hesitating manner. This could lead to that other sources of knowledge were investigated, such as the Internet and different kinds of websites regarding a relevant subject.

Some participants perceived that the midwife had her own checklist of medical measurements for the antenatal care visits, and as long as she could tick off the items on the list, she was satisfied leaving minimal opportunity and space for discussion on other subjects such as exercise or other life style habits.

The participants, especially those who were overweight or obese, often felt that the midwife was tiptoeing around the issue of being overweight or obese and expressed that they preferred honesty and direct counselling on their weight. Participants with normal weight often felt neglected due to their normal weight and not being supported by the midwife in advice regarding a healthy lifestyle. Both of these groups described these situations as dishonest and not trustworthy.

Other participants were satisfied with their midwife’s counselling and felt supported and encouraged, which is described in the second category, “Appreciating supportive and trustworthy counselling”. They reported that the midwife was trustworthy, knowledgeable, and presented convincing evidence for the significance of a healthy lifestyle and physical activity during pregnancy. In addition, they experienced that they were being seen and heard. Being positive, determined, goal-oriented, and clear were some of the characteristics of a trustworthy midwife according to the participants. A midwife with a large body size could be considered as less trustworthy by some of the participants but others did not consider the size of the midwife as having any impact on her trustworthiness.

The third category “Wrestling with different cultures” reflects the balance between different cultural beliefs regarding the participants’ physical activity and this seemed to concern the immigrant women the most. Some participants experienced contradictions between the midwife’s counselling on physical activity compared to their relatives’ advice. The midwives were perceived as encouraging the participants to be more physically active, but their relatives promoted a more sedentary lifestyle due to their own belief that physical activity could harm the fetus. It was obvious among the participants that they tried to become independent in relation to the midwife and their relatives’ advice, and despite these conflicting suggestions, they tried to find their own way. However, some participants reported that they adjusted their physical activity level just to please their midwife.

The fourth and last category, “Dealing with physical activity in daily life”, addresses the barriers and facilitators to performance of physical activity. The participants experienced different kinds of bodily pain as a barrier to physical activity. Furthermore, their own mind could act as an obstacle to physical activity, described as lack of motivation, postponing, and fear of harming the fetus. The participants emphasized the importance of support to perform physical activity and the struggle when this support was absent. Some participants reported no problems finding motivation and were worried about whether they could maintain the same level of physical activity as before their pregnancy. In addition, they agreed that being physically active before pregnancy was a facilitator.

Table 11. Overview of results Papers I-IV

	Paper I	Paper II	Paper III	Paper IV
Counselling on physical activity during pregnancy		Midwives (participants) tried to adjust their counselling on physical activity to each individual pregnant woman's needs. They perceived counselling as challenging and multifaceted. Lack of personnel resources and economic cutbacks resulted in surveillance of many pregnant women per midwife and few opportunities for training and education, all factors that complicated the counselling.		Pregnant women (participants) experienced midwives' counselling on physical activity as encouraging and supportive. However, counselling was also reported as insufficient and not adjusted to the pregnant woman's individual needs and expectations. In addition, pregnant women could experience the midwife as having her own agenda, mostly focusing on medical surveillance during pregnancy.
Physical activity during pregnancy		Midwives (participants) reported several barriers for pregnant women to perform physical activity, such as tiredness, different kinds of pain, heavy workload, and fear of not being able to succeed with specific kinds of exercise. Facilitators for performing physical activity were environmental support, motivation, and being physically active before pregnancy.	Almost half (47%) of the pregnant women (participants) reported reaching the recommended level of physical activity during pregnancy, i.e., ≥ 150 minutes/week. BMI $\leq 30 \text{ kg/m}^2$, higher educational level, and "very good" or "good" self-rated health was significantly higher among pregnant women who reported reaching the recommended level of physical activity compared to those who did not. No significant association was found between physical activity and pregnancy outcomes.	Pregnant women (participants) reported several challenging areas for being physically active during pregnancy. Physical barriers were pelvic pain during pregnancy, excessive gestational weight gain, and tiredness. Some reported lack of time, having many children, and lack of environmental support and postponed their physical activity to post-partum. Facilitators for physical activity during pregnancy were being physically active before pregnancy, finding a motivation for exercise, knowing physical activity is beneficial for the unborn child, and a supportive partner.
Overweight and obesity during pregnancy	In the study sample, 38.5% of women were overweight (25.6%) or obese (12.9%). Obesity during pregnancy more than four-doubled the odds of developing GDM, OR 4.14 95% CI (3.81-4.50).	Overweight and obesity were considered sensitive topics by the midwives (participants) when counselling on physical activity. The participants acted like they were "tip-toeing" and "walking on thin ice" during the encounters and tried to guard their relationship to the woman so they were not very direct. However, some midwives thought this approach was insincere and chose a more straightforward approach.	Pregnant women who reported that they did not achieve the recommended level of physical activity were characterized by significantly higher BMI ($\geq 30 \text{ kg/m}^2$) compared to those who reported reaching the recommended levels.	Some of the overweight and obese pregnant women (participants) felt that exercise during pregnancy was an "insuperable mountain", since they had failed so many times. Most of the overweight or obese participants perceived their midwife as "tip-toeing" due to the women's weight. Some women preferred a more straightforward approach from the midwife on the issue of weight. Some experienced the midwife as nagging when providing advice related to their weight and physical activity.
Gestational diabetes mellitus	There was no national consensus regarding methods of screening or cut-off value for diagnosis of GDM in 2011 or 2012. Four screening regimes were identified: three regimes where selective screening was applied (with three different 2-hour cut-off values - 8.9, 10.0, and 12.2 mmol/L), and one regime where universal screening was used with a 2-hour cut-off value of 10.0 mmol/L. Risk factors for developing GDM were primarily obesity but also non-Nordic origin, maternal age >35 years, and low educational level.		The prevalence of GDM was 1.1%. No significant association was found between physical activity and GDM.	

	Paper I	Paper II	Paper III	Paper IV
Non-Nordic origin	Non-Nordic origin more than doubled the risk of developing GDM during pregnancy.	Midwives (participants) experienced counselling immigrant women on physical activity as challenging. This was related to some relatives' views on physical activity as something harmful for the fetus or the pregnant woman. Instead, the opinions from relatives suggested that the pregnant woman should have a sedentary lifestyle during pregnancy rather than being active. The midwife tried to lower the recommended goals for the women with immigrant background to achieve some physical activity. Walking was often recommended.	Participants of non-Nordic origin demonstrated decreased odds of reaching the recommended level of physical activity.	The immigrant pregnant women (participants) experienced contradictions between the midwife's counselling on promotion of physical activity and the advice given by relatives, which often suggested that exercise during pregnancy could be dangerous. Instead the relatives suggested that the pregnant woman should get assistance with everything concerning daily work tasks. The pregnant woman herself had a will to find her own way through these different approaches.
Educational level	Educational level less than university level increased the risk of developing GDM during pregnancy.		Pregnant women (participants) who had a higher educational level demonstrated increased odds of reaching the recommended level of physical activity.	
Self-rated health	Among the pregnant women who reported their self-rated health as "very good" or "good", the prevalence of GDM was 1.0% and 1.5%, respectively. The corresponding prevalence of GDM among those who reported their health as "either good or poor" or "poor" were 1.9% in both groups. The highest prevalence of GDM (2.1%) was found among those pregnant women who rated their health as very poor.		Pregnant women who achieved the recommended level of physical activity during pregnancy were half as likely to report "poor" or "very poor" self-rated health compared to the women who did not. Accordingly, women who reached the recommended level of physical activity rated their health as "good" or "very good".	

DISCUSSION

In the cross-sectional study (Paper I), we found that there was no national consensus regarding screening regimes for GDM between 2011 and 2012 among the different MHCA (N=43) in Sweden. Four screening regimes were identified using different diagnostic criteria for GDM. As expected, the highest prevalence of OGTT (93.6%) was found in the MHCA using universal screening and the lowest was seen in the MHCA using selective screening with the highest OGTT 2-hour cut-off value (12.2 mmol/L). Furthermore, the highest prevalence of GDM (2.9%) was seen in the MHCA using selective screening with a cut-off value of 8.9 mmol/L and the lowest prevalence was logically found in the area using selective screening and applying 12.2 mmol/L as a 2-hour cut-off value for GDM diagnosis. Thus, the majority of women underwent selective screening and a few women were offered universal screening during the study period. Maternal age >35 years, obesity, non-Nordic origin, and lower educational level than university education were risk factors for GDM. However, very few of the MHCA included the background factors maternal age and non-Nordic origin as indicators for OGTT, and none of the MHCAs used low educational level as an indicator for OGTT.

When investigating the prevalence of GDM in Sweden, several difficulties appeared related to different screening methods and cut-off values. The prevalence of GDM varies in relation to screening method applied (universal/selective), the criterion for GDM (133), the proportion of pregnant women who underwent OGTT, and the background characteristics of the studied population (13). In a global perspective, the prevalence of GDM depends on the diagnostic tests and the population studied (134). The HAPO study has demonstrated a continuous association between maternal plasma glucose levels and increasing birth weight and prevalence of caesarean section (CS) (39, 135). Our findings are in line with previous findings demonstrating an increased risk of LGA, instrumental vaginal delivery, and CS as the maternal plasma glucose levels increase. In addition, we have demonstrated that higher maternal age and low socio-economic status were risk factors for GDM, risk factors also reported in earlier studies (24, 25). Therefore, we believe these risk factors should be included as indicators (maternal risk factors) for OGTT in the local guidelines for GDM screening in Sweden. The risk factor maternal age ≥ 35 years, to be

used as an indicator for OGTT, is further supported by the PAP's values calculated for the two GDM screening regimes (A and C), where 14% and 17% of the prevalence could be attributed to the higher maternal age.

The different screening methods and diagnostic criteria for GDM in Sweden have led to unequal healthcare for pregnant women. The diagnostic criterion 12.2 mmol/L in one of the MHCA was seen as diagnostic criterion for manifest diabetes mellitus in several of the other MHCA. Furthermore, as the adverse pregnancy outcomes and long-term negative health impact both fetus and mother later in life because of GDM, the situation is unacceptable. We consider that there has been an inequality of care of the pregnant women in Sweden for several years. For example, standards of care should not depend on geography (i.e., where pregnant women live). In Sweden, the situation could be seen as a mirror of the global non-consensus regarding GDM. However, it is more understandable that such diverseness can be seen globally compared to within regions in Sweden, a rather small country. Due to this, the new proposals for screening methods regarding GDM in Sweden by the National Board of Health and Welfare (NBHW) in June 2015 are welcome. After a substantial investigation of the evidence-based knowledge, the NBHW decided to adopt the recommended diagnostic criteria and cut-off values for GDM (52) proposed by the International Association of Diabetes and Pregnancy Study Group (IADPSG) and the World Health Organization (WHO) (48) based on the epidemiological HAPO study (47). However, the NBHW did not take a stand on whether the screening for GDM should be performed as universal or selective (52).

In Paper III, almost half of the pregnant women reached the recommended level of leisure time physical activity proposed by the NBHW. Furthermore, these women were characterized by lower weight and BMI, a higher educational level, more likely to be non-smokers, and self-rated their health as good or very good, compared to those who did not achieve the recommended level of physical activity. These findings are in line with another study where women with light or sedentary physical activity have the same characteristics as the women in our study who did not reach the recommended level of physical activity (136). Paper III showed a higher prevalence of pregnant women reaching the recommended level of physical activity than other studies, ranging from

3% to 25%. The higher prevalence demonstrated in Paper III is probably due to the different time points of measurement of physical activity in pregnancy (137-140). Our study is in line with an earlier Danish study where the estimated prevalence of women reaching the recommended level of physical activity was 38% (141) when measuring physical activity in the corresponding gestational age as the present study (i.e., gestational week 10). We found no significant associations between the level of LTPA and birth weight, GDM, or mode of delivery. We cannot disregard the possibility of associations between GDM and levels of LTPA might have been demonstrated in a larger study sample. However, a Cochrane review evaluating the impact of physical activity on GDM concludes that currently there is insufficient evidence for an association (69). A study investigating maternal well-being during pregnancy reports that higher educational level and physical activity increase well-being (142), and the present study confirms these associations showing that statistically significantly more pregnant women who reached the recommended level of LTPA rated their health as very good/good and had a higher educational level.

In Paper II, we found that the midwives worked very hard to adjust their counselling on physical activity for pregnant women. They tried to make the advice as individualized as possible. The results for Paper IV revealed a strong desire among pregnant women for an individually-tailored counselling on physical activity by the midwives. They did not want general advice; they wanted to be seen as individuals with individual needs. They also could experience the midwife as having her own agenda, which was mainly based on medical surveillance.

Our expectation when planning Paper IV was that it would reflect Paper II in several ways. However, we noticed that some findings had unexpected connections. As presented in the Results section, there are findings characterized by close similarities between the experiences of midwives and the experiences by pregnant women on counselling on physical activity during pregnancy (Table 11). However, interesting findings among others are those that are not coherent in Paper II and Paper IV. Apparently, these findings have to be assessed in relation to the different settings for Study II and Study IV. In Study II, the FGD were well distributed over Sweden, from north to south, whereas Study IV was performed in a local setting in northern Sweden. The midwives in the specific area where Study IV was conducted did not participate in

Study II. In fact, we cannot disregard that midwives working in this specific region (Study IV), where the participants (i.e., pregnant women) were recruited, may have had another approach to counselling in relation to the midwives participating in Study II, although we do not find this very probable. However, in Study II we performed one FGD in the same county as the region in Study IV and the results were in line with the other FGD in Study II.

A finding that did not show coherence between the experiences by midwives and pregnant women is related to how the advice on the recommended level of physical activity provided by midwives was perceived by pregnant women and midwives. The midwives believed they adjusted and individualized counselling in accordance to the pregnant woman's needs as well as to the pregnant woman's receptiveness of advice on physical activity. Some pregnant women believed the counselling on physical activity was limited or even absent and when advice was provided, it was insufficient probably due to lack of knowledge in the field. Furthermore, they desired individual counselling, not general advice, advice intended for all pregnant women. Some pregnant women of normal weight felt neglected due to their normal weight; that is, they felt that overweight and obese women received more of the midwife's attention. This concern is worrying as adverse pregnancy outcomes due to maternal overweight and obesity are equal between those who are overweight or obese when entering the pregnancy and those who become overweight or obese during pregnancy (143). As a midwife, it can be challenging to know ahead if a normal weight woman will suffer from being overweight at the end of her pregnancy. Accordingly, counselling on the significance of physical activity should be offered to all pregnant women.

A good relationship is one of the cornerstones of successful counselling (144), and a trustworthy relationship is important (89). The pregnant women (Paper IV), especially the obese, could experience the counselling by the midwife as "tiptoeing" around the issue of weight as some pregnant women believed the midwife was afraid to be straightforward due to the sensitive nature of the topic. This view was confirmed by the midwives who believed that they needed to be cautious and tried to get a sense of the situation before providing advice on the pregnant woman's weight. The literature reports that being overweight is stigmatized in lifestyle counselling (98, 145, 146). On the other hand, some midwives

chose to be more frank and outspoken when it came to this issue. Some of the pregnant women experienced the midwife as nagging and lecturing, while others appreciated that she was direct and rather preferred such advice when it came to physical activity.

In both Paper II and Paper IV, the midwives (Paper II) and the immigrant pregnant women (Paper IV) had similar experiences. The midwives felt it challenging to counsel on physical activity to many pregnant women with different background characteristics. However, they described counselling on physical activity to immigrant women as extra challenging. The midwives experienced discrepancies between the content of their counselling on physical activity compared to the advice given by the immigrant women's families and relatives and this is also shown in other studies regarding counselling on gestational weight gain (92, 146). A part of the counselling concerned dispelling myths about physical exercise during pregnancy argued by relatives as something that would be dangerous, affecting the pregnancy negatively, including harming the fetus. Furthermore, environmental barriers such as lack of proper clothing and shoes were perceived by the midwives as complicating factors for the pregnant women to become physically active. For example, both the pregnant immigrant women and the midwives saw it as a challenge to exercise outside if the neighbourhood was perceived as dangerous or unfamiliar. The midwives were innovative and tried to adjust the level of physical activity to the possibilities for the pregnant woman in relation to her circumstances. This has been reported in previous studies (145, 147). When the pregnant women who had immigrated to Sweden gave their views, it reflected several parts of the midwives' experiences. The pregnant women experienced strong influences from relatives on their lifestyle and that it was difficult to accommodate to a new country. These pregnant women shared experiences of striving to find their own way, not adjusting to the midwife or the family's way but to their own will. They also revealed they sometimes acted in a way in order to appease the midwife or that they received advice but did the opposite because they were convinced that they knew better.

Other similarities perceived by midwives (Paper II) and pregnant women (Paper IV) were experiences of various barriers to physical activity, physical as well as psychological barriers. These barriers have also been demonstrated in several previous studies (68, 94, 96).

The caregiver's body size and how it may affect the encounter with the patient is poorly studied. A couple of studies have reported that healthcare providers working with health promotion should be aware that they might be perceived as untrustworthy due to their own excessive weight (148). On the other hand, some healthcare providers consider their larger body shape as an asset when encountering and counselling patients (149). In Paper II, some midwives reported that their body size could imply not trusting their counselling on healthy lifestyle, whereas others did not perceive that their body size would affect the counselling at all. In Paper IV, this view was confirmed where some pregnant women reported that a large body shape would reduce the trustworthiness of the midwife's counselling. However, other participants indicated that the body size of the midwife did not matter as long as the midwife was well informed and professional in her delivery of advice.

A Swedish study that explored how midwives counselled pregnant women on diet concludes that advice provided by midwives often is vague and unsatisfying, therefore the pregnant women searched for information elsewhere. Moreover, the study noted that the midwives and the pregnant women often found it difficult to understand one another during counselling (109). In Paper II and Paper IV, there were similar findings: in Paper II, the midwives tried to counsel the women individually; however, in Paper IV, the pregnant women did not perceive the counselling as individualized, as they thought the counselling as insufficient and sometimes this deficiency was perceived to be the result of the midwife's lack of knowledge. There can be several possible reasons for this issue. In Paper II, the midwives reported a heavy workload, increased number of visits, and not enough midwives. The midwives also experienced that they were not offered educational opportunities that would have trained them on the significance of physical activity during pregnancy. The pregnant women could perceive that the midwife had her own agenda, mostly associated with medical surveillance during pregnancy. Furthermore, the midwives reported that there was not enough time to focus on health consultations and lifestyle issues. Because the midwives had a heavy workload and lack of time, they had to prioritize their work tasks, leading to a focus on the "musts". As a result, perhaps midwives become risk factor-oriented and act on the pregnant woman's pregnancy risks rather than promoting a healthy lifestyle. During the encounters with a pregnant woman who has an

uncomplicated pregnancy, the midwife could “let her go” and instead focus on pregnant women with pregnancy complications or risk factors such as being overweight. However, to perform a lifestyle change and to adapt a healthier lifestyle is not only depending on the caregivers’ counselling skills and knowledge and the quality of the relationship between the midwife and the woman (89, 90). We would like to emphasize that in the end it comes down to each individual woman, the ability and motivation to change, the environmental conditions and the social networks (104).

Methodological considerations

This thesis has its strengths and limitations. The internal validity of data included in the Maternal Health Care Register (MHCR) has been investigated previously and has demonstrated good internal validity (130) for the majority of the variables included in Study I and Study III. The data in the study sample in Study I and III are probably representative for the population of pregnant women in Sweden, as the coverage in the MHCR was high (81% and 85% for 2011 and 2012, respectively). The Medical Birth Register (MBR) that is a health register characterized by mandatory participation, i.e. it covers almost all births in Sweden (150). The maternal background characteristics in MHCR such as maternal age and BMI were consistent with data in the MBR. However, data on maternal height and maternal weight in the MHCR are mostly self-reported data and underreporting of true maternal weight (i.e., reporting false lower weight) might have influenced the results, resulting in an underestimation of the prevalence of overweight and obesity in the Swedish pregnant population, and accordingly biasing the associations related to BMI. However, we do not consider this situation as a major source of bias.

In Study III, the variable used for estimating physical activity during pregnancy was self-reported and retrieved from the SALUT-R. We cannot disregard that an underestimation or an overestimation of “physical activity during leisure time” may bias the results in our study and therefore the results should be interpreted with caution. The difficulty with questionnaires in general is that they are prone to some sources of bias, such as recall bias. Furthermore, bias that occurs in relation to social desirability, where the individual’s desire to make a favourable impression affects the results, usually leads to an

overestimation of reported physical activity (151). More objective measurements such as measurements obtained from an accelerometer and/or a heart rate monitor have their benefits, but these instruments are almost impossible to use in large epidemiological studies, where questionnaires are more feasible. Furthermore, the use of an accelerometer or heart rate monitor can affect behaviour of the individual (i.e., the Hawthorne effect); the very use of these instruments can prompt the individual to be more physically active during the monitoring period. This bias can lead to difficulties when interpreting the results. The question regarding physical activity in Study III was based on a similar validated questionnaire (152). The Swedish National Board of Health and Welfare has also recommended that the target variable estimating self-reported physical activity level be used in questionnaires (152). In addition, the variables in the MHCR are mostly collected from medical records, a method of collection that could be considered a strength. A limitation of Study III is that it does not include information about dietary habits. Several studies investigating physical activity during pregnancy consider this variable important when interpreting the results of pregnancy outcomes. When measuring physical activity, it is important to collect data not only on the level of physical activity (amount of time engaged in sustained activity) but also on intensity, duration, and frequency (153).

In the qualitative Studies II and IV, we aimed to ensure and assess the trustworthiness of the study by applying the following components of qualitative research: transferability, credibility, dependability, and confirmability (124). One strength of Study II and Study IV is the measure of purposive sampling where the participants represented varying background characteristics as this strategy may strengthen the transferability of the study. To further enhance transferability of the findings, the study size had no pre-set number of FGD or in-depths interviews. As a result, data collection continued until no major new information regarding the topics under study was expressed, so additional interviews probably would not have provided major new information if data collection had continued. Additionally, a rich description of the procedure and analysis was provided to enable the reader to follow all the steps of the research process. To increase the credibility of the study findings in Study II, member checks were performed, which could confirm the findings. Writing memos and keeping records of the process of data collection and analysis addressed

the dependability of the findings. Moreover, in Studies II and IV the same member from the research team performed the data collection and the same person (ML) transcribed all FGD and in-depths interviews, a procedure that contributed to increasing dependability. Finally, the confirmability of the findings was achieved through discussing the findings within the research team until consensus was obtained. As members of the team had different professional backgrounds, objectivity was enhanced as individual pre-understandings could be challenged. Despite these efforts to address trustworthiness, there are some limitations. In Study II the participants were initially approached and informed about the study by the consultant midwife in their MHCA. Although these consultant midwives were given detailed information on the purpose of the study and the inclusion criteria, it is possible that the consultant midwives chose convenient participants irrespective of this information.

CONCLUSIONS AND IMPLICATIONS FOR PRACTICE

No consensus was found regarding screening regimes for GDM from 2011 through 2012. Increasing OGTT-values were strongly associated with adverse pregnancy outcomes. Therefore, the new fasting glucose value, 1-hour and 2-hour cut-off glucose values for diagnosis of GDM proposed by the NBHW in Sweden are welcome. Almost half of the pregnant women reached the recommendations for physical activity and had significantly lower BMI compared to those who did not. Being overweight or obese during pregnancy are strongly associated with adverse pregnancy outcomes. Because physical inactivity is associated with obesity, it is beneficial to be physically active before pregnancy and during pregnancy since it results in decreased risk of adverse pregnancy outcomes. Our findings emphasise the need for healthcare professionals to focus on early detection and encourage fertile and pregnant women to participate in health-enhancing physical activity, especially those with low levels of physical activity and those who are overweight or obese, to improve overall health in this population. The midwives desired to find individual solutions to encourage physical activity among pregnant women, although some pregnant women experienced the counselling as too general, even insufficient and as the midwife having her own agenda, mostly focusing on medical surveillance during pregnancy. To improve counselling, educational efforts, reasonable time allocated for surveillance of pregnant women, and personnel resources need to be provided if an individualized counselling promoting physical activity and healthy lifestyle is to be perceived as satisfactory by pregnant women. This counselling may help improve the health in this population, leading to improved self-rated health among these women. In addition, there is a need for efforts to promote physical activity to strengthen the health among pregnant women with an immigrant background.

FUTURE RESEARCH

- Exploring immigrant pregnant women's aspects on midwives' and other healthcare professionals' counselling and advice during pregnancy.
- Exploring other health professionals' role in counselling on physical activity and lifestyle.
- Further investigate the pregnant women's sources of knowledge regarding pregnancy-related issues.
- Exploring the partner's views on the significance of physical activity during pregnancy.
- Planning for an intervention programme on lifestyle change during pregnancy to investigate the impact of a physical activity intervention program during pregnancy on specified pregnancy outcomes.
- Mapping the screening methods in Sweden after the new guidelines on GDM and further investigate pregnancy outcomes in relation to changed cut-off values for GDM.

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APPENDIX 1

Intervjuguide, barnmorskor

- **Fysisk aktivitet (FA) under graviditeten - allmänt**
 - Hur ser ni på betydelsen av att vara fysiskt aktiv under graviditeten?
 - Vilka svårigheter/hinder upplever ni att gravida kvinnor kan ha för att vara fysiskt aktiva?
 - Vad upplever ni är det viktigaste som ni som barnmorskor kan tillföra gravida kvinnor när det gäller FA?
- **Rådgivningssituationen**
 - Vilka erfarenheter har ni gällande rådgivning i FA till gravida?
 - Svårigheter/underlättare
 - Skillnader hos de gravida? Svensk/immigrant?
- **Barnmorskans egen betydelse vid rådgivning**
 - Hur tänker ni när det gäller att ni är en möjlig förebild för den gravida kvinnan/paret när det gäller livsstilsfrågor?
 - Hur tror ni att er egen livsstil kan påverka er rådgivning?
 - Hur kan rådgivningen i FA påverkas av att vara smal/normalviktig alt. överviktig vid?
- **Avslutning**
 - Erfarenheter som ni upplever att vi inte berört?
 - Har ni goda exempel på FA och graviditet som ni vill dela med er av - t.ex. berätta om något fall ni har haft!

APPENDIX 2

Intervjuguide, gravida kvinnor

- **Vad har du för erfarenheter av barnmorskans rådgivning gällande levnadsvanor/(fysisk aktivitet)?**
 - Vad har varit bra/mindre bra?
- **Vilka andra personer har haft betydelse för rådgivning gällande levnadsvanor/(fysisk aktivitet)?**
 - Olika professioner inom hälso- och sjukvård
 - Andra personer som haft betydelse, i så fall vem/vilka?
- **Vilka är dina erfarenheter av rådgivning gällande levnadsvanor/(fysisk aktivitet) under tidigare graviditeter?**
 - Positiva erfarenheter/negativa erfarenheter
 - Har barnmorskans rådgivning lett till en förändring av dina levnadsvanor? Om ja, vad ledde i så fall till en förändring av levnadsvanorna? Vilken levnadsvana? Om ingen förändring av levnadsvanorna skedde, vad berodde det på?
- **Vilka är dina egna upplevelser/erfarenheter av rådgivning gällande levnadsvanor/(fysisk aktivitet) under denna graviditet?**
 - Positiva erfarenheter/negativa erfarenheter
 - Har barnmorskans rådgivning lett till en förändring av dina levnadsvanor? Om ja, vad ledde i så fall till en förändring av levnadsvanorna? Vilken levnadsvana? Om ingen förändring av levnadsvanorna skedde, vad berodde det på?
- **Upplever du att barnmorskans rådgivning gällande levnadsvanor/(fysisk aktivitet) har förändrats över tid? På vilket sätt?**
- **Vad är betydelsefullt för att barnmorskans rådgivning gällande levnadsvanor/(fysisk aktivitet) ska vara trovärdig?**
 - Trovärdighet
 - Barnmorskans egna levnadsvanor/kroppskonfiguration
 - Andra faktorer som påverkar barnmorskans trovärdighet/vårdrelationen?

RESEARCH ARTICLE

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No consensus on gestational diabetes mellitus screening regimes in Sweden: pregnancy outcomes in relation to different screening regimes 2011 to 2012, a cross-sectional study

Maria Lindqvist^{1*}, Margareta Persson^{1,2}, Marie Lindkvist³ and Ingrid Mogren^{1†}

Abstract

Background: Although associated adverse pregnancy outcomes, no international or Swedish consensus exists that identifies a cut-off value or what screening method to use for definition of gestational diabetes mellitus. This study investigates the following: *i)* guidelines for screening of GDM; *ii)* background and risk factors for GDM and selection to OGTT; and *iii)* pregnancy outcomes in relation to GDM, screening regimes and levels of OGTT 2 hour glucose values.

Methods: This cross-sectional and population-based study uses data from the Swedish Maternal Health Care Register (MHCR) (2011 and 2012) combined with guidelines for GDM screening (2011–2012) from each Maternal Health Care Area (MHCA) in Sweden. The sample consisted of 184,183 women: 88,140 in 2011 and 96,043 in 2012. Chi-square and two independent samples t-tests were used. Univariate and multivariate logistic regression analyses were performed.

Results: Four screening regimes of oral glucose tolerance test (OGTT) (75 g of glucose) were used: A) universal screening with a 2-hour cut-off value of 10.0 mmol/L; B) selective screening with a 2-hour cut-off value of 8.9 mmol/L; C) selective screening with a 2-hour cut-off value of 10.0 mmol/L; and D) selective screening with a 2-hour cut-off value of 12.2 mmol/L. The highest prevalence of GDM (2.9%) was found with a 2-hour cut-off value of 8.9 mmol/L when selective screening was applied. Unemployment and low educational level were associated with an increased risk of GDM. The OR was 4.14 (CI 95%: 3.81–4.50) for GDM in obese women compared to women with BMI <30 kg/m². Women with non-Nordic origin presented a more than doubled risk for GDM compared to women with Nordic origin (OR = 2.24; CI 95%: 2.06–2.43). Increasing OGTT values were associated with increasing risks of adverse pregnancy outcomes.

Conclusions: There was no consensus regarding screening regimes for GDM from 2011 through 2012 when four different regimes were applied in Sweden. Increasing levels of OGTT 2-hour glucose values were strongly associated with adverse pregnancy outcomes. Based on these findings, we suggest that Sweden adopts the recent recommendations of the International Association of Diabetes and Pregnancy Study Group (IADPSG) concerning the performance of OGTT and the diagnostic criteria for GDM.

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Background

Gestational diabetes mellitus (GDM), one of the most common metabolic disorders complicating pregnancy, is defined as any degree of glucose intolerance with onset or first recognition during pregnancy, and that is not considered manifest diabetes mellitus type 2 [1]. Risk factors for GDM are family history of diabetes mellitus type 2 (DM2), previous GDM, macrosomic infant (defined as 4500 grams or more), BMI ≥ 30 kg/m² [2], unexplained intrauterine fetal death, maternal age ≥ 35 years, and immigrant status [3-5]. The results from the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study show that higher maternal glucose levels are associated with increased macrosomia, caesarean sections and neonatal hypoglycemia [6]. Compared to normoglycemic pregnancies, women with GDM are associated with a seven-fold increased risk of DM2 later in life [7]. Offspring of women with GDM pregnancies have increased risk of obesity, glucose intolerance, and diabetes mellitus in puberty or early adulthood, all conditions included in metabolic syndrome [8,9].

The global prevalence of GDM is 7% (1-14% depending on diagnostic tests and the population studied) [10]. Applying the diagnostic criteria of the International Association of Diabetes and Pregnancy Study Group (IADPSG) and the international multi-centre HAPO has demonstrated significant variability of prevalences of GDM among participating countries and even among participating study centres within the same country [11]. From a global perspective, Sweden is considered a low risk country for GDM with an annual prevalence of 1 to 2.6% of this pregnancy-related disorder [12,13]. There is, however, no international consensus regarding how women should be screened for GDM, whether screening should be undertaken universally, or whether women who present risk factors [14] should undergo screening, i.e. selective screening. This lack of consensus persists even though it is recognized that adverse pregnancy outcomes are associated with GDM and a diagnosis of GDM results in increased medical surveillance for mother and fetus during pregnancy [15]. Therefore, it is impossible to estimate the true prevalence of GDM.

In Sweden, there is no national consensus with respect to GDM screening [16]. The International Association of Diabetes and Pregnancy Study Group (IADPSG) has presented recommendations for thresholds of GDM based on the epidemiological HAPO study [17], and these recommendations have also been adopted by the World Health Organization (WHO) [18]. The proposed criteria for GDM when using a 75-gram oral glucose tolerance test (OGTT) include a fasting plasma glucose of 5.1-6.9 mmol/L (92-125 mg/dL) or a 1-hour plasma glucose of 10.0 mmol/L (180 mg/dL) or a 2-hour plasma glucose of 8.5 mmol/L (153 mg/dL) [17].

Antenatal care (ANC) in Sweden is free and currently organized in 43 different areas called Maternal Health Care Areas (MHCA) characterized by geographic boundaries corresponding mainly to the Swedish counties. A consultant obstetrician and a consultant midwife are responsible for the guidelines regarding maternal and fetal surveillance and medical management within each MHCA. National guidelines of surveillance during pregnancy in antenatal care have been suggested by the professional associations of obstetricians and midwives [19]; however, local guidelines may differ between MHCA [16,19]. The overall aim of antenatal care in Sweden is to achieve "good sexual and reproductive health for the whole population", a goal that is similar to the WHO's guidelines for sexual and reproductive health. Almost all pregnant women in Sweden register in Swedish antenatal care [19].

In the Nordic countries, there is a unique opportunity to use population-based national registers for research. Due to these unique personal data registers, data may be linked, and individuals and families can be identified in several generations. The national registers are creating unique possibilities and are a valuable source of information and matrix for clinical trials [20]. The Swedish Maternal Health Care Register (MHCR) is a national health register, and data have been collected since 1999 by midwives in antenatal care. The MHCR underwent a major revision of the included variables between 2007 and 2009, and a new version of the register was launched in 2010. The MHCR is currently monitoring around 85% of all pregnant women (personal correspondence).

There is an ongoing discussion internationally regarding the diagnostics of GDM. However, suggestions of lowering cut-off values for GDM diagnosis, the situation of GDM screening in Sweden has not changed in the last decade and there are several regimes of screening available in clinical practice. Hence, there is an opportunity to study the outcomes of different screening regimes as to add further information to the knowledge of outcomes in relation to screening regimes.

This study, which includes data on deliveries in Sweden from January 1st 2011 to December 31st 2012, investigated the following: *i*) guidelines for screening of GDM; *ii*) background and risk factors for GDM and selection to OGTT; and *iii*) pregnancy outcomes in relation to GDM, screening regimes and levels of OGTT 2 hour glucose values.

Methods

This cross-sectional and population-based study uses data retrieved from the Swedish Maternal Health Care Register for 2011 and 2012 in combination with local guidelines for screening of GDM collected from each MHCA in Sweden.

All women, irrespective of single birth or multiple births, with data registered in the MHCR between 2011 and 2012 were included in the study. The coverage of registered deliveries in the MHCR was estimated to be 81% for 2011 and 85% for 2012 (personal correspondence). The following variables retrieved from the MHCR were included in the study: country of origin, maternal age, parity, maternal height, maternal weight, body mass index, smoking, level of education, self-reported health, number of visits to antenatal care, use of professional interpreter at visits in ANC, treatment for psychological ill-health during pregnancy, GDM, OGTT, gestational age, delivery mode, birth weight, small for gestational age (SGA), appropriate for gestational age (AGA), and large for gestational age (LGA) [21].

Local guidelines for screening of GDM were collected from all MHCA in Sweden ($n = 43$) through an initial e-mail request between September and October 2012. The e-mail requesting local guidelines was sent to the consultant midwife in each MHCA. The majority of guidelines were collected during the first round. For those MHCA that did not respond to the first e-mail, the consultant midwife in each MHCA was contacted by telephone or by another e-mail. Finally, guidelines for screening for GDM were collected from all MHCA in Sweden. Similarities and differences in the guidelines were compared. All local guidelines for screening GDM were unchanged during the study period (2011 to 2012).

Selective screening for GDM based on risk factors

Since 1990, Sweden has officially used the recommendations developed by the European Association for the Study of Diabetes for screening for GDM. Both universal and selective screening regimes stipulate a 75-g glucose load and the two-hour value of the capillary plasma glucose for the diagnosis. However, there is no national consensus regarding the threshold for definition of GDM in Sweden, so it varies among the different MHCA. Presently, there are two national approaches for screening for GDM: one universal screening approach where all pregnant women are offered an OGTT and one selective screening approach based on specified risk factors in the local guideline. The risk factor approach (i.e., selective screening) is used by approximately 89% of the MHCA in Sweden (personal communication). The risk factors that indicate a need for screening for GDM include family history of diabetes mellitus type 2 (DM2), GDM, macrosomic infant (defined as 4500 grams or more) or stillbirth in previous pregnancy, BMI ≥ 30 kg/m², and non-European nationality. The risk factors during pregnancy indicating an OGTT are accelerating fetal growth, polyhydramnios, and elevated random capillary plasma glucose. Both universal and selective screening regimes for the diagnostic procedures stipulate the use of a 75-g glucose load and the

2-hour value of the capillary plasma glucose. One-third of the MHCA also uses fasting glucose as a diagnostic criterion for GDM.

Definitions of background and outcome variables

Maternal age was defined as age at delivery. *Parity* was defined as total number of deliveries (including the index pregnancy in the register). *Maternal height* (cm), and *maternal weight* in early pregnancy (kg) were self-reported by the pregnant woman. *Body mass index (BMI)* was calculated with the formula BMI kg/m². The different BMI groups were defined according to WHO's definition of BMI: underweight: <18.5 kg/m²; normal range: 18.5–24.99 kg/m²; overweight: 25–29.99 kg/m²; obesity class 1: 30–34.99 kg/m²; obesity class 2: 35–39.99 kg/m²; and obesity class 3: ≥ 40 kg/m². *Smoking* at three months before pregnancy and at the first antenatal visit was reported. *Level of education* was defined as elementary school, high school, and university. *Self-reported health* was reported by the woman during early pregnancy and divided into five categories: very good, good, either good or poor, poor, and very poor health. *Gestational diabetes mellitus (GDM)* was defined as any degree of glucose intolerance with onset or first recognition during pregnancy. The cut-off values – 8.9 mmol/L, 10.0 mmol/L, and 12.2 mmol/L – for the diagnosis of GDM were determined by the MHCA. *OGTT* (75 g 2-two-hour oral glucose tolerance test) was used to diagnose GDM in all parts of Sweden. For analysis, the OGTT glucose values were categorised into two different sets. The first set of categories was as follows: <7.5 mmol/L, 7.5–8.8 mmol/L, 8.1–8.9 mmol/L, 9.0–9.9 mmol/L, 10.0–12.1 mmol/L, and ≥ 12.2 mmol/L. The second set used the categories defined by IADPSG, which define a normal OGTT as a glucose value of <8.5 mmol/L, GDM (i.e., glucose value) between 8.5 and 11.0 mmol/L, and manifest diabetes mellitus type 2 (i.e., glucose value ≥ 11.1 mmol/L) [17]. *Delivery mode* was reported as either as vaginal non-instrumental, vaginal instrumental, elective caesarean section, or emergency caesarean section. *Birth weight* was reported in grams. In calculations of birth weight, the birth weight of single births were included as well as birth weight of first child of duplex or triplex pregnancy. *Small for gestational age (SGA)*, *appropriate for gestational age (AGA)*, and *large for gestational age (LGA)* were calculated using Marsal's curve [21].

Ethical approval from the Ethical Review Board in Umeå was granted 2012 (Dno. 2012-407-3IM).

Statistical analysis

Two-independent samples t-tests were used to test differences of parametric data, and non-parametric two-independent samples tests were used to test differences

of categorical variables. Univariate and multivariate logistic regression analyses were performed and presented with odds ratios (OR) and their 95% confidence intervals (CI) where different models were demonstrated. The population attributable proportion (PAP) was calculated for specified exposures using the formula $PAP = p(RR-1) / [1 + p(RR-1)]$, where PAP is the proportion of cases in the population that should not have occurred had the exposed had the incidence of the unexposed. Statistical analysis was done using SPSS version 19.

Results

The total sample consisted of 184,183 deliveries (88,140 in 2011 and 96,043 in 2012). Mean maternal age and mean parity at delivery was 30.25 years and 1.8, respectively (Table 1). Table 1 shows the background characteristics for the whole sample as well as for each year (2011 and 2012). Test of difference was calculated for 2011 vs. 2012 for all variables. The following significant p-values were found comparing the variables for the year 2011 and the year 2012: maternal age in years ($p = 0.032$), weight (0.005), and BMI ($p = 0.001$). Regarding performed OGTT, 2011 vs. 2012 significant p-values were found for the variables weight ($p = 0.001$), BMI (0.001), educational level ($p = 0.003$), employment status ($p = 0.012$), number of visits to ANC ($p = 0.011$), SRH ($p = 0.001$), reported smoking three months before pregnancy ($p = 0.001$), and reported smoking at first visit ($p = 0.001$). The variables are presented in Table 1.

Four screening regimes for diagnostics of GDM in Sweden

Nationally, four GDM screening regimes were used between 2011 and 2012, using different capillary plasma glucose values for the diagnosis of GDM. Accordingly, there was no national consensus regarding screening and diagnosis of GDM in Sweden (Table 2). Four schemes for GDM screening were followed: A) universal screening with a 2-hour cut-off value of 10.0 mmol/L; B) selective screening with a 2-hour cut-off value of 8.9 mmol/L; C) selective screening with a 2-hour cut-off value of 10.0 mmol/L; and D) selective screening with a 2-hour cut-off value of 12.2 mmol/L. The OGTT 2-hour cut-off value of 12.2 mmol/L as diagnosis for GDM in the fourth category was regarded as diagnosis of manifest diabetes mellitus in the majority of the MHCA in Sweden. Most pregnant women (56.8%) in Sweden underwent selective screening of GDM with a 2-hour cut-off glucose value of 10.0 mmol/L. Fewer pregnant women (11.3%) were offered universal screening with the same criteria for diagnosis (10 mmol/L). In total, 88.7% of pregnant women in Sweden underwent selective screening. The background factors family history of diabetes mellitus type 2, previous GDM, macrosomic

infant (≥ 4.5 kg), and BMI >30 kg/m² were used by 81% of the MHCA as indicators for OGTT during pregnancy. Other indicators were unexplained intrauterine fetal death, maternal age more than 35 years, and immigrant status. Among the MHCA, only four had immigrant status as an indicator for OGTT. A vast majority of MHCA (81%) used BMI >30 or 35 as an indicator for OGTT. The most prevalent risk indicator for OGTT was elevated random plasma glucose (8.0-9.0 mmol/L), which was presented in all the MHCA using selective screening.

Prevalences of OGTT and GDM

Table 2 presents maternal background characteristics, prevalences of OGTT, GDM, and birth weight (mean, minimum, and maximum) in relation to current regimes of screening of GDM between 2011 and 2012. As expected, the prevalence of OGTT was highest (93.6%) in the MHCA that offered pregnant women universal screening of GDM, and the prevalence of OGTT was lowest (6.8%) in the screening category with a 2-hour cut-off value of 12.2 mmol/L as criteria for GDM (Table 2). The lowest prevalence of OGTT was for women younger than 19 years old (17.6%). The highest prevalence was for women 40 years old or older (24.0%) (Table 1). As body mass index increased, the prevalence of OGTT increased. The lowest prevalence was for women in the lowest BMI category (BMI <18.5 kg/m²; 13.6%), and the highest prevalence was for women with a BMI between 35 and 39.99 kg/m² (65.7%) and women with BMI 40 or higher (73.3%) (Table 1). The highest prevalence of GDM (2.9%) was found in the areas where selective screening was applied with an OGTT 2-hour value of 8.9 mmol/L as criteria for diagnosis of GDM (Table 2). As shown in Table 1, the prevalence of GDM increased with increasing values in categories of maternal age, BMI, and parity. Furthermore, the prevalence of GDM increased in women who had a low educational level, who were unemployed, and who rated their health as "either good or poor" or "very poor" compared to women with higher educational level, women who were employed, and women who rated their health as "good or very good" (Table 1).

Population attributable proportion

To calculate the population attributable proportion, we selected the two screening regimes universal screening "A" (Table 2) and selective screening "C" (Table 2) (i.e., two categories using the same 2-hour capillary plasma glucose value of 10 mmol/L for diagnosis of GDM). For each screening regime, the PAP for GDM was calculated for the exposures obesity, increased maternal age (i.e., maternal age 35 years or more), and non-Nordic origin. For the screening regime "A", 20%, 14%, and 22% of GDM cases could be attributed to

Table 1 Characteristics of subjects and test of difference between specified categories

Variables ^a	All subjects 2011-2012 N (%)	Subjects 2011 n (%)	Subjects 2012 n (%)	OGTT 2011-2012 N (%)	GDM 2011-2012 N (%)
Maternal (yrs)	184130 (99.8)	88016 (99.7)	96025 (99.9)	38302 (99.8)	2579 (99.8)
Mean(SD)	30.25 (5.3)	30.27 (5.3)	30.23 (5.3)	30.36 (5.4)	31.86 (5.5)
Min-Max	13-57	13-53	13-57	15-54	16-53
Maternal age					
≤19	2688 (1.5)	1369 (1.6)	1319 (1.4)	469 (17.6)	23 (0.9)
20-24	25212 (13.7)	11990 (13.8)	13222 (13.8)	5293 (21.2)	239 (1.0)
25-29	53971 (29.3)	25570 (29.0)	28393 (29.6)	11257 (21.0)	618 (1.1)
30-34	61706 (33.5)	29463 (33.4)	32243 (33.6)	12432 (20.3)	837 (1.4)
35-39	33225 (18.0)	16215 (18.4)	17010 (17.7)	7130 (21.5)	642 (1.9)
≥40	738 (4.0)	3490 (4.0)	3838 (4.0)	1748 (24.0)	220 (3.0)
Parity	181292 (98.4)	86189 (96.0)	95103 (98.2)	37603(96.8)	2548 (97.3)
1	79250 (43.7)	37569 (43.6)	41681 (43.8)	15493 (19.7)	949 (1.2)
2	67902 (37.5)	32340 (37.5)	35562 (37.4)	14130 (20.9)	861 (1.3)
≥3	34140 (18.8)	16280 (18.9)	17860 (18.8)	7980 (22.8)	738 (2.9)
Gest age^{bc}	180822 (98.2)	86434 (97.9)	94388 (98.1)	37684 (97.2)	2513 (97.6)
Pre-term	9838 (5.4)	4689 (5.4)	5149 (5.5)	1914 (19.6)	209 (2.1)
Term	156599 (86.6)	74874 (86.6)	81725 (86.6)	32714 (21.0)	2208 (1.4)
Post-term	14385 (8.0)	6871 (8.0)	7514 (8.0)	3056 (21.4)	96 (0.7)
Weight (kg)	179343 (97.4)	85359 (97.9)	93984 (97.9)	37062 (96.8)	2510 (97.3)
Mean (SD)	68.50 (13.7)	68.40 (13.6)	68.59 (13.7)	75.45 (17.7)	7704 (18.6)
Min-Max	29-183	29-183	30-183	36-183	40-163
Height (cm)	180124 (97.8)	85764 (97.3)	94360 (98.2)	37762 (97.3)	2519 (97.7)
Mean (SD)	166.2 (6.5)	166.2 (6.5)	166.2 (6.5)	166.2 (6.6)	163.8 (6.8)
Min-Max	113-196	113-193	113-196	133-195	133-187
BMI (kg/m²)^d	178723 (97.0)	85046 (97.5)		36967 (96.8)	2496(96.8)
Mean (SD)	24.78 (4.6)	24.74 (4.6)	24.82 (4.7)	27.29 (6.1)	28.70 (6.3)
Min-max	13.6-62.6	13.8-62.1	13.6-60.0	13.6-62.1)	16.0-60.0
BMI early pregnancy	178723 (97.0)	85046 (97.5)	93677 (96.7)	36967 (96.5)	2496(96.8)
<18.5	4329 (2.4)	2031 (2.4)	2298 (2.5)	586 (13.6)	23 (0.5)
18.5-24.99	1056679(59.1)	50622(59.5)	55057 (58.8)	15633 (14.9)	789 (0.7)
25-29.99	45667 (25.6)	21641 (25.4)	24026 (25.6)	9285 (20.4)	754 (1.7)
30-34.99	16126 (9.0)	7537 (8.8)	8589 (9.2)	6793 (42.4)	511 (3.2)
35-39.99	5117 (2.9)	2379 (2.8)	2738 (2.9)	3327 (65.7)	285 (5.8)
≥40	1805 (1.0)	836 (1.0)	969 (1.0)	1313 (73.3)	134 (7.4)
Educational level	151600 (82.3)	70638 (79.5)	80962 (84.0)	32183 (82.3)	2003 (76.5)
Elementary school	13532 (8.9)	6662 (9.4)	6870 (8.5)	3239 (24.1)	309 (2.4)
High school	60481 (39.9)	27821 (39.4)	32660 (40.3)	14263 (23.7)	904 (1.5)
University	77587 (51.2)	36155 (51.2)	41432 (51.2)	14681 (19.0)	790 (1.0)
Employment status	179628 (97.5)	85165 (94.6)	94463 (98.0)	37330 (96.1)	2501 (95.6)
Employed ^e	159566 (88.8)	75669 (88.8)	83897 (88.8)	32805 (21.9)	2057 (1.6)
Unemployed ^f	20062 (11.2)	9496 (11.2)	10566 (11.2)	4525 (22.9)	444 (2.4)
Country of origin	184132 (100)	88140 (100)	96043 (100)	38308 (97.6)	2579 (97.2)
Sweden	144563 (78.5)	70376 (79.8)	74187 (77.2)	29637 (20.6)	1613 (1.1)

Table 1 Characteristics of subjects and test of difference between specified categories (Continued)

Nordic countries ^a	1445 (0.8)	613 (0.7)	832 (0.9)	350 (24.6)	23 (1.7)
Other countries	34134 (18.5)	17151 (19.5)	21024 (21.9)	8318 (22.4)	943 (2.8)
Visits at ANC^h	182137 (98.9)	86822 (98.6)	95315 (99.2)	37917(99.0)	2534 (98.3)
Mean:	8.8 (2.4)	8.8 (2.4)	8.7 (2.7)	9.0 (2.4)	9.3 (3.0)
Max-min:	1-29	2-26	1-24	1-29	1-26
SRHⁱ	153227 (83.2)	70633 (79.1)	82594 (85.7)	32442 (83.3)	2102 (80.3)
Very good	44310 (28.9)	19838 (28.1)	24472 (29.6)	8484 (19.2)	422 (1.0)
Good	89740 (58.6)	41299 (58.5)	48441 (58.6)	19650 (22.0)	1317 (1.5)
Either good or poor	13755 (9.0)	6793 (9.6)	6962 (8.4)	3142 (23.0)	260 (1.9)
Poor	4371 (2.9)	2174 (3.1)	2197 (2.7)	950 (21.8)	82 (1.9)
Very poor	1051 (0.7)	529 (0.7)	522 (0.6)	216 (20.7)	21 (2.0)
Smoking 3 months^j	182532 (99.1)	75316 (98.8)	81797 (99.2)	38305 (97.5)	2579(97.6)
No smoking	157113 (85.2)	75316 (85.5)	81797 (86.1)	31718 (20.3)	2167(1.4)
Smoking	25419 (14.8)	12134 (14.5)	13285 (13.9)	5976 (23.7)	387 (1.6)
Smoking first visit	182619 (99.0)	84134 (94.2)	96043 (98.5)	38305 (97.6)	2579 (97.6)
No smoking	172082 (94.3)	82451 (94.2)	89631 (94.1)	35139 (20.5)	2380 (1.5)
Smoking	10537 (5.7)	5062 (5.7)	5475 (5.9)	2578 (24.6)	174 (1.7)

^aFor each specified variable, n and% are presented.

^bGestational age calculated using the WHO's guidelines.

^cPre-term = 22 + 0-36 + 6, Term = 37 + 0-41 + 6, Post-term = 42 + 0-43 + 6 (weeks).

^dBody mass index (BMI).

^eEmployed includes employed, student, and parental leave.

^fUnemployed includes unemployed, sick leave, and other.

^gNorway, Denmark, Finland, and Iceland.

^hAntenatal care unit (ANC).

ⁱSelf-rated health (SRH).

^jSmoking three months before pregnancy.

obesity, increased maternal age, and non-Nordic origin, respectively. The corresponding PAPs for screening regime "C" were 31%, 17%, and 19% of GDM cases that could be attributed to obesity, increased maternal age, and non-Nordic origin, respectively.

Maternal characteristics and pregnancy outcomes in relation to screening regimes

Maternal characteristics and pregnancy outcomes such as maternal age, maternal BMI, birth weight, large for gestational age, and small for gestational age are presented in

Table 2 Maternal characteristics and specific outcomes in relation to four screening regimes for gestational diabetes mellitus (GDM) in Sweden between 2011 and 2012

Variables	All n (%)	MA ^a (yrs)	Height (cm)	BMI ^b	BMI ^b	OGTT ^c	GDM
		Mean Min-max	Mean Min-max	Mean Min-max	≥30 n (%)	n (%)	n (%)
A. Universal screening 10.0 mmol/L ^d	20822 (11.3)	30.0 15-49	166.4 140-190	25.04 13.63-55.98	2784 (14.1)	19294 (93.6)	456 (2.2)
B. Selective screening 8.9 mmol/L ^d	8634 (4.7)	29.8 15-49	166.4 135-190	24.99 13.82-56.65	1110 (13.4)	1674 (19.6)	252 (2.9)
C. Selective screening 10.0 mmol/L ^d	104688 (56.8)	29.8 13-54	166.2 113-195	25.04 13.90-62.06	14523 (14.2)	13934 (13.4)	1494 (1.4)
D. Selective screening 12.2 mmol/L ^d	50039 (27.2)	31.4 14-57	166.2 123-196	24.11 13.97-56.40)	4631 (9.6)	3403 (6.8)	377 (0.8)

^aMaternal age (MA).

^bBody mass index (BMI) kg/m².

^cOral glucose tolerance test (OGTT).

^dCut-off value.

Table 1 for the four different screening regimes and in relation to the subcategories of GDM and non-GDM within each screening regime. The levels of maternal BMI among non-GDM cases were similar between regimes with the exception of non-GDM cases in the category where selective screening with a cut-off value of 12.2 mmol/L was applied, which presented a lower BMI-value (Table 3). Overall, the highest prevalence of LGA cases (20.6%) was found among women with GDM in the MHCA where selective screening and a 2-hour cut-off value of 12.2 mmol/L for diagnosis of GDM was applied (Table 3).

Pregnancy outcomes in relation to OGTT 2-hour glucose values

Increasing OGTT 2-hour glucose values were associated with increasing prevalences of adverse pregnancy outcomes such as instrumental vaginal delivery, caesarean section (elective CS as well as emergency CS), and large for gestational age (Table 4). Prevalences of LGA ranged from 5.7% (OGTT 2-hour glucose value of ≤ 7.5 mmol/L) to 15.6% (OGTT 2-hour glucose value ≥ 12.2 mmol/L). Prevalences of SGA were fairly similar in the different categories of OGTT values, ranging from 2.0 to 2.7% (Table 4). Furthermore, we categorized the OGTT 2-hour glucose values according to the criteria defined by IADPSG and WHO. The same pattern as in Table 4 was seen with increasing prevalences of similar adverse pregnancy outcomes (Table 5).

Gestational diabetes mellitus in relation to maternal characteristics

Table 6 presents univariate and multivariate logistic regression analyses for the outcome GDM in relation to non-GDM for different background variables such as BMI, maternal age, country of origin, employment status, and educational level. Among the background variables investigated, obesity (defined as BMI >30 kg/m²) demonstrated the strongest impact on risk of GDM (Table 6). The OR for GDM was 4.14 (95% CI 3.81-4.50) for women with obesity compared to women with BMI less than 30. When adjusting for age, country of birth, employment status, and educational level, the OR was moderately changed with an OR of 3.66 (95% CI 3.31-4.01). Women with a non-Nordic origin had more than twice the risk for GDM in relation to women with Nordic origin (Table 6).

Pregnancy outcomes in relation to gestational diabetes mellitus

Maternal characteristics and pregnancy outcomes are presented in Table 3 in relation to the four screening regimes and the subcategories of GDM and non-GDM within each screening regime. The maternal BMI was significantly higher for GDM cases compared to non-GDM cases regardless of screening regime category. The highest mean BMI was found for GDM cases exposed to screening regime C (29.22 kg/m²) (Table 3). The prevalence of LGA was significantly higher for GDM cases in all screening regime categories. In relation to non-GDM cases in each screening regime

Table 3 Maternal characteristics and specified pregnancy outcomes in relation to categories of universal and selective screening regimes for gestational diabetes mellitus (GDM) between 2011 and 2012

Variables	Maternal age (years)	Maternal BMI ^a	Birth weight (grams)	LGA ^b	LGA/non LGA	SGA ^c	SGA/non LGA
	Mean	Mean	Mean	n (%)	p-value		p-value
Universal screening 10.0 mmol/L^d				890 (4.4)		478 (2.4)	
GDM	31.58	27.63	3540	46 (10.5)	<0.001	17 (3.9)	0.121
Non GDM	29.98	24.98	3533	844 (4.3)		59 (2.3)	
Selective screening 8.9 mmol/L^d				382 (4.7)		218 (2.7)	
GDM	31.67	28.27	3567	25 (10.4)	<0.001	7 (2.9)	0.588
Non GDM	29.72	24.89	3555	352 (4.4)		210 (2.6)	
Selective screening 10.0 mmol/L^d				4375 (4.3)		2586 (2.5)	
GDM	31.71	29.22	3636	215 (14.9)	<0.001	19 (1.3)	0.063
Non GDM	29.77	24.98	3534	4184 (4.1)		2561 (2.5)	
Selective screening 12.2 mmol/L^d				1903 (4.0)		1289 (2.7)	
GDM	32.94	27.98	3610	84 (20.6)	<0.001	14 (3.8)	0.058
Non GDM	31.39	24.08	3506	1819 (3.9)		1273 (2.7)	

^aBody mass index (BMI) kg/m².

^bLarge for gestational age (LGA).

^cSmall for gestational age (SGA).

^dOGTT 2-hour cut-off value.

Table 4 Oral glucose tolerance test (OGTT) 2-hour values in categories in relation to specified pregnancy outcomes between 2011 and 2012

OGTT values in categories (mmol/L)	All n (%)	Birth weight (grams) Mean min-max	LGA ^a n (%)	SGA ^b n (%)	Vaginal non instrumental Delivery n (%)	Vaginal instrumental Delivery n (%)	CS ^d n (%)	Elective CS n (%)	Emergency CS n (%)
<7.5	26307 (71.6)	3594 300–5890	1445 (5.7)	590 (2.4)	20082 (76.5)	1781 (6.8)	4388 (16.7)	1928 (7.3)	2455 (9.3)
7.5–8.0	3644 (9.9)	3663 345–5940	316 (9.0)	68 (2.1)	2646 (72.7)	264 (7.2)	732 (20.1)	302 (8.3)	430 (11.8)
8.1–8.9	3576 (9.7)	3682 990–6020	355 (10.3)	64 (2.0)	2537 (71.1)	262 (7.3)	770 (21.6)	315 (8.8)	455 (12.7)
9.01–9.9	1504 (4.1)	3640 491–6270	177 (12.2)	31 (2.4)	1024 (68.4)	105 (7.0)	369 (24.1)	157 (10.4)	211 (14.1)
10.0–12.1	1411 (3.8)	3620 512–5955	198 (14.8)	30 (2.5)	917 (65.2)	101 (7.2)	388 (27.6)	174 (12.4)	214 (15.4)
≥12.20	310 (0.8)	3619 1103–5540	46 (15.6)	7 (2.7)	188 (60.8)	24 (7.8)	97 (31.4)	44 (12.7)	57 (17.8)

^aLarge for gestational age (LGA).

^bSmall for gestational age (SGA).

^cVacuum extraction or forceps.

^dCesarean section (CS).

category, the LGA prevalences were more than doubled in screening regimes A and B, more than three times higher in screening regime C, and five times higher in screening regime D (Table 3). The highest mean birth weight was demonstrated for GDM cases in screening regime C (3636 g) (Table 3). There was a significantly increased risk of CS delivery in the group of GDM cases compared with non-GDM cases (OR = 1.90, 95% CI 1.74–2.07). However, there was no statistically significant difference between elective CS or emergency CS regarding GDM ($p = 0.169$).

Large for gestational age in relation to maternal characteristics

Large for gestational age fetus was strongly related to maternal obesity (BMI > 30), with an OR of 2.46 and

95% CI 2.33–2.60. When adjusting for maternal age, the OR for LGA moderately changed with an OR of 2.44 (95% CI 2.31–2.58). Furthermore, when adjusting for screening regime category, the OR was only slightly altered (OR 2.38, 95% CI 2.25–2.54). Non-Nordic origin demonstrated a protecting effect for LGA (OR 0.75; 95% CI 0.71–0.80).

Discussion

Between 2011 and 2012 there was no national consensus regarding screening regimes of GDM in Sweden, and this situation is still prevailing. In this population-based cross-sectional study, we found that four screening and diagnostic regimes of GDM were applied in Sweden. The highest prevalence of OGTT (93.6%) was seen in

Table 5 Oral glucose tolerance test (OGTT) 2-hour values in categories in relation to specified pregnancy outcomes between 2011 and 2012

OGTT values in categories (mmol/L)	All n (%)	Birth weight (grams) Mean min-max	LGA ^a n (%)	SGA ^b n (%)	Vaginal non instrumental Delivery n (%)	Vaginal instrumental Delivery n (%)	CS ^d n (%)	Elective CS n (%)	Emergency CS n (%)
<8.5	31974 (87.0)	3605 300–5964	1940 (6.2)	696 (2.2)	24162 (75.7)	2201 (6.9)	5548 (17.4)	2392 (7.8)	3156 (9.6)
8.5–11.0	4082 (11.1)	3661 491–6270	474 (11.8)	76 (1.9)	2799 (68.8)	285 (11.2)	987 (24.2)	433 (10.6)	554 (13.6)
≥11.1	696 (1.9)	3646 1103–5955	124 (18.3)	18 (2.7)	433 (62.5)	51 (7.4)	209 (30.2)	95 (11.9)	114 (18.3)

^aLarge for gestational age (LGA).

^bSmall for gestational age (SGA).

^cVacuum extraction or forceps.

^dCesarean section (CS).

Table 6 Univariate and multivariate logistic regression analysis^{a, b} for gestational diabetes mellitus (GDM) in relation to non-GDM for specified variables between 2011 and 2012

Variables	Crude OR ^a	Model 1 ^b (n = 178038)	Model 2 ^b (n = 178038)	Model 3 ^b (n = 176145)	Model 4 ^b (n = 148610)
BMIf <30.00	1	1	1	1	1
BMI ≥30.00	4.14 (3.81–4.50)	4.10 (3.74–4.42)	4.00 (3.68–4.35)	3.93 (3.62–4.28)	3.66 (3.31–4.01)
Age <35	1	1	1	1	1
Age ≥35	1.79 (1.15–1.95)	1.72 (1.58–1.87)	1.71 (1.57–1.86)	1.71 (1.57–1.86)	1.60 (1.59–1.93)
Nordic countries ^d	1		1	1	1
Non Nordic countries	2.24 (2.06–2.43)		2.18 (2.01–2.37)	2.10 (1.92–2.28)	2.10 (1.87–2.28)
Employed ^e	1			1	1
Unemployed ^f	1.74 (1.57–1.93)			1.27 (1.14–1.42)	1.20 (1.10–1.36)
University level ^g	1				1
<University level	1.62 (1.48–1.77)				1.34 (1.21–1.47)

^aCrude odds ratio.

^bAdjusted odds ratio and their 95% confidence intervals.

^cBody mass index (BMI) kg/m².

^dNorway, Finland, Denmark, and Iceland.

^eEmployed includes employed, student, and parental leave.

^fUnemployed includes unemployed, sick leave, and other.

^gElementary school/high school.

the MHCA that used universal screening, and the lowest prevalence of OGTT was seen in the MHCA that used selective screening with an OGTT 2-hour cut-off value of 12.2 mmol/L as criteria for GDM. The highest prevalence of GDM (2.9%) was seen in the area where selective screening used an OGTT 2-hour cut-off value of 8.9 mmol/L. Maternal obesity, maternal age more than 35 years, non-Nordic origin, and lower level of education were all prominent risk factors for GDM. Furthermore, these background variables constituted risk factors for LGA except for women with a non-Nordic origin, resulting in a decreased risk of LGA. Most pregnant women in Sweden underwent selective screening of GDM using different OGTT 2-hour cut-off values for diagnosis. Few Swedish pregnant women (11.3%) were offered universal screening for GDM. In the MCHA with the lowest OGTT 2-hour cut-off value (8.9 mmol/L) as criteria for diagnosis of GDM, the prevalence of GDM was significantly higher (2.9%), compared to areas that used higher OGTT 2-hour cut-off values (10.0 and 12.2 mmol/L; 2.2% and 0.8%) as criteria for GDM diagnosis.

Sweden is considered to have a rather low prevalence of GDM (i.e., around 1.4%) [12]. Using the current screening methods and thresholds in Sweden, this study confirmed this level of GDM. Clearly, the “true level” of GDM within a specific setting depends on screening method (universal/general), the criterion for diagnosis of GDM [22], coverage of OGTT in the targeted population, the OGTT 2-hour cut-off value, and background characteristics of the pregnant population [23].

The International Association of Diabetes and Pregnancy Study Group (IADPSG) and WHO suggest the following

diagnostic criteria and cut-off values for diagnosis of GDM: a fasting plasma glucose of 5.1 mmol/L (92 mg/dL) or a 1-hour plasma glucose of 10.0 mmol/L (180 mg/dL) or a 2-hour plasma glucose of 8.5 mmol/L (153 mg/dL) [18]. Only a minor part (4.7%) of Swedish pregnant women were exposed to a screening regime for diagnosing GDM at a 2-hour plasma glucose of 8.9 mmol/L, which is higher than the cut-off value of 8.5 mmol/L recommended by IADPSG and WHO [17,18]. Furthermore, more than one quarter of Swedish women underwent selective screening regime with a 2-hour plasma glucose value of 12.2 mmol/L or more, which commonly is graded as manifest diabetes mellitus. We find this selective screening regime unacceptable. The results in our study agree with the findings in the HAPO studies, where increasing 2-hour glucose values are associated with increasing risks for adverse pregnancy outcomes [2,6]. In fact, a major part of the world has adopted the recommended diagnostic criteria presented by IADPSG and WHO and our suggestion is that Sweden should follow this trend as well.

The resistance to accepting IADPSG and WHO recommendation of using the OGTT 2-hour cut-off values is related to expectations of increased work load for primary health providers due to the demand of follow-up by health services and the issue of unproven cost-effectiveness [24].

In our study, the highest prevalence of LGA (20.6%) was found in the MHCA where selective screening with a 2-hour cut-off value of 12.2 mmol/L for GDM diagnosis was applied. This high level of LGA differs from the prevalence of LGA in other MHCA where other

diagnostic criteria for GDM were applied, such as a 2-hour cut-off value of 10.0 mmol/L (universal screening; LGA prevalence of 10.5%) and selective screening with a 2-hour cut-off value of 8.9 mmol/L (selective screening; LGA prevalence of 10.4%).

This high level of LGA (20.6%) might be explained by undiagnosed glucose intolerance with additional non-exposure to intervention by health care services. This situation is especially noteworthy since the mean maternal BMI (24.11 kg/m²) in this GDM screening regime category was significantly lower (p -value <0.001) compared to the mean maternal BMI in the other categories of GDM screening regimes (Table 3). The non-consensus regarding OGTT 2-hour cut-off values for diagnosis of GDM and the different regimes for screening is consistent with European protocols as a whole, demonstrating inconsistencies in GDM screening practices [23].

As demonstrated by the HAPO studies, there are continuous associations between maternal glucose levels and increasing birth weight and prevalence of caesarean section [6,14,25]. As previously mentioned, our study's results agree with these results and demonstrate increased risks of LGA, instrumental vaginal delivery, and caesarean section in relation to increased levels of OGTT 2-hour glucose values. Increased maternal age as a risk factor for GDM has been reported previously [3,4], and our study confirms this association. Low socioeconomic status as a risk factor for GDM has also been reported previously [4], a finding also confirmed by our study. We suggest that older maternal age and low socioeconomic status should be considered as indicators for performance of OGTT when using a selective screening approach. Adverse pregnancy outcomes such as CS are well known as an adverse pregnancy outcome related to GDM, an association also confirmed by our study where the prevalence of CS increased with increased OGTT 2-hour glucose values. The OR was 1.92 times higher (95% CI 1.75-2.06) for CS compared to vaginal delivery for women with GDM compared to pregnant women without GDM. The same pattern could be seen regarding the risk of LGA. Women of non-Nordic origin presented a significant lower risk for LGA compared to women of Nordic origin (OR 0.75, 95% CI 0.71-0.80) and these findings have been reported previously [26].

The OR was 1.79 times higher (95% CI 1.15-1.95) for maternal age ≥ 35 years compared to maternal age <35 years. The importance of including maternal age of 35 years or more as an indicator for OGTT was supported by the PAPs values calculated for GDM for the two screening regimes "A" and "C" (see Results), showing that 14% vs. 17% could be attributed to maternal age ≥ 35 years.

Obesity is a global epidemic and has become a public health issue due to its association with complications during pregnancy, including significant adverse conditions

such as preeclampsia, GDM, LGA, stillbirth, and caesarean section [27,28]. In our study, obese women had a substantial increased risk of GDM (OR 4.14; CI 95%: 3.81-4.50) compared to normal weight women.

Methodological considerations

The internal validity of data included in the Maternal Health Care Register (MHCR) has been investigated. Unpublished results have shown an overall high coverage of variables and a satisfying quality of a major part of variables included in the register (personal communication). Because the coverage in the MHCR is considered high (81% in 2011 and 85% in 2012; personal communication), we believe the materials to be representative of the population of pregnant women in Sweden. Data on maternal height and maternal weight in the MHCR are mostly self-reported data (personal communication). Underreporting of the true maternal weight (i.e., reporting false lower weight) might have influenced the results, resulting in an underestimation of the prevalence of obesity in the Swedish pregnant population, and accordingly an underestimation of the associations related to BMI. However, we do not consider this situation as a major source of bias.

Ethical considerations

All health national registers in Sweden, including MHCR, comply with the rules and procedures stated by The National Board of Health and Welfare in Sweden. Collection and management of patient data in health systems and health registers are regulated through the Swedish Patient Data Law. Participation in MHCR is voluntarily. Midwives in antenatal care inform pregnant women on the aims and participation of MHCR using the following strategies: a) advertisements in the waiting room at the antenatal clinic, b) written information provided if requested by the pregnant woman, and c) at registration in antenatal care the pregnant woman receives information orally from the midwife on how data are documented in the medical files and in MHCR. In a majority of the MHCA, a pregnant woman completes a form on health issues before registration in antenatal care. Furthermore, the eligible participants receive information that all results will be presented on an aggregated level, so no individual subject can be identified.

Conclusions

There was no consensus regarding screening regimes for GDM in Sweden. Increasing levels of OGTT 2-hour glucose values were strongly associated with adverse pregnancy outcomes. Applying different screening regimes and definitions of GDM in Sweden results in different procedures in clinical management of pregnant women which contributes to unequal health care. Using 2-hour

capillary glucose does not follow international recommendations. We therefore suggest that Sweden adopts the recent recommendations outlined by IADPSG concerning the performance of OGTT and the diagnostic criteria for GDM. The results in our study further support that maternal age ≥ 35 years of age and educational level should be regarded as risk indicators for performance of OGTT during pregnancy.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

All authors have sufficiently contributed to this study. ML, IM, MP, and MLT designed the study. ML collected the data, conducted the first analyses, and drafted the manuscript in close collaboration with IM. ML and IM performed the statistical analyses with assistance from MLT. MP and MLT contributed to the manuscript during the work process. All authors have read and approved the final manuscript.

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RESEARCH ARTICLE

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“An on-going individual adjustment”: a qualitative study of midwives’ experiences counselling pregnant women on physical activity in Sweden

Maria Lindqvist^{1*}, Ingrid Mogren¹, Eva Eurenus², Kristina Edvardsson^{1,3} and Margareta Persson^{4,5†}

Abstract

Background: In Sweden, midwives play prominent supportive role in antenatal care by counselling and promoting healthy lifestyles. This study aimed to explore how Swedish midwives experience the counselling of pregnant women on physical activity, specifically focusing on facilitators and barriers during pregnancy. Also, addressing whether the midwives perceive that their own lifestyle and body shape may influence the content of the counselling they provide.

Methods: Eight focus group discussions (FGD) were conducted with 41 midwives working in antenatal care clinics in different parts of Sweden between September 2013 and January 2014. Purposive sampling was applied to ensure a variation in age, work experience, and geographical location. The FGD were digitally recorded, transcribed verbatim, and analyzed using manifest and latent content analysis.

Results: The main theme– “An on-going individual adjustment” was built on three categories: “Counselling as a challenge”; “Counselling as walking the thin ice” and “Counselling as an opportunity” reflecting the midwives on-going need to adjust their counselling depending on each woman’s specific situation. Furthermore, counselling pregnant women on physical activity was experienced as complex and ambiguous, presenting challenges as well as opportunities. When midwives challenged barriers to physical activity, they risked being rejected by the pregnant women. Despite risking rejection, the midwives tried to promote increased physical activity based on their assessment of individual needs of the pregnant woman. Some participants felt that their own lifestyle and body shape might negatively influence the counselling; however, the majority of participants did not agree with this perspective.

Conclusions: Counselling on physical activity during pregnancy may be a challenging task for midwives, characterized by on-going adjustments based on a pregnant woman’s individual needs. Midwives strive to find individual solutions to encourage physical activity. However, to improve their counselling, midwives may benefit from further training, also organizational and financial barriers need to be addressed. Such efforts might result in improved opportunities to further support pregnant women’s motivation for performance of physical activity.

Background

In Sweden, almost all pregnant women regularly visit midwives in antenatal care (ANC). One of the aims of ANC services in Sweden is to achieve “good sexual and reproductive health for the whole population”, which is in agreement with the WHO definition of sexual and reproductive health [1]. The ANC services are free of charge and

organized in 43 Maternal Health Care Areas (MHCA), mainly corresponding to Swedish counties (personal communication). Each MHCA is led by a consultant obstetrician and a consultant midwife who have the responsibility to develop medical guidelines, in-service training, and evaluation of provided health services at the ANC. More than a third of the Swedish ANC centers are currently organized within primary health care, a quarter are organized as free-standing units, another quarter are private clinics, and the rest are organized as part of departments of obstetrics and gynaecology. Midwives working in ANC provide medical support for all fertile women as well as medical

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surveillance during pregnancy. The professional associations of obstetricians and midwives have issued national guidelines for surveillance during pregnancy [1]. These guidelines specify eight to ten ANC visits for uncomplicated pregnancies. The ANC surveillance programme aims to identify risk factors during pregnancy that could result in complications for the mother or foetus. The midwife also provides counselling on healthy lifestyle [1].

The content and quality of the relationship established between the midwife and the pregnant woman is central for successful health care. Effective communication not only increases the quality of maternity care, but also ensures clinical safety [2-5]. In addition, trust and confidence are significant components with respect to the relationship between caregivers and patients [6]. The supportive role of the midwife is prominent as is her mission to promote a healthy lifestyle during pregnancy. Furthermore, an individual assessment of the woman's psychosocial situation is part of the midwife's supportive and counselling role [1]. Swedish midwives apply different strategies, such as being a caring companion or acting as a medical guardian, when advising pregnant woman and her partner to promote healthy behavior and to protect the relationship. These strategies depend on whether the pregnancy is normal or complicated [5,7].

The Swedish national guidelines recommend 30 minutes of physical activity per day during normal pregnancy [1]. The current national recommendations, based on the international WHO recommendations, suggest that adults 18 to 64 years of age, pregnant women included, should perform at least 150 minutes per week of moderate intensity aerobic physical activity or at least 75 minutes per week of vigorous intensity aerobic physical activity or a combination of these. In the majority of cases, physical activity is a safe and beneficial component of a healthy pregnancy and does not cause an increased risk of adverse pregnancy outcome [8]. Regular physical exercise can maintain or improve fitness during pregnancy and may reduce adverse pregnancy outcomes, such as gestational diabetes mellitus and preeclampsia [8,9].

As reported by pregnant women, barriers for performing physical activity during pregnancy include lack of time and motivation, increased body size, pain, and other physical barriers [10,11]. The wellbeing of the foetus can motivate pregnant women to perform physical activity and strive for a healthy lifestyle [11,12]; however, pregnant women may receive conflicting information about physical activity from health care providers and other health professionals [11]. Furthermore, previous studies have also shown that pregnant women experience lack of information regarding physical activity, advice on appropriate gestational weight gain, and physical exercise during pregnancy. In addition, they often perceive the caregivers' knowledge as limited [13]. A qualitative study concludes that pregnant women

need unambiguous advice regarding healthy lifestyle, diet, and exercise during pregnancy [14]. As a result of these findings, health care providers are demanding specific evidence-based guidelines on physical activity for pregnant woman [11]. Physical activity is associated with very good or excellent self-rated health [15] and well-being, and women who are physically active before pregnancy seem to continue their physically active lifestyle into pregnancy [16].

Few publications have addressed counselling on physical activity during pregnancy. To our knowledge, no study has been conducted that explores how Swedish midwives experience counselling pregnant women on physical activity. This study attempts to fill this gap in knowledge.

Aims

This study aimed to explore how Swedish midwives experience the counselling of pregnant women on physical activity, specifically focusing on facilitators and barriers during pregnancy. Also, addressing whether the midwives perceive that their own lifestyle and body shape may influence the content of the counselling they provide.

Methods

A qualitative approach was applied in order to explore the research questions under study. By using focus group discussions (FGD), experiences and opinions of the participants were collected. Swedish ANC centers were selected to represent differences related to age, size of city, MHCA, demography, socio-economy, coastland, and inland. To be included in the study, the participant had to work as a midwife in an ANC exclusively. Purposive sampling was applied when inviting eligible participants to participate in the study. The study aimed for variety in age, work experience as a midwife, and number of years of employment in an ANC. We aimed for six to eight participants in each FGD in the selected areas. This goal was impossible to fulfill in the most rural areas as midwives worked in small units with few employees or units were located far from each other.

The first author (ML) contacted the consultant midwife in each selected MHCA to distribute the information on the study to the midwives working in the specific MHCA. Thereafter, the consultant midwife provided a list with names of midwives who had been approached, who fulfilled the inclusion criteria, and who were willing to participate to the first author (ML). Before the FGD, ML orally and in writing informed each potential participant about the objectives of the study. Each participant signed a consent form before the FGD started. No eligible participant declined participation in the study. The participants were informed that they could drop out at any time during the study period. The characteristics of the participants are presented in

Table 1. Shortly before one of the FGD, three of five participants dropped out due to unexpected work tasks, resulting in only two participants. A majority of the participants (68.3%) reported additional education, such as courses in diet, motivational interviewing, psychology, breastfeeding, pedagogics, and sexology.

An interview guide was developed based on ideas from the current literature as well as on the authors' work experiences. As two of the authors (MP and IM) had significant experience with clinical work in ANC (MP as a midwife and IM as a consultant obstetrician), they understood the organization and the content of the daily work in the ANC. This experience and knowledge was essential to the development of the interview guide. A pilot FGD was conducted including seven midwives currently working in ANC to test the interview guide; this pilot FGD resulted in a few minor revisions of the interview guide. The pilot study was later included in the data analysis with the permission of the participants. The specific topics of the interview guide were the midwives' experiences of counselling pregnant women on physical activity during pregnancy in relation to:

- Counselling on physical activity in general
- Barriers and facilitators for physical activity
- Counselling native Swedish women
- Counselling immigrant women
- Significance of midwife's own body shape
- Significance of midwife's own lifestyle

Data analysis

The transcribed interviews were analyzed using qualitative manifest and latent content analysis, a systematic approach that analyses what the text says and how the underlying meaning of the text could be interpreted [17]. First, the transcripts were read several times by the first

and the last authors (ML and MP) to achieve a sense of the whole and to identify possible content areas. Second, meaning units were identified, condensed, and coded. Third, the codes were compared to identify similarities and differences in content and meaning. During this process, sub-categories and categories were identified. Fourth, the transcripts were then re-read several times to ensure that the categories covered all the aspects of the interviews. During the creation of the categories, the discussion of the findings was mainly performed by ML and MP with input from IM. Later in the analysis, all authors had an opportunity to challenge and discuss the findings until consensus was reached. To validate the findings, the first author arranged a meeting with participants in FGD 4; all but one participant participated. The preliminary results were presented and discussed with the participants. In general, the participants confirmed our findings. During the final steps of the analysis, a theme (i.e., a thread of underlying meanings of the experience under study) emerged [17]. The theme captured how the overall experience of counselling on physical activity was described by the participating midwives.

Ethical approval

Ethical approval for the study was granted by the Ethical Review Board, Umeå University (Dno. 2012-407-31 M).

Results

An overview of the theme, categories, and subcategories is presented in Table 2. All quotations used to illustrate the categories are presented in italics and with the focus group number listed after each quotation. The theme revealed – *An on-going individual adjustment* – reflects the midwives on-going need to adjust their counselling approach depending on each woman's specific situation. Furthermore, counselling pregnant women on physical activity

Table 1 Characteristics of participants (n = 41) attending the focus group discussions (FGD)

FGD	(n)	Mean age years	Work experience as midwife mean years (range)	Work experience in ANC mean years (range)
Northern Sweden				
FGD 1	2	49.5	17.5 (10-25)	9.5 (4-15)
FGD 2	7	53.2	23.7 (5-35)	12.7 (5-27)
FGD 3	6	52.5	26.7 (2-35)	16.7 (8-27)
Mid Sweden				
FGD 4	5	36.5	7.0 (2-9)	2.3 (1-5)
FGD 5	5	58.3	23.0 (5-26)	16.5 (4-24)
FGD 6	9	42.1	16.1 (8-19)	11.9 (3-17)
Southern Sweden				
FGD 7	5	48.8	13.8 (2-22)	12.8 (2-18)
FGD 8	2	47.5	17.5 (15-20)	7.5 (2-13)

Table 2 Theme, categories, and sub-categories

Theme	Category	Sub-category
An on-going individual adjustment	Counselling as a challenge	<ul style="list-style-type: none">• Fighting lack of resources• Responding to high-achieving women• Responding to perceived barriers to physical activity in pregnant women• Responding to the cultural tug-of-war
	Counselling as walking the thin ice	<ul style="list-style-type: none">• Fearing no success• Guarding the relationship• Acting upon individual needs
	Counselling as an opportunity	<ul style="list-style-type: none">• Navigating within cultural traditions• Identifying women's individual facilitators

was experienced as complex and ambiguous, presenting challenges as well as opportunities. When midwives challenged barriers to physical activity, they risked being rejected by the pregnant women. Despite risking rejection, the midwives tried to promote increased physical activity based on their assessment of individual needs of the pregnant woman. Some participants reported that their own lifestyle and body shape might negatively influence the counselling; however, the majority of participants did not agree with this perspective.

The presentation of the findings is structured as follows: an initial summary of each category is followed by a presentation of the included sub-categories. Findings are illustrated using quotations.

Counselling as a challenge

This category comprises four sub-categories: *Fighting lack of resources*; *Responding to high-achieving women*; *Responding to perceived barriers in pregnant women*; and *Responding to the cultural tug-of-war*. Each sub-category represents aspects of counselling with respect to physical activity experienced as difficult or demanding. These different aspects involve organizational and economical issues that encourage highly active women to rest as well as helping sedentary women to be more active. In addition, these aspects reflect cultural beliefs.

Fighting lack of resources

The participants believed that economical cutbacks and organizational changes within the ANC's made their work more difficult, resulting in worse outcomes for the midwives. These changes implied additional work tasks and increased demand for high productivity. As a result, the participants negatively viewed their working conditions; for example, they had less time to fulfill their commitments and less time to provide satisfactory counselling. Experienced participants found that these slowly evolving changes added to their work stress. This demoralizing situation left most participants feeling that they were not providing the best care possible. Furthermore, the

economical cutbacks led to decreased possibilities to attend courses or meetings to acquire up-dated information on recommendations and guidelines as well as making it more difficult for them to find inspiration and support for how to best motivate pregnant women to perform physical activity.

I feel that we're expected to squeeze in more and more in fewer visits. When I started working, we had maybe 16 visits, but now...We're expected to fit such a lot into a short time. I would really like to [provide] quality; fewer visits are fine, but you need to have quality... (Participant, FGD no. 3).

...what's more, I don't know if the money allocated for education has changed or not, but nowadays we have significantly less time for education. (Participant, FGD no. 8).

Responding to high-achieving women

A specifically demanding situation discussed by participants was how to counsel high-achieving pregnant women. These women were in general highly educated, of high socio-economical status, used to accomplishing goals, and to a high extent physically active. The participants perceived this group of pregnant women as generally self-confident, fit, and professionally skilled, but at the same time having problems evaluating their individual needs during pregnancy. As the midwives described that many of these women were physically active at a high intensity level, a more appropriate level of physical performance (i.e., a decreased level of physical activity) was perceived as essential to improve the wellbeing of these women during pregnancy. However, counselling these women to reach a more suitable level of physical activity was perceived as very challenging:

They have good self-confidence. All of them work in high-level positions. They do what they've decided they want to do and make sure things go according to their wishes...But they're very concerned with how things

look from the outside: everything has to be planned before the baby is born, and that creates a kind of stress that isn't always so good. Those who are very performance-oriented don't feel good. They have problems setting limits for themselves and saying no to their bosses and others in their social circles. You have to help them reduce their workload and reassure [them] that it's OK to do so. (Participant, FGD no. 5).

Responding to perceived barriers to physical activity in pregnant women

It was perceived that most of the pregnant women did not prioritize physical activity. Several barriers to physical activity in terms of physical problems – tiredness due to the pregnancy, back pain, or pelvic pain were discussed. Other perceived barriers were lack of time, caring for children, or having a heavy workload:

The multiparous women say they don't have the time [to be physically active]. You know – dropping off and picking up children from day care, fatigue, a lot of things. So sometimes I find multiparous women are more difficult [to counsel] about their physical activity when I meet them. (Participant, FGD no. 3).

The participants expressed that some pregnant women also exhibited psychological resistance towards physical activity because they may have had a history of failure of achieving their goals regarding physical activity. Other perceived obstacles to participating in physical activity included a sedentary lifestyle and lack of knowledge on how to perform physical activity. Some women simply preferred a sedentary lifestyle; these women viewed their pregnancy as a time when they did not have to exert themselves in voluntary physical activities.

They've tried so many times already and are afraid of failing yet again. So perhaps they get stuck in this mind-set somehow. I'm sure that many would like help, but often other things are needed for them to have the strength to make a change in their lifestyles. Sometimes they seem to prefer living an unfulfilling existence to the risk of failing in something enjoyable. (Participant, FGD no. 3).

...to lie on the sofa and eat pralines just because it's allowed. It's almost like they're making hay while the sun shines, because it's somehow permissible now [when they are pregnant]. (Participant, FGD no. 2).

Low socio-economic status was perceived as associated with physical inactivity; participants working in low socio-economical areas stressed that many pregnant women had neither economical means nor previous experience with

physical activity. Hence, some pregnant women would not even attend free exercise sessions that promoted and required physical activity designed specifically for pregnant women.

Responding to the cultural tug-of-war

For both the Swedish-born and the immigrant women, culture influenced how pregnant women were counselled. This tug-of-war of beliefs – resting versus physical activity – was characterized by contradictions between the messages conveyed by the participants, and the opinions and traditions expressed by the pregnant women and their relatives. It was challenging to explore pregnant women's own wishes for physical activity during pregnancy in relation to her cultural traditions, as they often did not coincide. The participants discussed the importance of adjusting their recommendations of physical activity to conform to the wishes, often influenced by cultural expectations, of the pregnant women, although these recommendations did not comply with general recommendations in the guidelines.

And many stop being active when they become pregnant because of quite severe pressure from relatives [who say] that it [physical activity] is dangerous and so on. So it becomes difficult for them to manage this issue during pregnancy, I feel. They stay home for the first three months and do nothing but lie on the sofa, sedentary. (Participant, FGD no. 7).

Conditions, such as uncomfortable weather and lack of appropriate clothing, were other reasons for pregnant women to avoid physical activity. Some women were not used to outdoor activities in cold or rainy weather conditions. Others were afraid of getting lost when walking in unfamiliar areas. As such, these women experienced some social isolation due to these circumstances. Some other cultural situations made it difficult for women to be active. For example, some cultural expectations require women to be escorted by a male relative when out of the house, so participants had to consider cultural expectations when providing counselling:

There are many who are afraid, who won't go outside on their own, and there may be many reasons why they're reluctant to do so. Many don't know their way around, so I make a point of telling their husbands: "You need to walk with her on the same route several times so she gets to know the way. Then she can walk on her own." Others tell me that they've never been out on their own, that they're not allowed to do so. They have to go with a cousin, mother, brother, or someone else. (Participant, FGD no. 4).

Some recommended physical activities, such as swimming in public pools, were not an alternative for some groups of immigrant women. When there was no other alternative for physical activity, the midwives recommended walking:

If you suggest that they should go swimming, it could prove to be a snag because they aren't allowed to swim at the same time as men. That's one thing. The second is that they don't know how to swim. There are swimming schools for women, but then they don't have the money for that...There are so many barriers the whole time. So walking has become our mantra because it's so beneficial and it is for free. (Participant, FGD no. 4).

Personal suffering (such as depression, economical problems, health issues, and isolation) could be a barrier to physical activity during pregnancy. Some pregnant women had other problems to face, such as being a refugee with many other worries in their life. In these cases, counselling did not focus on physical activity:

People have different priorities in life. If your life involves having migrated from somewhere else and you're trying to adapt, then physical activity is not your first priority... (Participant, FGD no. 4).

Counselling as walking the thin ice

This category includes the sub-categories *Fearing no success*, *Guarding the relationship*, and *Acting upon individual needs* and addresses how participants experienced the situation of counselling as such. The three subcategories involve participants' fear of failing to fulfill the counselling goals identified in recommendations and guidelines. Furthermore, the participants attempted to protect the relationship and to individualize counselling to each woman's specific needs.

Fearing no success

The encounters were often considered as golden opportunities to promote lifestyle changes and to increase physical activity for most pregnant women. Fear of failure to provide appropriate counselling in relation to recommendations and guidelines while not being offensive often resulted in tiptoeing. Most expectant parents were perceived to have high expectations with respect to midwives' professional performance, and the participants also expressed high expectations with respect to their performance as counsellors. Additionally, colleagues and physicians expected that the pregnant women would follow the midwives' recommendations. If a pregnant woman voluntarily left one ANC clinic for another or one midwife for another, it was perceived as indication of professional failure.

There were some situations when the midwives did not succeed in promoting any level of physical activity, leaving these midwives feelings frustrated, indifferent, and resigned:

Sometimes you succeed. Sometimes you don't and they remain inactive throughout their pregnancy no matter what you do...And some equate housework with physical activity and you try to explain that cleaning and cooking is not the same as taking a 30-minute walk...But, well... (Participant, FGD no. 8).

Guarding the relationship

The participants were eager to safeguard the relationship and they wanted to ensure that the encounters were held in a positive atmosphere. To avoid overly pressuring the pregnant women, they slowly gave out advice, step-by-step. This strategy was especially important when helping sedentary women. In such cases, the midwives gradually introduced strategies to help encourage physical activity. To provide individualized counselling, the participants had to evaluate the woman's life situation. This knowledge could suggest strategic decisions such as waiting for an appropriate time to discuss a problem:

You want the encounters to be nice and enjoyable when they visit us. And if they're overweight and perceive that we're only focusing on these issues [diet and physical activity], then it will not be nice to see us, so you have to choose when to address the issues. (Participant, FGD no 6).

Acting upon individual needs

Evaluating each woman's situation was perceived as necessary for effective counselling on physical activity. This individualization was viewed as an on-going process during the course of the pregnancy. This on-going adjustment of strategies was used to meet the individual needs of each woman and was expressed in terms such as "intuitive assessment", "tiptoeing", and "being a chameleon".

Of course, it [counselling] is an individual thing because the women who come to us are so very different from one another. Some talk about certain things while others have such difficulties socially that there is no use in trying. They're not in situations where diet and physical activity are appropriate topics for discussion. So, for me, there is a constant need to adapt, which makes this line of work both fascinating and difficult. (Participant, FGD no. 3).

Being overweight or obese was perceived as a sensitive issue. Some of the pregnant women had been overweight since early childhood and had been exposed to a variety of advice from other health care providers, advice that

had not always been received positively. Although being overweight was considered a sensitive topic to address, some of the participants felt that information concerning maternal weight should be delivered frankly; these participants thought too much tiptoeing or completely ignoring the weight issue was unprofessional:

Of course she knows she's overweight; it would just be silly not talking about it or pretending she's not. (Participant, FGD no. 1).

Some participants felt that their own lifestyle and body shape might negatively influence the counselling. For example, some participants thought that their fitness (i.e., their physical appearance with respect to their perceived body shape) influenced how the pregnant women received their advice on physical activity. However, the majority of participants did not agree with this perspective as they believed counselling should be performed in a professional manner irrespective of the midwife's own lifestyle and perceived fitness.

Counselling as an opportunity

This category includes the two sub-categories *Navigating within cultural traditions* and *Identifying women's individual facilitators*, subcategories that highlight the midwives' experiences and strategies navigating cultural concerns and identifying and using facilitators that would help individual women participate in appropriate physical activity.

Navigating within cultural traditions

Despite challenges due to cultural traditions, the participants tried to comprehend the situation and adjust their counselling based on their cultural understanding, looking for culturally acceptable alternatives for physical activity. A major part of counselling consisted of informing these women on the significance of physical activity during pregnancy, assessing possible forms of physical activity, and assuring them that physical activity for most pregnant women would be safe and beneficial.

Working with immigrant women is so much harder; to make them believe what I'm saying. I find it easier to convince educated women... But this issue [not listening to advice] seems to be influenced by culture and, in my eyes; we have a very long way to go before [our counselling] meets with a response. (Participant, FGD no. 4).

Cultural or psychosocial concerns also required participants to adjust the recommended physical activity goals. The desired levels of physical activity during pregnancy were lowered in order to reach some level of physical

activity during pregnancy that was acceptable for the pregnant woman.

That they make an effort at all, even if it's not... That is to say, they don't have to aim for the stars. A short walk is good enough. (Participant, FGD no. 4).

Identifying women's individual facilitators

The participants tried to identify each woman's individual motivational factors for physical activity. General factors motivating physical activity were strengthening of maternal health during pregnancy, avoiding extensive gestational weight gain, and maintaining a healthy foetus. It was easier to motivate pregnant women for physical activity if they had been physically active before their pregnancy. In those cases, counselling often addressed suitable forms and activity levels of physical activity instead of promoting increases in activity.

There are women who discovered this [wellbeing as a result of physical activity] before their pregnancy. They are more motivated ... And it's easier to motivate someone who was already exercising beforehand. (Participant, FGD no. 8).

This [identifying individual motivators] is important and, in such cases, you need to be incredibly perceptive too. What will their situation be when they come in today? What is their starting point? What motivates them? And then, [for me to] provide as much help as possible. (Participant, FGD no. 6).

Discussion

This study investigated midwives' experiences with counselling pregnant women on physical activity during pregnancy. The findings show that counselling pregnant women about appropriate levels of physical activity was perceived as multifaceted. The participants identified barriers and promoted facilitators. As the participants considered these topics sensitive for some women, especially overweight and obese women, they were concerned that their counselling could offend some women to such an extent that their advice would be ignored. These demands added to the stress they already felt performing their other professional duties. The theme "An on-going individual adjustment" describes how the participants repeatedly assessed pregnant women's barriers and facilitators to physical activity, adjusting their counselling accordingly. Even small improvements in physical activity were acceptable when the participants realized the extent of barriers – cultural or individual – some women had to face. The participants reported a number of perceived barriers – tiredness, lack of time, and bodily pain – pregnant women had to overcome to perform physical activity. Similar

barriers for performing physical activity have been described previously [10,11,16].

Achieving desired behavioral change in pregnant women often requires giving the women themselves a central role in the antenatal care; such an approach requires a good relationship between the midwife and the pregnant women [5,18]. A mutually trusting relationship is important when counselling women with gestational diabetes mellitus [5], but some studies report that intensive counselling on physical activity using interventions may be associated with a decrease in physical activity during pregnancy [19,20]. Similarly, midwives have reported resistance when counselling pregnant women about cessation of smoking, also a case where maintaining a good relationship with the women is important for a successful outcome [21]. Our findings highlight the significance of individual adjustments of counselling based on the on-going assessment and evaluation of a pregnant woman's individual needs and situation. Similar results are demonstrated when investigating health care providers' counselling on diet and gestational weight gain, where assessment of individual needs is important for improving changes in lifestyle [22]. Furthermore, the participants noted that financial cutbacks have negatively affected the quality of their counselling.

The participants found it challenging to provide effective counselling to women whose participation in physical activity was limited by cultural expectations. Similar results have been reported in studies exploring maternity care assistants and midwives providing postpartum care [23,24]. These studies, performed in a Dutch setting, describe how the work with immigrant women needs to be flexible and creative, especially addressing issues related to lack of financial resources, low socioeconomic status, and family pressure. Individualized solutions for these women have been shown to improve the quality of the health care [23,24]. Studies addressing weight gain during pregnancy have shown that midwives' counselling may not have the desired impact on pregnant women from other ethnic backgrounds since these women may be more influenced by the traditions in their own culture and by the views of their relatives [25,26]. Our study's findings agree with these assessments.

Few studies have considered whether midwives' own body shape and lifestyle influence how they counsel pregnant women. When providing health promotion advice, overweight and obese nurses have to deal with the fact their patients may perceive their advice as insincere [27]. In our study, some participants did not believe that their own body shape would affect their counselling; however, others reported that this could influence their counselling both in a negative and in a positive way. These findings are consistent with a study exploring overweight nurses' experiences with overweight non-pregnant patients; some overweight nurses believed their body shape helped them

connect and empathize with their patients, although some did not [28]. In our study, some participants felt uncomfortable discussing their own body shape during the FGD. Similarly, some participants were afraid to directly address individual patient's weight issues, tiptoeing around the issue. These findings agree with findings in previous studies where excessive weight gain and obesity during pregnancy were perceived by health care providers as sensitive subjects to discuss [14,24,25].

Our study's findings have some clinical implications. Additional formal education and in-service training for midwives should be provided so midwives have the tools and strategies to use when providing counselling of complex situations and living conditions. A meta-analysis evaluating the efficacy of motivational interviewing (MI) in 48 studies in medical care settings reveals that using MI may be beneficial in a number of areas, for example, improving sedentary behavior [29]. Of course, more education and extensive training means that organizational barriers such as time restraints and economical cutbacks need to be addressed. However, the Swedish National Board of Health and Welfare suggests that counselling about lifestyle changes, such as increasing physical activity, should be performed in short sessions of 10-15 minutes and for more challenging cases, 30 minutes [30]. It is unknown whether this fairly new recommendation was known and implemented by the midwives participating in our study. As 10-15 minutes is a rather short time, it is also difficult to know if "time restraint" is used as an excuse for not prioritizing counselling about physical activity.

Future studies should investigate counselling about physical activity in relation to cultural issues. In addition, future studies should address whether and how health care professionals' own body shape and lifestyle influences their work as counsellors. Individual in-depth interviews may address this research question, as such sensitive topics may be difficult to discuss in a group setting.

Methodological considerations

A strength of this study is the purposive sampling where the participants represented varying characteristics in relation to age, length of working experience, and geographical regions with different socio-economical status. To ensure transferability of the findings, the data collection had no pre-set number of FGD. As a result, data collection continued until no major new information regarding the topics under study was expressed (i.e., additional interviews would not have provided major new information). Additionally, a rich description of the procedure and analysis was provided to enable the reader to follow all steps of the research process. To increase credibility of study findings, member checks were performed, which confirmed the findings. Writing memos and keeping records

of the process of data collection and analysis addressed dependability of the findings. Moreover, the same persons from the research team performed all FGD, which also contributed to increase dependability. Finally, the confirmability of the findings was achieved through discussing the findings within the research team until consensus was obtained. As members of the team had different professional backgrounds, objectivity was enhanced as individual preunderstandings could be challenged.

Despite these efforts to address trustworthiness, there are some limitations in the study. The participants were initially approached and informed about the study by the consultant midwives in their MHCA. Although these consultant midwives were given detailed information on the purpose of the study and the inclusion criteria, we cannot exclude that the consultant midwives chose convenient participants irrespective of this information.

Conclusions

Counselling on physical activity during pregnancy may be a challenging task for midwives, characterized by on-going adjustments based on a pregnant woman's individual needs. Midwives strive to find individual solutions to encourage physical activity. However, to improve their counselling, midwives may benefit from further training, so organizational and financial barriers need to be addressed. Such efforts might result in improved opportunities to further support pregnant women's motivation for performance of physical activity.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

All authors have sufficiently contributed to this study. ML, MP, and IM designed the study. ML collected and analyzed data, drafted the manuscript, and submitted the final manuscript. MP collected and analyzed data and supported the drafting of the manuscript. IM participated in data collection, contributed to data analysis, and drafting the manuscript. KE and EE participated in the later stages of the data analysis and drafting of the manuscript. All authors read and approved the final manuscript.

Authors' information

The authors represent various professional disciplines and research traditions including midwifery, obstetrics and gynaecology, physiotherapy, nursing, and public health.

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III

Leisure time physical activity among pregnant women and its associations with maternal characteristics and pregnancy outcomes

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ABSTRACT

Background

Physical activity during pregnancy is generally considered safe and beneficial for both the pregnant woman and her fetus. The overall aim was to investigate pregnant women's pre-pregnancy and early pregnancy physical activity and its associations with maternal characteristics and pregnancy outcomes.

Methods

This cross-sectional study combined data from the Maternal Health Care Register in Västerbotten (MHCR-VB) and the Salut Programme Register (SALUT-R). Data were collected from 3,868 pregnant women living in northern Sweden between 2011 and 2012.

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Results

Almost half of the participants (47.1%) achieved the recommended level of physical activity. Compared to the women who did not achieve the recommended level of exercise, these women had lower BMI, very good or good self-rated health, and a higher educational level. No significant associations could be established between physical activity levels and GDM, birth weight, or mode of delivery.

Conclusions

Positively, a considerably high proportion of Swedish pregnant women achieved the recommended level of physical activity. Factors associated with recommended physical activity level were BMI ≤ 30 kg/m², very good or good self-rated health, and higher educational level. Our findings emphasise the need for health care professionals to early detect and promote fertile and pregnant women towards health-enhancing physical activity, especially those with low levels of physical activity and overweight/obesity, to improve overall health in this population.

Keywords Cross-sectional study, physical activity, pregnancy outcomes, body mass index, education, health promotion

BACKGROUND

Physical activity during pregnancy

Globally, physical inactivity is the fourth leading risk factor for mortality and is considered a major threat to public health (1-3). Physical activity during pregnancy is generally safe and beneficial for both the pregnant woman and her fetus and does not increase the risk of adverse pregnancy outcomes (4). Physical exercise during pregnancy can maintain or improve fitness and may further improve pregnancy outcomes (4-6). For obese pregnant women, physical activity reduces the risk of pre-eclampsia (6), decreases pelvic pain and back pain (7), reduces gestational weight gain during pregnancy (8), and increases well-being (9). There is, however, insufficient evidence to conclude that physical exercise prevents pregnancy glucose intolerance or gestational diabetes mellitus (GDM) (10). Although health care providers advise pregnant women to maintain or increase their physical activity, pregnant women tend to lower their physical activity (11).

Guidelines regarding physical activity

Considering physical activity as a preventive factor, national guidelines in many countries recommend specified levels of physical activity during pregnancy (12, 13). For the ages 18-64 years, the World Health Organization (WHO) recommends levels of physical activity to be at least 150 minutes (performed in bouts of at least 10 minutes) of moderate-intensity aerobic physical activity per week or 75 minutes of vigorous-intensity aerobic physical activity per week, or a combination of these. Pregnant women should seek medical advice before striving to achieve these recommendations (14). These recommendations are endorsed by the Swedish Professional Associations for Physical Activity and are also applicable for pregnant women (4). These recommendations are in line with guidelines on health promotion developed by the Swedish National Board of Health and Welfare (NBHW) (15).

Rationale of the study

Few studies have been investigating the prevalence of self-reported physical activity during pregnancy in Sweden in relation to the national recommendations and their associations with pregnancy outcomes. Furthermore, the literature is limited regarding the associations between maternal background characteristics and level of physical activity during pregnancy.

Aims

The overall aim was to investigate pregnant women's pre-pregnancy and early pregnancy physical activity and its associations with maternal characteristics and pregnancy outcomes.

The specific objectives were to: 1) investigate prevalence of self-reported physical activity during leisure-time in early pregnancy, 2) investigate associations between pre-pregnancy and early pregnancy physical activity during leisure time and to investigate maternal background characteristics, mode of delivery, birth weight, prevalence of gestational diabetes mellitus, and self-rated health.

METHODS

This population-based, cross-sectional study combined data from the Swedish Maternal Health Care Register (MHCR) and the Salut Programme Register (SALUT-R) for 2011 to 2012.

The study sample

In MHCR (2011-2012), we identified a sub-set of participants from the county of Västerbotten (MHCR-VB), located in northern Sweden, who also participated in the Salut-R from 2011 to 2012. All pregnancies, irrespective of single birth or multiple births, were included in the study sample. The final dataset consisted of 3,868 pregnant women. If cases were not identified in both registers, they were excluded ($n=979$). The following variables retrieved from the MHCR-VB were included in the dataset: country of origin, maternal age, parity, maternal height, maternal weight, body mass index at first visit to ANC, smoking, level of education, self-rated health, GDM, oral glucose tolerance test (OGTT), gestational age, mode of delivery, and birth weight. The variables

extracted from the SALUT-R were self-reported data on pre-pregnancy and early pregnancy physical activity during leisure time.

Information on physical activity levels was available from the SALUT-R, and all other variables of background characteristics and pregnancy outcomes were retrieved from the MHCR. The sample size was estimated for different outcomes under study. With the power of 90% at significant level of 5%, it would be possible to detect a difference of 0.5 in BMI ($SD=4.5$) between two groups with a sample size of 1800 in each group. Achieving the power of 90% at a significant level of 5%, it would be possible to detect a difference in proportion of 0.03 between two groups with a sample size of 1500 in each group for self-rated health: “very good” and “good” and “neither good nor poor” or “very poor”.

The Maternal Health Care Register

The Nordic countries have a unique opportunity to perform register-based research due to their population-based national registers (16). The Swedish Maternal Health Care Register (MHCR) a national health quality register, characterized by a satisfying internal validity for the majority of the variables have been collected since 1999 by midwives in antenatal care (ANC) (17). The coverage in the MHCR is to be considered high. In 2011, 2012 and 2013 the MHCR monitored around 81%, 85%, and 89% of all pregnant women in Sweden, respectively (18). MHCR data are collected on two occasions: first during the pregnant woman’s first visit to an ANC and then during a visit within the first 16 weeks postpartum.

The Salut Programme and its register

The Salut Child-Health Promoting Intervention Programme (Salut Programme) is headed by the County Council of Västerbotten (19). The Salut Programme Register (SALUT-R) includes data collected through a questionnaire from early pregnancy (around gestational week 10) from the woman and her partner at their first visit to an ANC. The pregnancy questionnaire contains information on obstetric and medical history, living conditions, and lifestyle habits.

Ethical approval

Ethical approval from Ethical Review Board in Umeå was granted for The SALUT-R (Dno 2010-63-31) and MHCR and MHCR-VB (Dno 2012-407-31M and 2014-152-32M).

Definitions and categorizations of variables

Some variables acted both as independent and dependent variables. See the descriptions below.

Independent variables

Maternal age was defined as age (years) at delivery. *Parity* was defined as total number of children born (including the index pregnancy in the MHCR). *Maternal height* (cm) and *maternal weight* in early pregnancy (kg) were self-reported. *Gestational age* was divided into pre-term, term, and post-term. *Early pregnancy body mass index (BMI)* was calculated with the formula $\text{BMI} = \text{kg}/\text{m}^2$. The different BMI groups were defined according to the WHO's definition of BMI: underweight: $<18.5 \text{ kg}/\text{m}^2$; normal range: $18.5\text{--}24.99 \text{ kg}/\text{m}^2$; overweight: $25\text{--}29.99 \text{ kg}/\text{m}^2$; obesity class 1: $30\text{--}34.99 \text{ kg}/\text{m}^2$; obesity class 2: $35\text{--}39.99 \text{ kg}/\text{m}^2$; and obesity class 3: $\geq 40 \text{ kg}/\text{m}^2$ (20). *Smoking* at three months before pregnancy and at the first antenatal visit was self-reported. *Level of education* was defined as elementary school, high school, and university. *Country of origin* was categorized into Sweden, other Nordic countries, and other countries. *Employment status* was categorized into employed, student, parental leave, unemployed, sickness leave, and other status. *Pre-pregnancy and early pregnancy self-reported physical activity during leisure time (LTPA)* (included as a dependent variable) was based on the following question: "How often do you perform any kind of physical activity during leisure-time? Please have the last 12 months in mind when responding the question". There were three groups of physical activity levels: low (not breathless or sweaty), moderate (warm, possible to have a conversation), and vigorous (high pulse, breathless, and sweaty). The respondent assessed the number of days they were physically active on each level. To calculate activity minutes, the reported number of days in the second group (moderate) was multiplied by 30 minutes and the third group (vigorous) was multiplied by 60 minutes. Group one (low) was defined as <150 activity minutes. Finally, the variable was dichotomized as <150 physical

activity minutes (i.e., not achieving the recommended level) and ≥ 150 physical activity minutes (i.e., achieving the recommended level) during leisure time.

Dependent variables

Self-rated health (SRH) was reported by the woman during early pregnancy and divided into five categories: “very good”, “good”, “neither good nor poor”, “poor”, and “very poor” health. The following variables in MHCR were collected from pregnant women’s medical records. *Gestational diabetes mellitus* (GDM) was defined as any degree of glucose intolerance with onset or first recognition during pregnancy and was not considered as manifest diabetes mellitus type 2. GDM was diagnosed with a 75-g oral glucose tolerance test (OGTT) followed by a capillary two-hour blood glucose value of ≥ 10 mmol/L. *Delivery mode* was reported as vaginal delivery, non-instrumental vaginal delivery, instrumental vaginal delivery, elective caesarean section, or emergency caesarean section. *Birth weight* was reported in grams. When calculating birth weight, the birth weight of single births was included as well as birth weight of first child of duplex or triplex pregnancy. *Body mass index* (BMI) was calculated and categorized as described in the section above.

Statistical analysis

Two-independent samples t-test and one-way ANOVA test was used to test difference of parametric data, and Pearson’s Chi-Squared test was used to test difference of proportions for categorical variables. Univariate and multivariate logistic regression analyses were performed and presented with odds ratios (OR) and their 95% confidence intervals (CI). Statistical analysis was done using SPSS version 22.

RESULTS

Study sample in relation to the source population

In an earlier study (21), we had access to a total dataset from MHCR including all pregnant women from 2011 to 2012. This dataset included 184,130 women, and was used in the present study to evaluate the representativeness of the sample. The coverage of the variables in the study sample was generally higher than in the total MHCR. There were

small but statistically significant differences between the study sample and MHCR-VB. In the study sample, maternal height was higher (166.6 cm vs. 166.3 cm), parity was lower (1.79 vs. 1.80), BMI was lower (24.5 kg/m² vs. 24.8 kg/m²), educational level was higher, employment proportion was higher (77.8% vs. 73.7%), and non-Nordic origin proportion was lower (9.4% vs. 11.7%).

Pre-pregnancy and early pregnancy physical activity levels and their associations with maternal characteristics

Table 2 presents physical activity during leisure time and its associations to maternal background characteristics. Almost half of the pregnant women (47.1%) reported that they achieved the recommended level of physical activity, and a significantly higher proportion of women reported their health as very good or good. Distribution of self-rated health is presented in Figure 1, which shows that it was less common with very good health when the leisure time physical activity (LTPA) was low. In addition, the presented proportion of the pregnant women that reported their health as “very poor” or “poor” were very few (1.3%) (Table 1). Pregnant women who did not achieve the recommended level of LTPA had significantly higher weight and BMI and lower educational level and more were of a non-Nordic origin and were smokers before pregnancy compared to pregnant women who achieved the recommended level of LTPA (≥ 150 activity minutes/week) (Table 2).

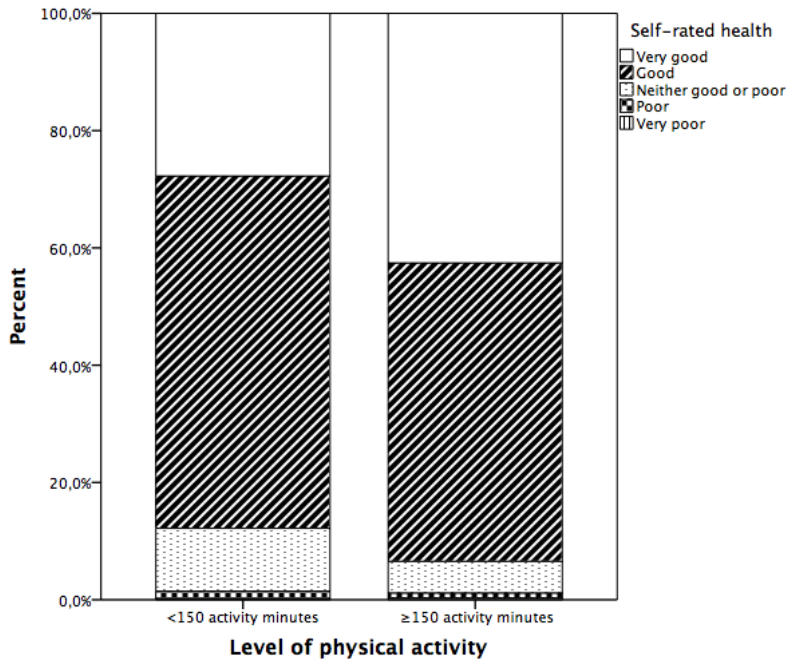


Figure 1. Distribution of self-rated health in relation to two different levels of physical activity

Table 1. Characteristics of the study sample (N=3868)

Variables ^a	Subjects MHCR-VB ^b & SALUT-R 2011-2012 n (%)	Variables ^a	Subjects MHCR-VB ^b & SALUT-R 2011-2012 n (%)
Maternal age ^c	3862 (100)	Educational level	3741 (96.7)
Mean; SD	29.7; 4.9	Elementary school	167 (4.5)
Min-Max	16-46	High school	1528 (40.8)
Maternal age ^c		University	2046 (54.7)
≤19	45 (1.2)	Employment status	3841 (99.3)
20-24	553 (14.3)	Employed	2988 (77.8)
25-29	1304 (33.8)	Student	400 (10.4)
30-34	1292 (33.5)	Parental leave	184 (4.8)
35-39	578 (15.0)	Unemployed	174 (4.5)
≥40	90 (2.3)	Sickness leave	58 (1.5)
Parity	3862 (99.8)	Other status	37 (1.0)
Mean; SD	1.79; 0.85	Country of origin	3868 (100.0)
Min-Max	1-9	Sweden	3447 (89.9)
Parity		Nordic countries ^g	28 (0.7)
1	1929 (44.0)	All other countries	363 (9.4)
2	1599 (38.3)	SRH ^h	3472 (89.8)
3	548 (13.0)	Very good	1206 (34.7)
≥4	205 (4.6)	Good	1933 (55.7)
Gest age	3814 (98.6)	Neither good/poor	288 (8.3)
Mean; SD	281.6; 6.7	Poor	37 (1.1)
Min-Max	166-303	Very poor	8 (0.2)
Gest age ^{d e}		Smoking 3 months ⁱ	3868 (100.0)
Preterm	177 (4.7)	No smoking	3593 (92.9)
Term	3196 (85.5)	Smoking	272 (7.0)
Post-term	369 (9.8)	Smoking first visit	3868 (100.0)
Weight (kg)	3838 (99.2)	No smoking	3793 (98.1)
Mean; SD	68.2; 13.3	Smoking	74 (1.9)
Min-Max	39-156		
Height (cm)	3856 (99.7)		
Mean; SD	166.6; 6.2		
Min-Max	141-186		
BMI (kg/m ²) ^f	3830 (99.7)		
Mean; SD	24.5; 4.6		
Min-max	15.1-51.0		
BMI early pregnancy			
<18.5	87 (2.3)		
18.5-24.99	2406 (62.8)		
25-29.99	886 (23.1)		
30-34.99	303 (7.9)		
35-39.99	119 (3.1)		
≥40	29 (0.8)		

Table 2. Leisure time physical activity levels in relation to maternal background characteristics (N=3868) and test of difference of specified categories

Variables ^a	All n (%)	<150 PA min ^b n (%)	≥150 PA min ^b n (%)	p-value ^c
Maternal age ^d	3762 (97.3)	1989	1773	
Mean; SD		30.0; 5.0	29.4; 4.8	<0.001
Min-Max		19-44	16-46	
Maternal age ^d				
≤19		26 (1.3)	16 (0.9)	<0.001
20-24		256 (12.9)	280 (15.8)	
25-29		638 (32.1)	637 (35.9)	
30-34		689 (34.6)	570 (32.1)	
35-39		325 (16.3)	239 (13.5)	
≥40		55 (2.8)	31 (1.7)	
Parity	3762 (97.3)	1992	1770	0.005
Mean; SD		1.80; 0.81	1.79; 0.79	
Min-Max		1-9	1-6	
Parity				
1		754 (37.9)	904 (51.1)	<0.001
2		860 (43.2)	592 (33.4)	
3		272 (13.7)	212 (12.0)	
≥4		106 (5.3)	62 (3.5)	
Gest age	3715 (96.0)	1962	1753	0.343
Mean; SD		281.4; 6.4	281.5; 6.5	
Min-Max				
Gest age ^{e f}				
Preterm		100 (5.1)	73 (4.2)	0.250
Term		1680 (85.6)	1499 (85.5)	
Post-term		182 (9.3)	181 (10.3)	
Weight (kg)	3739 (96.7)	1976	1763	
Mean; SD		71.1; 14.0	68.5; 14.0	0.034
Min-Max		48-113	39-156	
Height (cm)	3756 (97.1)	1984	1772	
Mean; SD		165.1; 6.5	166.4; 6.3	0.007
Min-Max		150-183	141-186	
BMI (kg/m ²) ^g	3731 (96.5)	1969	1762	
Mean; SD		24.8; 4.8	24.3; 4.2	0.001
Min-max		18.4-42.0	15.1-50.9	
BMI early pregnancy ^a				
<18.5		54 (2.7)	31 (1.8)	<0.001
18.5-24.99		1180 (59.9)	1180 (67.0)	
25-29.99		476 (24.2)	377 (21.4)	
30-34.99		166 (8.4)	126 (7.2)	
35-39.99		76 (3.9)	37 (2.1)	
≥40		17 (0.9)	11 (0.6)	
Educational level	3653 (94.4)	1922	1731	
Elementary school		94 (4.9)	57 (3.3)	0.002
High school		809 (42.1)	669 (38.6)	
University		1019 (53.0)	1005 (58.1)	

Employment status	3742 (96.7)	1983	1759	
Employed		1546 (78.0)	1384 (78.7)	0.025
Student		187 (9.4)	202 (11.5)	
Parental leave		104 (5.2)	71 (4.0)	
Unemployed		101 (5.1)	65 (3.7)	
Sickness leave		25 (1.3)	26 (1.5)	
Other status		20 (1.0)	11 (0.6)	
Country of origin	3766 (97.4)	1995	1773	
Sweden		1784 (89.4)	1627 (91.8)	0.043
Nordic countries ^h		14 (0.7)	12 (0.7)	
Other countries		197 (9.9)	134 (7.6)	
SRH ⁱ	3390 (87.6)	1782	1608	
Very good		495 (27.8)	685 (42.6)	<0.001
Good		1070 (60.0)	818 (50.9)	
Neither good/poor		191 (10.7)	87 (5.4)	
Poor		23 (1.3)	13 (0.8)	
Very poor		3 (0.2)	5 (0.3)	
Smoking 3 months ^j	3768 (97.4)	1995	1773	0.017
No smoking		1841 (92.3)	1663 (93.8)	
Smoking		152 (6.6)	109 (2.9)	

^a For each specified variable, n and % are presented

^b <150 Physical Activity minutes at leisure time (52.9%) and ≥150 Physical Activity minutes at leisure time (47.1%)

^c Test of difference, t-test for continuous variables and Chi-squared test for categorical variables

^d Maternal age in years

^e Gestational age calculated using the WHO's guidelines

^f Pre-term=22+0-36+6, Term=37+0-41+6, Post-term=42+0-43+6 (weeks)

^g Body mass index (BMI)

^h Norway, Denmark, Finland, and Iceland

ⁱ Self-rated health (SRH)

^j Smoking three months before pregnancy

Maternal and fetal outcomes and their associations with leisure time physical activity

The recommended level for LTPA was found to be protective for having a BMI ≥ 30 kg/m². However, there were no statistically significant associations between the two groups of PA levels and GDM or mode of delivery. Women who achieved the recommended level of PA were half as likely to report poor or very poor self-rated health compared to the women who did not (Table 3). When adjusting for age, parity, body mass index, educational level, employment status, country of origin, and smoking, the odds ratios were almost unchanged (Table 3). The probability of reaching the recommended level of PA during leisure time was related to level of education and these odds increased if the pregnant woman had reached a university level education compared to an educational level below university (OR=1.44, 95% CI 1.22-2.03).

Table 3. Maternal and fetal outcomes in relation to specified physical activity level. Univariate and multivariate logistic regression, OR, and their 95% confidence intervals.

Dependent Variables	All n (%)	<150 PA min ^a n (%)	≥150 PA min ^a n (%)	Crude OR (95% CI)	Adjusted ^b OR (95% CI)
BMI early pregnancy ^c	3731 (96.5)				
<30		1710 (86.6)	1588 (90.1)	Ref.	Ref.
≥30		259 (13.2)	174 (9.9)	0.72 (0.59-0.88)	0.74 (0.61-0.91)
SRH ^d	3390 (87.6)				
Very good/Good		1565 (87.8)	1503 (93.5)	Ref.	Ref.
Neither good/poor or poor/very poor		217 (12.2)	105 (6.5)	0.50 (0.40-0.64)	0.52 (0.48-0.71)
GDM ^e	3735 (96.9)				
Yes		23 (1.2)	13 (0.7)	0.63 (0.32-1.26)	
No		1956 (98.8)	1743 (99.3)	Ref.	
Mode of delivery	3767 (97.4)				
Vag. non instr.		1588 (79.6)	1418 (80.0)	Ref.	
Vag. instr. ^f /CS ^g		406 (20.4)	355 (20.0)	0.98 (0.84-1.15)	
Birth weight ^h	3757 (97.1)				
Mean; SD		3555.8; 534.9	3551.5; 518.3		
Min-Max		803-5524	521-5340		

^a <150 Physical Activity minutes at leisure time (52.9%) and ≥ 150 Physical Activity minutes at leisure time (47.1%)
^b Adjusted for age, parity, body mass index, educational level, employment status, country of origin, self rated health and smoking
^c Body mass index (BMI) (kg/m²)
^d Self-rated health (SRH)
^e Gestational diabetes mellitus (GDM)
^f Vacuum extraction or forceps
^g Caesarean section (CS)
^h Birth weight of the child

DISCUSSION

Almost half of the pregnant women achieved the recommended level of LTPA in early pregnancy, and these participants were characterized by significantly lower weight and BMI, higher educational level, and were more likely to be non-smokers compared to those who did not achieve the recommended levels of physical activity. However, our new findings – i.e., almost half of pregnant women achieved the recommended level of physical activity – are not consistent with earlier studies. Previous studies report corresponding figures ranging between 3 and 25% (22-25). The differences in these results are most likely explained by the different ways (i.e., time points) these studies estimated physical activity during pregnancy. For example, two previous studies do not report any gestational week at all as the measure point for physical activity (22, 23) and two studies report 10-24 weeks of gestation (24) 17-22 and 27-30 weeks of gestation (25). These differences clearly affect the prevalence due to the decreasing levels of physical activity during pregnancy. In our study, there was only one measure point, around 10 weeks of gestation, and the participants were asked to have the last 12 months in mind when

responding to the question. Thus, in our study pre-pregnancy and early pregnancy physical activity was estimated. In addition, a prevalence of 38% was found in a Danish study investigating the prevalence of pregnant women in early pregnancy (i.e. 10 weeks of gestation) reaching the recommended levels of physical activity (26). In a study investigating the prevalence of pre-pregnancy physical inactivity, 60.8% of the women achieved the recommended level of physical activity 3 months prior to pregnancy (27). In addition, the guidelines used for recommended levels of physical activity differ and should be taken into account when comparing results. Women who report light or sedentary physical activity one year prior to pregnancy are more likely to be young, obese, smoker, or having a lower educational level, in relation to women reporting competitive physical activity or moderate/heavy physical activity (28).

These findings were confirmed by the present study. A study of well-being during pregnancy reports that higher educational level and physical activity increase well-being (29), and the present study confirms these associations that statistically significantly more pregnant women who reach the recommended level of LTPA reported their health as very good/good and had a higher educational level. Furthermore, studies indicate that physical activity before and during pregnancy increases well-being and decreases depression (9, 30). In the present study there were also statistically significantly more women with non-Nordic origin in the category with lower level of LTPA, this finding was a concern due to the public health in this group of pregnant women. A prospective cohort study reports that women with low physical activity levels during pregnancy are more likely to have a caesarean section (CS) or an instrumental delivery compared to pregnant women with higher physical activity levels (31). However, the study sample was fairly small and maternal BMI was not included in the regression model; only maternal age, parity, and LGA were included as confounders (31). Furthermore, a previous meta-analysis of 16 different randomized control studies including a total of 3,359 pregnant women concluded that women who benefit from a structured exercise programme during pregnancy have a significantly lower risk of CS in relation to those who do not participate in such a programme (32). In contrast, we did not find a higher prevalence of CS or instrumental delivery among women who did not achieve the recommended LTPA.

A previous study shows no significant associations between pre-pregnancy and first half of pregnancy physical activity level and low birth

weight or GDM (33). In a study of 79,692 single pregnancies that compared pregnancy outcomes in exercising and non-exercising pregnant women, no significant association was found regarding birth weight (34). Our study is in line with this finding, as we found no significant associations with GDM or birth weight between women who did and women who did not reach the recommended levels of LTPA. A Cochrane review has concluded that the evidence is insufficient regarding the impact of physical activity on the risk of GDM (10). Our study was primarily dimensioned for investigating the associations between specified maternal characteristics and pre-pregnancy and early pregnancy physical activity. Our study may have failed in demonstrating associations between different physical activity levels and GDM or birth weight due to insufficient sample size.

Methodological considerations

The strengths of this study are as follows; the variables included in the MHCR have recently been investigated and demonstrate good internal validity (17). The data in the study sample probably represent the population of pregnant women in Sweden, as the coverage in the MHCR is high (81% and 85% for 2011 and 2012, respectively). The Medical Birth Register (MBR) that is a health register characterized by mandatory participation, covers almost all births in Sweden (35) and maternal background characteristics in MHCR such as maternal age and BMI are consistent with data in the MBR. Another strength of our study, related to representativeness of the study sample, was the fact that we could compare key maternal background characteristics with the sub-sample of MHCR-VB (i.e., the source population). The statistically significant differences between MHCR-VB and the study sample (Table 1) regarding parity, maternal height, BMI, educational level, employment status, and country of origin were small, so they were considered to have exerted no major influence.

The variable used for estimating physical activity during pregnancy was self-reported and retrieved from the SALUT-R. We cannot disregard that an underestimation or an overestimation of “physical activity during leisure time” may bias the results in our study. This limitation has to be considered when interpreting our results. However, the question was based on a similar questionnaire that previously had been validated (36). The study concludes that the questions should be closed-ended and preferably categorical or at least in form of a table with closed-ended

alternatives (36). The variable has been recommended by the Swedish National Board of Health and Welfare to be used in questionnaires estimating self-reported physical activity level (36). In addition, the variables in the MHCR-VB are mostly collected from medical records, which could be seen as strength. A limitation of our study is that it does not include information about dietary habits. Several studies investigating physical activity during pregnancy consider this variable important when interpreting the results of pregnancy outcomes. Furthermore, the protective effect of physical activity may differ regarding the physical status of each pregnant woman, the trimester when physical activity occurs, and the intake of calories (5).

The present study included information on pre-pregnancy and early pregnancy physical activity. Thus, there was no later measure point in pregnancy, and that may be considered a limitation. It is well known that pregnant women usually lower their physical activity when they become pregnant (11). Furthermore, there is an association between the level of physical activity before pregnancy and early pregnancy and that there is a decrease in physical activity later and throughout the pregnancy. Based on this, the results of the present study are probably to be considered representative.

Furthermore, a careful validation of the different instruments used for measuring physical activity in pregnancy should be considered. Considerable difficulties arise when interpreting the results of different studies regarding the measurement of physical activity during pregnancy due to the major variety of measure points, scales, and instruments. A review of self-reported physical activity as a measurement concludes that the target should be to collect data not only on the level of physical activity (amount of time engaged in sustained activity) but also on intensity, duration, and frequency of physical activity (37).

Ethical considerations

All quality national registers in Sweden, including MHCR and SALUT-R, comply with the rules and procedures stated by The NBHW in Sweden. Collection and management of patient data in health systems and health registers are regulated through the Swedish Patient Data Law. The participation in MHCR is voluntary, and midwives in antenatal care are obliged to inform pregnant women of the aims and consequences of participation in the MHCR. The eligible participants were provided oral

and written information about the study and information was provided through advertisement at the local antenatal clinic. Furthermore, eligible participants in the MHCR were informed that all data are aggregated, so no individual woman can be identified. The SALUT-R has ethical clearance for their data collection (Dno 2010-63-31). Information provided to the pregnant woman included the purpose of the visit, the aim of the SALUT-R, and that participation in the register was voluntary.

CONCLUSIONS

Almost half of pregnant women achieved the recommended physical activity level, and these pregnant women were characterized by normal weight or overweight, very good or good self-rated health, and a higher educational level. No significant associations could be established between physical activity levels and GDM, birth weight, or mode of delivery. There were significantly more pregnant women with immigrant background in the category with lower physical activity.

IMPLICATIONS FOR PRACTICE AND FUTURE RESEARCH

Being overweight or obese during pregnancy are strongly associated with adverse pregnancy outcomes. Physical activity is significantly associated to BMI $<30 \text{ kg/m}^2$ and should be seen as beneficial due to the decreased risk of adverse pregnancy outcomes. Health care professionals have an opportunity to promote physical activity when counselling fertile and pregnant women. This counselling may help improve the health in this population, leading to good or very good self-rated health among these women. In addition, there is a need for efforts to promote physical activity to strengthen the health among pregnant women with immigrant background. In addition, future randomized studies should investigate the impact of different physical activity levels on GDM.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

AI is principal investigator of the Salut Programme and its register (SALUT-R) with author EE as close collaborator. Author MLT is responsible for data handling within both registers. Authors IM, ML, MLT, EE, AI, and MP designed the study. ML performed the statistical analyses with assistance from IM and MLT and drafted the manuscript in collaboration with IM. EE, MP, AI, and MLT contributed to the manuscript during the work process. All authors have read and approved the final manuscript.

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IV

“Longing for individual recognition” – pregnant women’s experiences of midwives’ counselling on physical activity during pregnancy

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Abstract

Background

Physical activity, generally considered safe during pregnancy, may maintain the wellbeing of the pregnant woman and her fetus. National Swedish guidelines recommend ≥ 150 minutes per week of moderate exercise. Individual counselling on physical activity is considered a supportive factor for remaining physically active during pregnancy. The aims to explore among pregnant women were: *i)* The experiences of lifestyle counselling provided by a midwife in antenatal care, addressing health promotion with special focus on physical activity during pregnancy, *ii)* Factors influencing the trustworthiness of counselling conducted by a midwife.

Methods

This qualitative study collected data from 14 pregnant, parous women in gestational week 35 to 36 using in-depth interviews. The data were collected in Sweden in 2015. Qualitative content analysis was applied.

Results

The theme “*Longing for fulfilment of individual needs and expectations*” emerged during analysis, including four categories; “*Being exposed to unsatisfying counselling*”; “*Appreciating supportive and trustworthy counselling*”; “*Wrestling with cultures*”, and “*Dealing with physical activity in daily life*”. The results

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indicated that some participants experienced limited counselling that was characterized by lack of knowledge, support, and trustworthiness in the midwife. Other participants reported valuable encouragement and support by the midwife. Participants were longing for individual recognition instead of receiving general advice on physical activity that was designed for all pregnant women.

Conclusions

Individual counselling on physical activity during pregnancy based on the participant's individual needs was desired. On the contrary, the participants could experience the midwife as having her own agenda, primarily focusing on medical surveillance. This situation could result in a one-way communication and was therefore experienced as less trustworthy. Knowledge conveyed, on physical activity during pregnancy, was often experienced as insufficient and not adjusted to the pregnant woman's individual needs. Our results indicate a need of increased level of knowledge, among midwives in antenatal care, regarding lifestyle and lifestyle change during pregnancy. This may enhance promotion of a healthy lifestyle for the pregnant woman during counselling.

Background

Physical activity is generally considered beneficial and safe during pregnancy, and there is no evidence of increased risk of adverse pregnancy outcomes in an uncomplicated pregnancy (1). Moreover, physical activity may reduce adverse pregnancy outcomes (1-3). The international recommendations by the World Health Organization (WHO) on physical activity during pregnancy suggest that pregnant women should perform at least 150 minutes (performed in bouts of at least 10 minutes) per week of moderate intensity aerobic physical activity, or at least 75 minutes per week of vigorous intensity aerobic physical activity, or a combination of both. Pregnant women should seek medical advice before striving to achieve these recommendations (4). These guidelines have been adopted in Sweden (1). Although positive health effects of being physically active are well known, pregnant women tend to lower their physical activity when they enter their pregnancy (5). Lack of time, somatic pain, and changes in body size are well-documented reasons for being less active during pregnancy (6-8).

Pregnancy is an ideal opportunity to promote change of lifestyle that may benefit both the pregnant woman and her fetus (9). The relationship between the caregiver and the patient relies on trust and confidence (10) and two-way communication with a person-centred approach are significant components in the relationship (11). In Sweden, almost every pregnant woman attends free antenatal care (ANC) (12). Counselling on a healthy lifestyle and medical surveillance during pregnancy are prominent work tasks for an ANC midwife (12). Individual counselling on physical activity encourages pregnant women to maintain their pre-pregnant leisure-time physical activity into their pregnancy (13).

However, the literature is limited regarding pregnant women's experiences of being counselled on physical activity and the significance of midwives' trustworthiness during counselling. Therefore, the aims to explore among pregnant women were: *i)* The experiences of lifestyle counselling provided by a midwife in antenatal care, addressing health promotion with special focus on physical activity during pregnancy, *ii)* Factors influencing the trustworthiness of counselling conducted by a midwife.

Methods

In this study a qualitative approach was used and inspired by Qualitative content analysis (QCA).

The interview guide

A thematic interview guide was created by the authors that corresponded to the aims of the study. Some topics mirrored the topics in a previous study where the participants were midwives (14). The interview guide was tested in a pilot interview and this test resulted in minor revisions. The interview was included in the materials. The following topics were included in the interview guide: Experiences of midwives counselling on lifestyle habits and life style change in general and physical activity in particular, the significance of lifestyle counselling in general, and the trustworthiness of the midwife in relation to the counselling.

Recruitment of study participants

Pregnant women were asked to participate in the study before their routine ultrasound examination, which is performed between 18 and 20

weeks of gestation. All participants were clients at a hospital-based Specialist Maternal Health Care Centre (SMHC) at a hospital in northern Sweden. Using purposive sampling, the study aimed for healthy, parous women who had a routine ultrasound examination indicating normal outcome and women who spoke Swedish or English. In addition, aiming for a variation in age, country of birth, and body mass index (BMI) (i.e., normal weight, overweight, or obesity). We defined immigrant women as those who were not born in Sweden. All pregnant women visiting SMHC for their routine ultrasound examination were consecutively approached. The appointed midwife briefly informed an eligible pregnant woman about the study "counselling on lifestyle habits during pregnancy", and received permission for first author (ML) to contact the eligible participant for additional information about the study. The first eight pregnant women who were approached gave their verbal consent for further contact; the ninth eligible participant declined participation. The first author contacted all eight eligible participants by telephone, and all agreed to participate in the study and agreed on a date and place for an in-depth interview. During the course of the data collection, it was recognized a need of recruiting more immigrants and overweight or obese women in order to achieve the variation in the desired background characteristics. Accordingly, an additional recruitment process took place aiming for obese pregnant women ($\text{BMI} \geq 30 \text{ kg/m}^2$) and/or immigrant women. This recruitment resulted in six more participants, resulting in 14 total participants in the study. All participants were married or cohabiting, and their educational level was equally distributed between university and high school level. Most of the participants were born in Sweden and their BMI varied between 20.1 kg/m^2 and 38.5 kg/m^2 (mean= 27.5 kg/m^2) (Table 1).

Table 1. Background characteristics of the participants in study IV.

Variables	n (%)
Participants	14
Age (years)	
Mean	31.5
Min-Max	23-38
BMI (kg/m)	
<25	6
25.0-29.9	2
≥30	6
Marital status	
Cohabiting	14(100)
Educational level	
University	7 (50.0)
High school	7 (50.0)
Compulsory school	0
Country of birth	
Sweden	11 (78.6)
Other countries	3 (21.4)

Data collection procedure

The gestational age at interview was selected with the purpose to gather as much information and experience of the present pregnancy as possible. The pregnant women were interviewed at 35-36 weeks of gestation (mean value: 35 weeks and six days; range: 35 weeks and two days to 36 weeks and three days). The participants determined the venue for the in-depth interviews. Nine participants requested that the interview take place in their homes, and five participants chose a private venue at the hospital. The first author performed all in-depth interviews. All eligible participants received written and oral information on the study and were informed that they could withdraw their participation at any time without giving any particular reason. Each participant signed a written consent form before the interview. The interviews lasted between 45 to 80 minutes and the mean time was 50 minutes. All interviews were digitally recorded and were transcribed verbatim into text by one of the authors (ML).

Data analysis

The analysis was inspired by Qualitative content analysis as presented by Graneheim and Lundman (15). All transcribed data were read thoroughly by ML and IM. ML identified meaning units, condensed meaning units, codes, and emerging sub-categories and categories. ML and IM discussed the codes, sub-categories, and categories. The transcripts were then re-read to certify that no significant data were neglected. At this phase of analysis, the underlying latent meaning (i.e., the theme) emerged and the second author (MP) contributed to the analysis and discussion. Finally, all the authors arrived at a consensus regarding analysis and presentation of the findings.

Ethical approval

The study was granted approval by the Ethical Review B, Umeå University (Dno. 2014-152-32M).

Findings

An overview of the theme, categories, and their subcategories is presented in Table 2. The theme “Longing for fulfilment of individual needs and expectations” reflects the participants’ strong wish for individual counselling on physical activity based on their individual needs. Some of these needs concerned advice based on knowledge and delivered with trustworthiness; however, the participants described the opposite situation: general counselling that primarily focused on medical surveillance, content driven by midwives’ own agenda rather than the specific needs of the participants. As a result, some of the participants experienced their interactions with their midwives as unsupportive with respect to their individual needs. However, some of the participants reported situations where there was time during encounters where they experienced that they were seen and heard in an individual and supportive way. The participants reported several aspects that either complicated or facilitated their wish to integrate physical activity into their daily life.

Table 2. Theme, categories and their sub-categories

Theme	Category	Sub-category
Longing for fulfilment of individual needs and expectations	Being exposed to insufficient counselling	<ul style="list-style-type: none"> – Discovering the absence – Seeking answers – Recognizing midwife's own agenda – Sensing hesitation – Facing lack of support and trustworthiness
	Appreciating supportive and trustworthy counselling	<ul style="list-style-type: none"> – Meeting the body of knowledge – Being seen and heard – Sensing encouragement and trustworthiness
	Wrestling with different cultures	<ul style="list-style-type: none"> – Dealing with conflicting advice – Going my own way – Striving for independence
	Dealing with physical activity in daily life	<ul style="list-style-type: none"> – Being aware of the body – The own mind as an obstacle – Environmental support – Finding a driving force

Being exposed to insufficient counselling

This category includes five sub-categories: *“Discovering the absence”*, *“Seeking for answers”*, *“Recognizing midwife's own agenda”*, *“Sensing hesitation”*, and *“Facing lack of support and trustworthiness”*. Each of these sub-categories presents different aspects of pregnant women's experiences with insufficient counselling from their midwives in antenatal care with respect to physical activity and other lifestyle habits.

Discovering the absence

According to the participants, the midwives generally did not discuss lifestyle habits, but if lifestyle was discussed, the communication usually focused on lifestyle habits such as smoking and alcohol use. Participants also noted that they initiated most discussions on lifestyle matters. Several of the participants expressed that their midwife never discussed increasing physical activity during pregnancy.

What advice? My midwife doesn't talk much about anything... if you ask, she'll try to answer... but... about lifestyle habits specifically...? Do you smoke? No! Do you use snuff? No! That's about it... 9

The participants also expressed feelings of being neglected as the result of the non-existing counselling on physical activity. Some considered physical activity an important part of their life and their expectations of receiving useful advice to remain active in a safe manner were not met.

Some normal weight participants believed this sort of counselling was absent because they were of normal weight and their pregnancy was uncomplicated. Some normal weight participants believed that midwives provided more information to obese and sedentary pregnant women. If they did not approach the midwife with questions on physical activity, no information was provided.

...yes, but if they (the midwives) see that I am... don't weigh too much, then there isn't any more discussion... It's as if we are forgotten or something ... 14

Seeking answers

Participants were frustrated with the lack of information provided on physical activity during pregnancy or that the advice provided seemed out-of-date. This lack of advice or poor advice was interpreted as the result of the health care provider's insufficient knowledge. Several occasions were described where the midwife demonstrated insufficient knowledge when participants' questions on safety of different forms of exercise simply were left unanswered. Participants wanted clear and unambiguous answers to their questions.

I didn't receive any information that it (physical activity) would be good for anything else... so the child wouldn't be so big?... No, she never told me why it would be good... 6

Several of the participants expressed that they had discussed physical activity with a training instructor at their gym when they did not receive the needed advice from their midwife. They acknowledged that a midwife and a training instructor both had specific knowledge in their separate fields, but it was perceived that neither of them took the overall responsibility for the participant's situation with respect to physical activity during pregnancy. These ambiguous roles could result in individuals seeking strategies from other sources about physical activity during pregnancy.

I received advice from instructors about how I should exercise when I'm pregnant and such... but at the same time I can be a bit scared... what if you hurt the child... because obviously the instructors aren't... they don't know everything about pregnancy and such... 14

The Internet was a significant source for information since it was "always available". Websites from local or national authorities were considered more trustworthy. Popular Swedish websites such as "Life of

families”, “Pregnant”, and “Your pregnancy” were also visited. However, these sites were all usually based on statements by non-professionals and could not therefore be considered true and objective.

You should take those family websites with a grain of salt... but that is where you turn for information. You only see them (the midwives) every two-three weeks and calling them isn't easy... So you end up using Google, which is always ready and waiting... 6

I'm so careful about where I look for information... I think you should stick to 1177 [the county council's healthcare website] since I feel like it is more professional. I don't use forums since anyone can contribute there... 4

Participants could double-check information retrieved from websites by asking their midwife to confirm or reject the new information. However, some participants were satisfied with a simple confirmation from their midwife such as “Does it feel right, then it is OK!”, whereas others were insecure and wanted more objective facts.

Recognizing midwife's own agenda

Some participants believed their midwife had her own “check list” and that it could dominate the ANC visits. For example, one midwife focused on actions like examining the symphys-fundus measurement, taking blood samples, and collecting information regarding smoking and alcohol habits. In addition, some participants experienced that this checklist better suited the midwife's presumed work tasks rather than a procedure adjusted to their individual needs.

...but there hasn't been a focus on exercise and such, but rather almost exclusively about all the values looking good... 4

For some participants, the midwife seemed satisfied as long as she checked the standardized items of her agenda. Moreover, sometimes the midwife could seem uninterested in anything other than her checklist. This approach could result in an absence of a two-way communication, communication that most of the participants desired.

She checked at the beginning. This is a girl who exercises, so we can skip that... even though I would have liked to have had some follow up and talked about it more since it (physical activity) is something that is such a big part of my life... But she was able to tick it off! 3

Sensing hesitation

Hesitant and unclear advice about physical activity was discussed as probably related to midwives' concerns that their improper advice could lead to pregnancy complications. For example, some questions by participants (e.g., "Is this physical activity during pregnancy safe?") were rarely answered in a straightforward fashion.

...it is as if they are scared to say something is okay and if I had complications because of it or say that something isn't okay... so they don't give any concrete advice, just to be careful... 3

The participants, in particular those who were overweight, often felt that the midwife tiptoed around the subject of weight, as if the midwife was holding back, avoiding the overweight issue. Some participants experienced this behaviour as dishonesty.

I don't think that the midwife should hold back anything for fear... you should be able to have an open and honest dialogue... I would rather know... I would go crazy if she held back something important about how it could go badly... just because she is afraid I'd take it badly...9

Facing lack of support and trustworthiness

Participants expressed feelings of being invisible because they were normal weight. As a result, they were not given much time or useful information and advice regarding physical activity during pregnancy. Furthermore, they could experience counselling as restrained, untrustworthy, and unsupportive. Some participants desired a midwife that would encourage them to accomplish their goals and that would demonstrate her belief in them. Some participants also perceived a patronising attitude from their midwife. Such experiences could turn into unresponsiveness and lack of motivation to change targeted lifestyle habits.

I didn't listen...I just thought she was irritating...it was just talking, talking. You don't listen to that. Say whatever you like, I'm not going to listen... You've burned your bridges with me... and you turn off... 6

Appreciating supportive and trustworthy counselling

This category includes the sub-categories “*Meeting the body of knowledge*”, “*Being seen and heard*”, and “*Sensing encouragement and trustworthiness*”, all reflecting the participants’ desire and experience of individual counselling and their experiences of counselling on lifestyle.

Meeting the body of knowledge

Some participants experienced the midwife as a very knowledgeable health professional with a positive attitude towards physical activity during pregnancy. These participants were encouraged by convincing evidence and advice presented by the midwife. They experienced their interaction with their midwife as valuable support; that is, the midwife assisted them to achieve their goals for physical activity during their pregnancy. The participants highly valued information on why it was important to be physically active, but they were less enthusiastic about just being given information regarding recommendations.

I want to know more... about the background and such... That convinces you that it (physical activity) is good...⁹

Being seen and heard

Encounters focusing on participants’ individual needs and capacity were highly valued, especially if the message was delivered in a personal way. Advice related to physical activity was expected to be individualized. The occasions when there was sufficient time to really discuss this matter were considered golden moments by the participants.

She is so calming... very little lecturing, she says: it will work out. Women have given birth throughout the ages! Reliable and straightforward and clear... If it feels good, then it is good. I have an incredible amount of confidence in her! ⁷

Meeting encouragement and trustworthiness

Participants valued support from their midwife on how to become more physically active. Furthermore, a midwife conveying significant knowledge was described by the participants as increasing their support and trustworthiness.

She is so straightforward and clear and inspires such confidence... yes, and her tone of voice, that's really important. She has confidence in her voice. 7

The “trustworthy midwife” was described as a health professional who was positive, determined, goal-oriented, and clear. However, some participants experienced that a midwife’s own body shape or apparent lifestyle negatively or positively affected the trustworthiness of her advice. A midwife with a larger body size could be seen as less trustworthy by some of the participants. However, some of the participants did not consider that the midwife’s body shape had any impact on her trustworthiness.

The midwife is like any other model. They (the midwives) become almost like a god, they are who you turn to and she should know everything about pregnancy. 3

...but if she had been severely overweight... well, you might need to listen to your own advice... How good do they work, really? 6

Wrestling with different cultures

This category reflects the balance between different cultural expectations regarding the participant’s expected physical activity level during pregnancy, a balance that seemed to affect immigrant women the most. This category comprises the following sub-categories: “*Dealing with conflicting advices*”, “*Going my own way*”, and “*Striving for independence*”. Situations and challenges that might arise in a new setting were reported. These participants also noted that their relatives influenced the way they understood pregnancy-related issues. It was clear that the participants struggled to find their own way.

Dealing with conflicting advice

Some participants who had immigrated to Sweden experienced conflicting situations concerning advice on lifestyle habits, and particularly advice regarding physical activity during pregnancy. Advice provided by their close relatives was often opposite to advice provided by their midwife. Some participants were encouraged by their midwife to be more active and that this activity would not harm her fetus. In contrast, some of these participants’ family members encouraged them to be inactive or rest or to avoid heavy activity. For example, some immigrant women noted that their families expressed that powerwalks could be harmful to their unborn child.

You should rest, your husband should do more and... your family... They come with food... You shouldn't carry anything heavy... But I! Hallo! It's okay, I don't feel bad from moving around, I want to keep moving... You don't want to gain weight much... You know you have to get rid of it... but for them (the relatives), if you get fat when pregnant, they feel it is good and ... healthy in some way... sigh. 14

Going my own way

Participants reported that they tried to comply with the recommendations and advice provided. However, sometimes the immigrant women chose their own way, hearing advice but doing the opposite. Additionally, the participants described situations where they adjusted their physical behaviour to make the midwife satisfied with their compliance rather than for the sake of improving their own health.

She (the midwife) has to say things... but I don't do it... She doesn't understand me... my country... my midwife says go for a walk every day. Yes, but she doesn't understand... I know it is good to rest, the child in my stomach will be healthy then. But I do it anyway (go out and walk)... Then she is happy! 12

I did the opposite. I got contractions and the doctor said I could still go out and walk... But I know that the last pregnancy I rested and it was okay... So I did the opposite and I laid down a lot... and it was fine... I didn't trust them that time... 13

Striving for independence

Navigation between close relatives' and the midwife's advice was a challenge specifically for the immigrant participants. In addition, participants expressed a strong desire to become independent women irrespective of the suggestions from others. They expressed feelings of struggle and were urged to receive support from the midwife.

You try to say that it isn't dangerous and such... but they (the relatives) believe what they believe and grandma said the same thing... In that situation it would have been good to say: my midwife says it is okay to exercise the way I do or something like that... It would have been good, but... 5

... it's difficult. I want to be different with my children when they are grown... not tell them what to do all the time but let them choose themselves... 13

Dealing with physical activity in daily life

This category comprises four sub-categories: “*Being aware of the body*”, “*The own mind as an obstacle*”, “*Environmental support*”, and “*Finding a driving force*”. Each of these sub-categories represents aspects of obstacles or facilitators for achieving physical activity in daily life during pregnancy.

Being aware of the body

The participants identified several physical obstacles to performing physical activity: back pain and pelvic pain, uterine contractions, tiredness, and nausea. In addition, being overweight was a physical obstacle to being physically active, such as playing with children or participating in other physical activities.

I have such pelvic pain so I can't take my long walks anymore... I used to walk one, one and half hours every day but now the pain hits me when I walk too long. 5

The own mind as an obstacle

The participants also mentioned lack of motivation or not knowing the benefits of physical activity as obstacles for physical activity during pregnancy. Although some of the participants were not motivated to participate in physical activity, they could describe physical activity as something of great significance. Physical activity was mentioned as something that could be postponed with the argument that an increase in weight is expected during pregnancy. Some participants chose not to be physically active because they feared physically stressful exercise would jeopardize the health of their unborn child.

...I'll do that later... I don't care... I eat well since you are punished so badly in a way. First you feel ill and vomit for several weeks and at the end you can't eat anything. You have to savour it. Maybe it is the same thing with exercise... as long as it doesn't take too much effort, you exercise. 5

Right now I'm here and pregnant with my baby... I'll do the other things later... I'll gain weight anyway. I'm pregnant... I'm doing this for the moment. We can go on walks later and then we can start exercising... once the baby has arrived... 6

...When I exercise, it feels a bit scary, when I start breathing so hard... Does the child really get enough oxygen like this? 7

The shame of being overweight was a reason not to participate in group exercise. Physical activity could be considered as an “insurmountable mountain” for these participants.

...but it feels like there's no point, it feels like an impossible goal in some way, a high mountain that many can conquer but not me. I climb and always fall down, if you know what I mean. Now I'm too tired to try again... 2

Environmental support

Participants emphasized the value of support for performance of physical activity during pregnancy. Having a supportive partner who enabled exercise was found encouraging and sometimes even crucial. However, lack of familial support – e.g., a husband occupied with work or the responsibility for the care of many children – was associated with feelings of frustration. Having a heavy workload at work was an additional reason for lack of time to perform physical activity. The participants reported that it was much easier to be physically active in their first pregnancy in relation to their second or third pregnancy due to their household responsibilities.

When you were alone before having children, everything was easier... With the second child, there's really not time... I'm so tired too... I don't have the energy... 11

Finding a driving force

Participants described the importance of finding their own motivation for physical activity and of taking the opportunity to be physical active when possible. Participants who had been physically active before their pregnancy found it easier to continue to be physically active during their pregnancy as they could rely on their pre-pregnancy routines.

Daily exercise! Finding the small opportunities during the day to get some exercise, take the opportunity simply... 7

Some participants reported no problems in finding their motivation for physical activity during pregnancy. These participants reported that they had been very active before their pregnancy, and that they were exercising five to six times per week at the time of the interview. These participants were more concerned with how to continue with their high frequency training rather than focusing on adverse effects of physical activity on fetal health. These participants wanted to maintain their exercise level during their pregnancy, and they expressed feelings of

failure when this was not possible. These high performance participants often discovered a more suitable form of exercise during their pregnancy although some reported being unsatisfied with the physical activity restrictions during pregnancy. Another feature of these women were that they all had a higher educational level.

The midwife had to calm me down, I'm such an incredibly physical person. I exercise an amazing amount but during the first three months until week 14, if I moved faster than walking speed I threw up... I had to stop to vomit. Okay, I can't run... I gave up... But I'm really looking forward to being able to control my body again... 7

A comfortable feeling after physical activity increased their motivation. Being active before pregnancy, achieving normal weight gain during pregnancy, participating in an exercise group or having an exercise partner, and positive fetal health effects were other positive factors for performance of physical activity during pregnancy.

...but I read on an app that the child actually benefits from me exercising. It isn't just for my sake... 1

If it is hard to get out, then it is a thousand times more difficult when pregnant... But if you just get out, then when you get back you feel so much better...to clear your head... I think that's what motivates me most.

Discussion

The participants highly appreciated receiving individualized, supportive, and trustworthy counselling conveyed by a knowledgeable and reassuring midwife. However, the overarching theme “Longing for fulfilment of individual needs and expectations” indicates several unsatisfying areas regarding midwives’ counselling on physical activity during pregnancy and how the participants undertook different approaches to deal with this.

A study that explored counselling on gestational weight gain reports that pregnant women experience limited or no advice on physical activity from their health care provider (16). This finding was confirmed by our study. A study on dietary counselling during pregnancy demonstrates that pregnant women turn to private contacts, magazines, and the Internet when seeking advice regarding dietary intake, especially if this information is not provided by their health care provider (17). In our study, when a midwife demonstrated insufficient knowledge or provided unclear advice, participants sought answers elsewhere, and the Internet

was a well-used source. In a previous study, we demonstrated that midwives might feel frustrated if they felt they could not fulfil their job description. In addition, this inability to fulfil perceived duties could sometimes generate feelings that they were not good enough (12, 14). In the present study, midwives who provided little guidance could have been being overly cautious because they were afraid they would give incorrect advice. Furthermore, there can be a risk that the health care provider's focus on risks and medical surveillance becomes the most important part of the job, a perspective that could lead to ignoring the specific needs of the patient (i.e. the pregnant woman's) (18). The participants felt that their midwives were attached to their own agenda and this prevented counselling that was aimed at their specific needs. A patient-centred and individualized care where the pregnant woman and her midwife are seen as partners is preferable and this relationship should be based on trust and respect (19). These conclusions were in line with our findings. However, we have previously shown that midwives in Swedish antenatal care aim to individualize their counselling on physical activity in order to meet each pregnant woman's individual needs even though this is considered a challenging task (14). The participating midwives in our earlier study emphasized that they tried several ways to achieve individualized counselling. However, the participating pregnant women in the present study sometimes did not seem to share the same experience.

The participants highlighted the importance of being seen and heard and described feelings of disappointment when not being treated as an individual. Some participants reported experiences of being neglected because they were normal weight. A Swedish study exploring pregnant women's views on maternity care reported that being supportive, friendly, and non-judgemental were important characteristics of a midwife (19). These findings were confirmed in our study where trustworthiness was perceived as a key factor for a good relationship between the participant and the midwife. A trustworthy midwife was described as someone supportive without judgemental pointers. However, there were different opinions of the significance of the midwife's own body shape on trustworthiness. Some of the participants implied that a professional approach and competence were the most important aspects of a midwife's duties. Others discussed that an overweight midwife or a midwife that otherwise demonstrated an unhealthy lifestyle negatively affected the trustworthiness and the participants' own willingness to change their lifestyle habits. Only a few

studies have investigated health care providers' experiences of their own body shape when encountering patients. The body shape of the health care provider can be seen both as a barrier (20) or an asset (21). Midwives see counselling overweight pregnant women as a sensitive issue (14, 22). In our earlier study, this ambivalence was described as a "tiptoeing" approach (14). However, some midwives look upon this behaviour among their colleagues as being unprofessional; they promote a more outspoken approach towards overweight pregnant women (14). Overweight pregnant women have been shown to be exposed to negative attitudes by health care providers, resulting in feelings of disappointment and helplessness (23). Some participants in the present study also experienced the midwife as naggy. Moreover, this situation could result in participants resisting lifestyle changes because they did not trust the midwife. In our study, overweight and obese women mainly experienced these situations. A few studies have concluded that overweight pregnant women need to be honestly counselled and be given direct advice regarding their overweight or gestational weight gain (7, 16). Some participants in our study felt that the midwife hesitated due to fear of hurting their feelings or acting disrespectful, although these participants wanted an open and honest discussion about their weight.

The participants experienced several barriers to physical activity during pregnancy, such as being overweight, lack of time, and insufficient support from the partner. Furthermore, being physically active before pregnancy was perceived by several of the participants as crucial for maintaining physical activity during pregnancy. Our study confirms similar findings (7, 8, 24, 25).

Some immigrant participants were frustrated when advice from the midwife conflicted with advice from their relatives. In one of our previous studies, we described a similar finding as a cultural tug-of-war. The midwives tried to support the immigrant women to stand on their own and find their own way (14). Counselling immigrant pregnant women on physical activity is challenging, requiring individual solutions for individual women (14), demanding creative and inventive instruction on the part of the health care providers (26).

The present study was conducted in a geographic area where different health care providers at health centres have been subjected to an educational intervention focusing on counselling on healthy lifestyle habits during pregnancy. Several lectures were offered to midwives and other health professionals for several years before this study. However,

there was no guarantee that the participants' appointed midwives in the present study had been exposed to this local intervention. Possible reasons for absence or limited counselling on physical activity during pregnancy may be insufficient personnel resources, too many clients, or a heavy workload (14). Our interpretation of the current situation is that there is a need for training, reasonable time, and personnel resources to enable midwives to perform individualized counselling on physical activity during pregnancy.

Methodological considerations

In this qualitative study, we aimed to ensure and assess the trustworthiness of the study by applying the following components of qualitative research: transferability, credibility, dependability, and confirmability (15). Through a variation in the background characteristics of the pregnant women we tried to ensure transferability. To further strengthen the transferability and credibility, data collection was thoroughly described step-by-step and the data collection continued until a sense of saturation in data was achieved. To strengthen dependability, the same person (first author) performed the interviews, transcribed all materials, and took notes during the interview process, which took place during a compressed period. The confirmability and credibility was obtained through discussions of the analysis by the three authors. Each author comes from a different professional discipline.

Conclusions

Participants desired individualized counselling based on their individual needs regarding physical activity during pregnancy. However, some participants could experience their midwife as having her own agenda, primarily focusing on the medical surveillance programme. Accordingly, a one-way communication and a lack of trustworthiness was perceived by the participants. Health care providers' knowledge on physical activity during pregnancy was often experienced as insufficient, and the advice was not adjusted to the pregnant woman's own situation. The immigrant participants experienced conflicting advice from the midwife and their close relatives regarding physical activity during pregnancy. Our interpretation of these results is that educational efforts, reasonable time allocated for surveillance of pregnant women, and personnel resources need to be provided if an individualized counselling promoting physical

activity and healthy lifestyle habits is to be perceived as satisfactory by pregnant women. We suggest that future studies focus on immigrant pregnant women's aspects on counselling during pregnancy.

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Competing interest

The authors declare that they have no competing interests.

Authors' contributions

ML, IM, and MP designed the study. ML collected, transcribed, and analysed the data, drafted the manuscript, and submitted the final manuscript. IM contributed to the analysis and supported the drafting of the manuscript. MP contributed to the analysis in a later phase of the work process and contributed to the manuscript. All authors read and approved the final version of the manuscript.

Authors' information

The three authors represent different professional disciplines including midwifery, obstetrics, and gynaecology.

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