

# Evaluation of an Early Childhood Caries Preventive Program Stretching from Pregnancy, in Areas with Low Socioeconomic Status in Sweden: 12-Month Results

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## Abstract

The purpose of this prospective controlled intervention study was to evaluate an Early Childhood Caries (ECC) prevention program from pregnancy to 12 months of age. Pregnant women living in socioeconomically disadvantaged areas in Sweden received an individual interdisciplinary ECC prevention program consisting of oral health promoting talks using motivational interviewing technique. Findings show a tendency towards a decrease in the proportion of children with high risk of ECC in the intervention group, although non-significant. The program reached a higher proportion of mothers, whose children had increased risk of ECC, with an oral health message during pregnancy compared to ordinary routines.

**Keywords:** Caries; Children; Promotion; Inequality; Interdisciplinary

**List of Abbreviations:** ECC: Early Childhood Caries; SES: Socioeconomic Status; MI: Motivational Interviewing; PDS: Public Dental Services; MHS: Maternal Healthcare Services; CHS: Child Healthcare Services

## Introduction

Dental health is unequally distributed globally and nationally. Early childhood caries (ECC) is more common among children living in areas with low Socioeconomic Status (SES) than among children in areas with higher SES [1-3]. The same pattern has been found in Region Östergötland in Sweden, where also an increasing difference in ECC prevalence between areas with low and high SES recently has been found [4,5]. ECC is however at large preventable and previous studies have shown that early prevention and parental education in oral health behaviors provide the best conditions for improvement in children's oral health [6-8]. It is increasingly recommended that children visit the dental service during the first year of life for caries risk assessment and preventive interventions if necessary [9,10]. Previous studies have also shown that the earlier the preventive

program is initiated, the better are the chances of avoiding ECC [11,12]. It has been suggested that screening of pregnant women from low-SES areas may be helpful in early identification of children with increased risk of ECC [11,12] and that interdisciplinary co-operation in prevention of ECC can be successful [9,13-15]. However, families living in areas with low SES may participate to a lesser extent in caries prevention programs [16]. In order to reduce differences in oral health, extended efforts should be directed in proportion to the needs of the population, so called universal proportionalism [17].

In 2013, the oral health prospective intervention study 'Equal oral health in children' was initiated in a low-SES area within Region Östergötland, Sweden. It was a directed at pregnant women in a high-risk population based on Region Östergötland's work on mapping and analyzing caries in children in relation to the region's socioeconomic

distribution [5]. The overall objective was to create and evaluate a model for interdisciplinary health promotion and ECC prevention among families living in areas with a high prevalence of ECC and low SES and to reduce socioeconomic related differences in caries prevalence in children. The specific aim of the study was to reduce caries prevalence in an area with low SES. Vital for the relevance of the model was to reach the families with increased risk of ECC in their children, a group scientifically recognized as hard to reach. The model consisted of a preventive program starting during pregnancy with ECC risk assessment. The program was based on a health promotion family perspective, and included oral health promoting talks with Motivational Interviewing (MI) as a method. The study comprised an interdisciplinary cooperation between the Public Dental Services (PDS), Maternal Healthcare Services (MHS), and Child Healthcare Services (CHS) and intended to continue until the expected child was three years old.

The purpose of the present evaluation was to study participation in the program, the mothers' demographic characteristics, self-perceived oral health, and oral health behaviors, and the children's ECC risk assessment from pregnancy to 12 months of age.

## Material and Methods

### Ethical approval

Ethical approval was received from the Regional Ethical Review

Board in Linköping before the start of the project (refs: 2012/259-31, 2018/367-32).

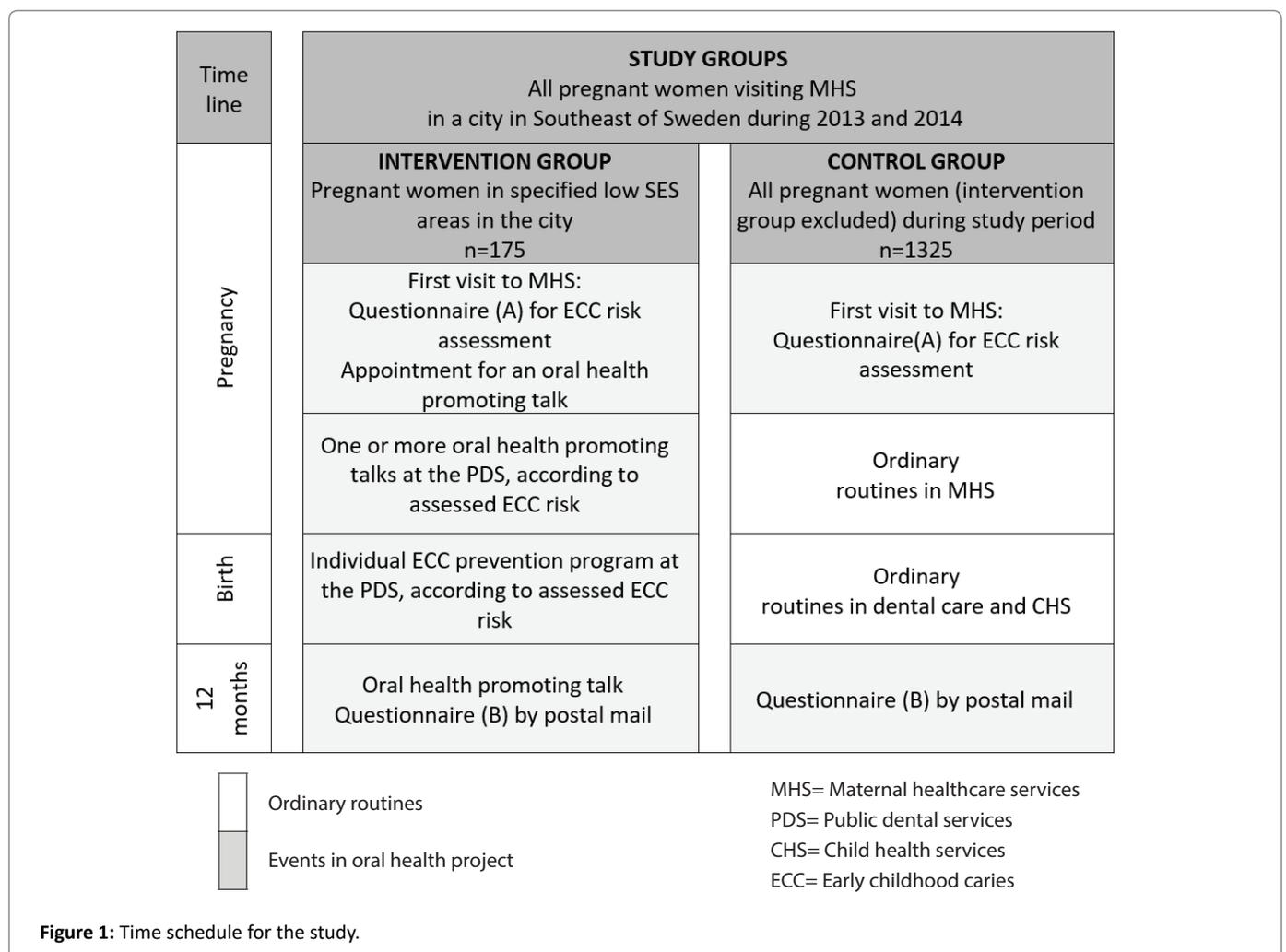
The time schedule for the study is presented in figure 1.

### Study groups

The intervention group was recruited consecutively from January 1, 2013 to December 31, 2014 using the following inclusion criteria: pregnant woman visiting the MHS for the first time in their current pregnancy and living in one of two low-SES areas in a city in Southeast of Sweden. SES was defined as the proportion of high-income individuals living in each very small area of the municipality of the specified the city [5].

In the most disadvantaged areas the prevalence of ECC was about 55 percent [5]. According to a power calculation (significance level of 0.05) based on an expected 15 percentage units decrease of ECC prevalence a sample size of 173 mothers was required in the intervention group. Recruitment was planned to last until 175 mothers agreed to attend, but for at least one year.

The control group consisted of pregnant women who visited the MHS during the study period for the first time in their current pregnancy and who lived in the specified city but not in the areas chosen for the intervention group. Hence, the SES of the control group is expected to be higher and used to study whether the project succeeded to include



and affect the group that was aimed for. The children in the control group were born during the same period of time as the children in the intervention group. They underwent ordinary routines in maternal and dental care and did not receive the additional ECC preventive program that was given to the intervention group.

When the pregnant mothers were invited to their first MHS visit, they were to receive information about the program and give their written consent to participate in the study.

Relevant subgroups will be studied separately in each study group.

### Questionnaire

A questionnaire was developed for studying demographic characteristics, oral health behaviors, self-perceived oral health and assessment of risk for ECC. The questionnaire was designed in consultation with psychologists and health-educated communicators with cultural knowledge and was translated into the ten most common languages in the neighborhood. The questions were based on well-known risk factors for ECC regarding the mothers social conditions, self-perceived oral health, and oral health behaviors [11,12,18]. The child's ECC risk was graded 0=low risk, 1=risk, and 2=high risk.

Mothers in both study groups answered the questionnaire during pregnancy (A) and when the child was 12 months old (B).

The answers were also used to follow up changes in the families concerning ECC risk and oral health behaviors pre-birth and at 12 months.

### ECC prevention program based on ECC risk assessment

The mothers in the intervention group received an ECC prevention program which began during pregnancy. Depending on the assessed ECC risk, the mother and child were offered oral health controls for the child and supportive oral health promoting talks at the PDS. The program also included practical instructions about ECC prevention and how the oral health promoting talks were to be performed.

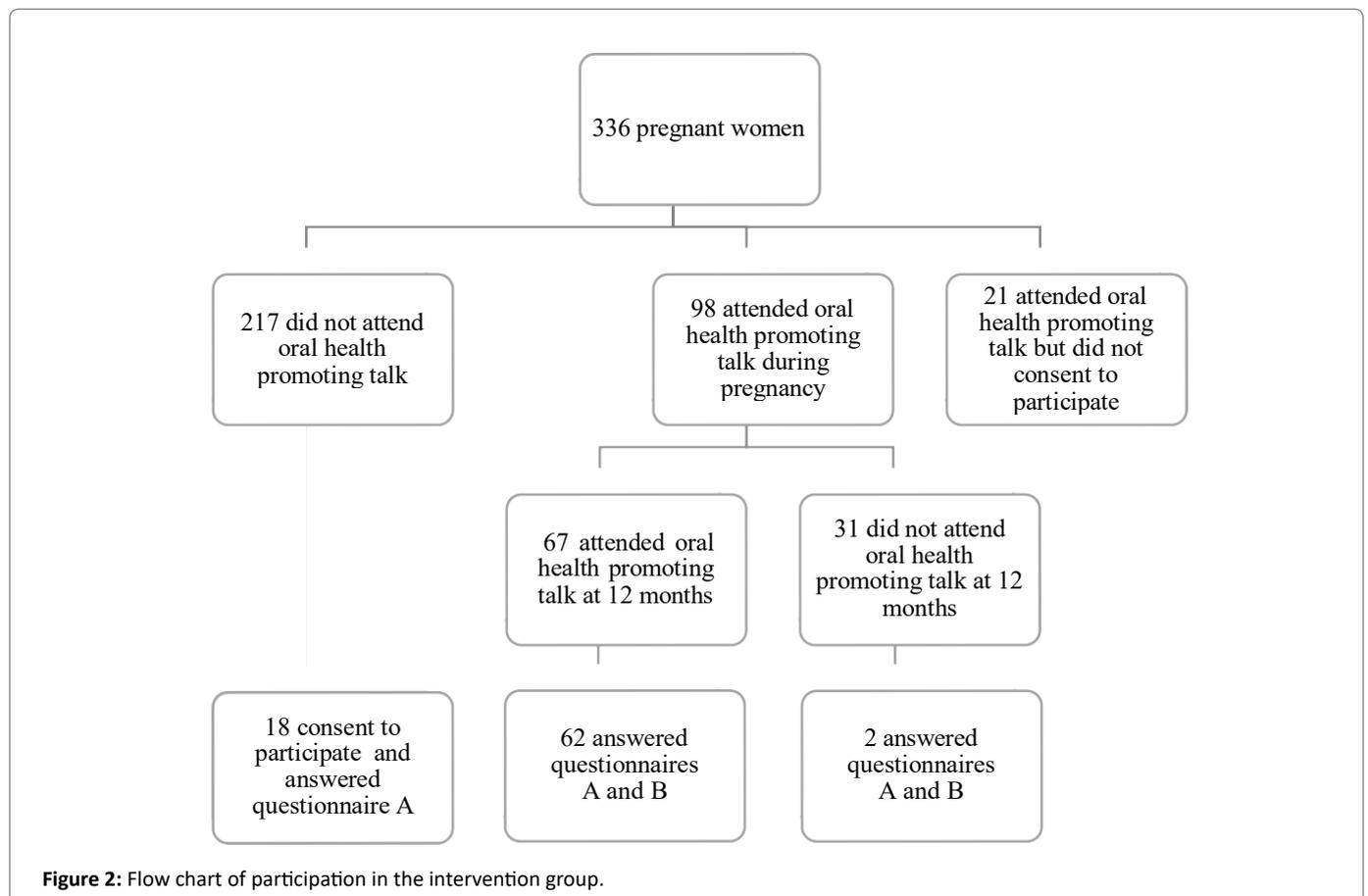
### Oral health promoting talks using motivational interviewing

Mothers in the intervention group were offered regular oral health promoting talks using the MI technique. Moderators who worked as dental hygienists or dental assistants conducted the talks at the PDS. The moderators underwent the same MI education and were professionally trained in the MI technique by psychologist. Interpreters were used when needed.

### Interdisciplinary co-operation

The MHS, CHS, and PDS all have a mission of influencing lifestyle and living habits such as diet, hygiene and exercise among their visitors/patients. A systematic collaboration between these three services was developed to enable the implementation of the program.

All pregnant women were invited to participate in the program at their first visit to the MHS. Women in the intervention group were invited to the PDS for participation in the ECC preventive program. When the child was born, the cooperation with PDS was transferred to the CHS.



**Table 1:** Demographics characteristics.

Demographic factor	Intervention group n=64	Control group (I) n=426	P-value (I)	Intervention group non- participating (II) n=18	P-value (II)
College education	31.3%	70.7%	<0.001	0%	<b>0.01</b>
Born in Sweden	11.1%	85.2%	<0.001	22.2%	0.22
Has a job	17.2%	89.4%	<0.001	27.8%	0.32
Living with the other parent	79.0 %	96.7%	<0.001	76.5%	0.82

Demographic characteristics of mothers in the intervention group who participated in the program compared to (I) the control group, and (II) mothers in the intervention group who did not participate in the program.

**Table 2:** Differences between intervention and control group in questionnaire a (pregnancy) and B (12 months after child birth).

Variable	Questionnaire A			Questionnaire B		
	Intervention group n=64	Control group n=426	P-value	Intervention group n=64	Control group n=426	P-value
Satisfied with dental health	56.5%	90.4%	<0.001	61.3%	86.6%	<0.001
Visits dental care regularly for examination of the teeth	39.3%	84.2%	<0.001	54.1%	81.8%	<0.001
Brushes teeth in the morning	88.9%	96.7%	0.004	92.1%	95.5%	0.237
Brushes teeth in the evening	88.9%	96.5%	0.007	96.8%	95.5%	0.639
Uses toothpaste	95.8%	99.8%	<0.001	100%	99.8%	0.726

## Statistical Methods

A z-test was used to examine differences in proportions between the intervention group and the control group responses to the questionnaires, and the McNemar test was used to determine whether the answers differed between the two questionnaires. P-values <0.05 were considered statistically significant.

## Results

### Participation in the program

The expected number of participants in the intervention group had not been reached after one year, why the recruitment period was extended to two years. After two years, 336 pregnant mothers had been invited to the intervention group; 119 of them accepted the offer and participated in at least one oral health promoting talk during pregnancy. Ninety-eight of them consented to participate in the research study, which means that the participation during pregnancy was 29%. Of these, 32% discontinued participation after the first oral health promoting talk, providing a total number of 67 participants completing the program. The remaining 217 did not attend any oral health promoting talk during their pregnancy. It was not considered feasible to continue the inclusion of new participants in the intervention group after two years. Figure 2 describes the participation and dropout for the different parts of the program in the intervention group. The two women who responded to questionnaire A and B but had not attended to the oral health promoting talk at 12 months had been at the PDS for individual supportive actions after birth.

### Non-response analysis

Of the 217 women who were invited to the intervention group but did not participate in the program, 94 declined participation either directly to the MHS or later in contact with the PDS, 30 did not attend their appointments or could not be reached when the PDS tried to contact them, and for 92 there was no registered reason for not participating in the program. However, for one case language problems was stated by the PDS as the reason for not participating.

Eighteen of these 217 women had completed the first questionnaire, consented to participate in the study, and could be compared to the women who participated (Table 1). The group that did not participate had a lower proportion (p=0.01) of women with college education, a higher proportion (p=0.22) born in Sweden, and a higher proportion (p=0.32) with a job.

### Demographic characteristics

In the intervention group 64 mothers responded to both questionnaires (A and B). Of the 2 630 mothers in the control group, 426 answered both questionnaires. There were significant differences between the intervention group and the control group regarding several demographic variables, as shown in table 1.

The average age of mothers at childbirth was 29 years in the intervention group and 31 years in the control group (range: 17-43 years and 19-45 years, respectively).

The group of immigrants in the control group differed from the group of immigrants in the intervention group in that a larger proportion of the immigrants (68%) in the control group had a college education compared to the intervention group (34%). Of the mothers with college education in the control group, 81% had a job when the child was 12 months old, while only 5% of the immigrant mothers with college education in the intervention group had a job by that time.

### Oral health and oral health behavior

As can be seen in table 2, the intervention group had worse values than the control group for all the analyzed variables concerning oral health and oral health behavior in questionnaire A. By the time questionnaire B was administered, the differences between the two groups had evened out and become non-significant for three variables but remained significant for two. When comparing the results from questionnaire A and B within each group no significant change for any of the analyzed variables was found; although, for example, the proportion of mothers visiting dental care regularly had increased by fifteen percentage units in the intervention group.

On the question whether they felt healthy or not, most of the mothers in both groups responded that they did, both during pregnancy and when the child was one year old.

### ECC risk assessment

ECC risk assessments using the answers to questionnaires A and B are presented in figure 3 for both groups.

In the intervention group, during pregnancy 11% of the children were considered to be at high risk (score=2) of developing ECC. When the children were at the age of 12 months, this proportion had decreased by eight percentage units to 3, 2% (p=0.125).

In the control group a large proportion was estimated to have a low risk (score=0) of developing ECC, both when assessed during pregnancy and when assessed at 12 months. The small proportion with risk of developing ECC (score=1-2) had increased (p=0.019) from 13% to 17%.

### Discussion

In this study we evaluated the 12-month results of a very early ECC prevention program (due to continue to 36 months) aimed at a high risk ECC population in an area with low socioeconomic status in Sweden. Participation in the program, demographic characteristics, perceived oral health, oral health behaviors, and ECC risk assessments after 12 months were studied.

### Participation in the program

In ordinary routines in the MHS all expecting mothers, regardless of SES were invited to receive group information about oral health, but the participation rate was low: 4% in 2013 and 2% in 2014. Since families living with low SES have a lower frequency of visits and a larger dropout rate from dental visits for their children it is expected that the participation for this group is even lower in this initiative [19,20]. The present program reached a higher proportion of pregnant women in low SES (29 percent) in comparison to this ordinary routine.

The difficulties in including participants is in line with previous knowledge about the targeted group [19,20]. It is also possible that not all prospective participants received an invitation.

Language barriers as well as cultural differences may have been aggravating factors in the recruitment process and can be assumed to have contributed to the low participation rate in the intervention group. This is despite the fact that the material in the program was translated into different languages, interpreters were used when needed, and the program was designed in consultation with health-educated communicators with cultural knowledge. The extensive program information (required for ethical reasons) could have contributed to the loss of participants in the program and in fewer consenting to participate in the research study. Another reason for difficulties in recruitment might be that the offer of participation could have been perceived as stigmatizing for residents in the intervention area, which may have led some potential participants to abstain.

Due to shortcomings in the recruitment process, the collection of data for the study took longer than planned, and the calculated sample size was not reached despite prolonging the recruitment from one to two years. Further extension of the recruitment time was discussed but was not considered feasible, firstly because the control group was already large and secondly because of difficulties in motivating the MHS personnel to continue the recruitment process.

Since there were major difficulties in recruiting mothers to the intervention group, it is appropriate to ask whether the disciplines involved in this study are the right ones for recruiting and cooperating in an interdisciplinary oral health program of this kind, from the perspective of both the prospective participants (the mothers) and the personnel. Three disciplines-MHS, CHS, and PDS-were involved in the program since they all have a public health assignment, oral health included. However, there may be differences in how this public health assignment is interpreted in terms of oral health. Sheiham A, Watt RG [21] emphasized the need to work in interdisciplinary partnership, with the underlying and mutual risk factors of chronic diseases

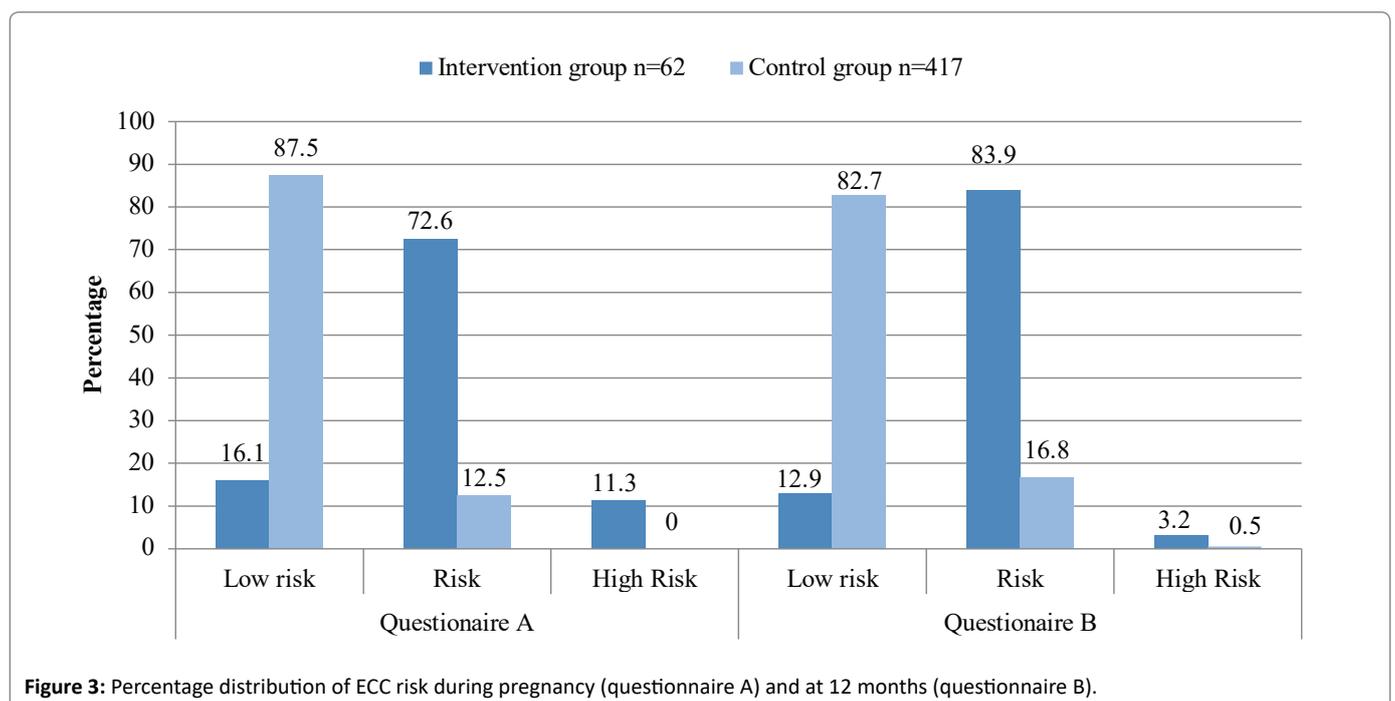


Figure 3: Percentage distribution of ECC risk during pregnancy (questionnaire A) and at 12 months (questionnaire B).

and recent research has proven this to be efficient in terms of caries prevention [22,23]. By integrating oral health into the educational level for all professions working with public health, oral health issues can be addressed by all disciplines when applicable, resulting in better-quality care and better public health in general.

In addition to the large drop-out rate in the recruitment phase, 32% discontinued participation during the ongoing program. There were probably several reasons for this, but one might have been that the mothers were not enough motivated or did not consider themselves to have the time. Another reason might have been the perceptions of the selected method for communicating, motivational interviewing, which may have been perceived as unaccustomed by the personnel, the mothers, and the interpreters who participated in the oral health promoting talks when needed.

### Demographics

Previous research has reported that demographic factors, including the parents' educational level, income, immigrant and occupational background are indicators of ECC risk in children [1,24,25]. Analyses of the demographics of the study groups showed that, in comparison to the control group, a significantly larger proportion of mothers in the intervention group lived under these circumstances, associated with a higher risk of ECC in their children. This indicates that the intervention, which was targeted at a high-risk population, reached the families that it was intended to reach; that is, those with an increased risk of developing ECC.

The questionnaire was designed to identify circumstances affecting families' risk of ECC development in their children. We found that the questionnaire identified a higher proportion of children with increased risk of ECC in areas that previous studies has pointed out as low SES areas with an increased risk of ECC. This indicates that the questionnaire might be a useful tool for early screening for ECC and a validation of the questionnaire will be performed henceforth.

Splieth CH, et al. [16] addressed the problem with non-responders to caries prevention and the fact that they more often might be the once with increased risk of caries. In present study the demographic differences between the mothers in the intervention group who chose to participate in the program and those who did not indicated that the group who did not participate had a larger proportion of mothers who were born in Sweden and had a job. It is possible that these circumstances led prospective participants to believe that the program was not about them or aimed at them. Having a job may also have prevented mothers from having the time or opportunity to attend the program. These tendencies of demographic differences may indicate that the program did not recruit only the most well-established mothers in the areas with low SES but the also the ones with increased risk of ECC, although no major conclusions can be drawn due to the low number of mothers in the sample.

### Oral health and oral health behaviors

Among the mothers in the intervention group, no major change in oral behaviors appeared between pregnancy and when the child was 12 months, but tendencies of improvement were seen in terms of regularity in dental care visits and in perceived dental health. In the control group the trends tended to be reversed. As the number of mothers participating in the program was far lower than the number required achieving statistical significance, we cannot expect to see more than trends in our results. In addition, a German study, including 706 children in the intervention group, evaluated an early interdisciplinary preventive program for ECC starting during pregnancy [23]. At the

age of four the children in the test group differed significantly from them in the control group terms of oral health behaviors in favor of the test group.

Another study [26] directed at a high risk population of parents to preschool children, reported improvement of self-reported behaviors for their children after participating in several interactive theory-based behavioral classes. The method chosen for changing parental oral behavior in this study, MI, has shown variable results in recent research. Colvara BC, et al. [27] concluded it to be more effective than conventional oral health education in reducing caries prevalence in children. Batliner TS, et al. [28] and Henshaw MM, et al. [29] reported MI was effective in improving maternal knowledge but had no effect on oral health behaviors or ECC progression. Further evaluation of this intervention in terms of caries prevalence is to be performed.

### ECC risk assessment

In the intervention group, the proportion of children considered at low risk of developing ECC remained unchanged from pregnancy to 12 months of age, but the proportion at high risk decreased. The tendency in the control group was in the opposite direction. The improvement, in reduced ECC risk, support the notion demonstrated in earlier studies, that parental education should be addressed in oral health interventions for young children [30-32].

### Conclusions

The design of this program allowed a higher proportion of expecting mothers to be reached with an oral health message during pregnancy than had previously been achieved by offering group information at the MHC. Furthermore, the intervention reached the families who were targeted; that is, those with increased risk of ECC. The questionnaire seems to be a useful tool for early ECC screening. We found trends of improved oral health behaviors and decrease in ECC risk in the intervention group.

### Declarations

#### Ethics approval and consent to participate

Subjects have given their written informed consent. The study received ethical approval from the Regional Ethical Review Board in Linköping (refs: 2012/259-31, 2018/367-32).

#### Consent for Publication

Not applicable.

#### Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

#### Author's Contributions

LR, EWG and KA initiated the project. All authors participated in the data analysis and writing the manuscript. MBR made the statistical analysis. CB and TD finalized the manuscript. All authors approved the final version.

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#### Conflicts of Interests and Sources of Funding

The authors have no conflict of interest to declare. The authors

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