# HEALTH INFORMATION FOR PREGNANT WOMEN AGAINST HEAVY LIFTING TO REDUCE RISK OF PREMATURE DELIVERY- a systematic review

Emma Kwegyir-Afful
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School of Medicine
Faculty of Health Sciences
University of Eastern Finland
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UNIVERSITY OF EASTERN FINLAND, Faculty of Health Sciences
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Instructors: Jos Verbeek, MD, PhD and Kimmo Räsänen, MD, PhD
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HEALTH INFORMATION FOR PREGNANT WOMEN AGAINST HEAVY LIFTING TO REDUCE RISK OF PREMATURE DELIVERY- A SYSTEMATIC REVIEW

Prematurity is a major cause of infant morbidity and mortality in the world and it is the number one cause of death of babies within the first 4 weeks of birth. Globally it is estimated that 15 million babies are born before their time out of which one million die of complications resulting from prematurity. Despite the advancement in medical interventions, the rate of preterm delivery keeps rising. One of the factors implicated for preterm delivery is the hazardous nature of working conditions. The objective of this review is to evaluate the effects of health education intervention against heavy lifting during pregnancy to prevent premature delivery. Reviewers sought to conduct a systematic review of existing randomized controlled trials on the subject.

Various electronic databases including Pub Med, CINAHL and Scopus were searched by two reviewers for randomized controlled trials. The trials should be comparing the outcomes in working pregnant women whose work is related to lifting heavy loads as participants that received health information as intervention and the outcomes in pregnant women who did not receive such intervention. Potentially relevant studies were assessed for their methodological quality to ascertain their appropriate inclusion but no study met the review inclusion criteria.

A total of 412 studies were pooled and they were assessed by the primary author based on the pre-specified inclusion criteria. A total of 6 studies appeared to be relevant for full text scrutiny. However, all of them were excluded because they did not meet the inclusion criteria. Although health education is a common intervention given to pregnant women to avoid heavy lifting, there is currently no evidence to support or refute its effectiveness for the prevention of premature labour. The lack of high rating evidence in the form of randomized control trial necessitates an appropriate research to justify health education against heavy lifting as a preventive measure for preterm delivery.

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To borrow the words of Sir Isaac Newton, I have been standing on the shoulders of giants to see this far and I will forever cherish each one of you and your contributions towards the successful completion of this task.

## ABBREVIATIONS

PTD – Preterm Delivery

LBW – Low Birth Weight

SGA – Small for Gestational Age

WHO – World Health Organization

FIGO - International Federation of Gynecology and Obstetrics

ILO - International Labour Organization

OHCOW - Occupational Health Clinic for Ontario Workers Inc

CINAHL- Cumulative Index to Nursing and Allied Health Literature

RCT – Randomized Controlled Trial

RevMan – Review Manager

CI - Confidence Interval

EUROPOP - European Occupational Risk and Pregnancy Outcome

EDD – Expected date of delivery

LMP – Last menstrual period

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# 1 INTRODUCTION

Among the major determinants of infant morbidity and mortality is prematurity (less than 37 weeks gestation) (WHO 2012a Facts Sheet No. 363). Within developing countries where the condition is of a major public health importance, the incidence is around 19% and between 5-7% in developed nations (Valero de Bernabe´ et al. 2004). The global estimation of preterm delivery in 2005 was 9.6% of all births, which is a total of 12.9 million, out of which 11 million was from Africa and Asia. With the exception of Mexico, Europe and North America had 0.5 million whilst 0.9 million happened in Latin America and the Caribbean. Globally, Africa and North America have the highest burden of premature births totaling about 11.9% and 10% respectively with the lowest of about 6.2% in Europe (Beck et al. 2010). According to Valero de Bernabe et al. (2004), the American Academy of Pediatrics in1935, defined prematurity as an infant with a birth weight of 2500g or less. However, the World Health Organization (WHO) in 1967 recognized the fact that, clinically, some infants reached their full gestational age but their underweight may be due to other factors rather than prematurity. Therefore, the WHO has since that time classified an infant with a birth weight of 2500g or less to be LBW where birth weight literally means the initial weight of the baby immediately after birth. Subsequent to this, WHO in 1982 accepted the international definition of LBW as contained in the Committee Annual Report and Definition of Terms in Human Reproduction of the International Federation of Gynecology and Obstetrics (FIGO). Out of the report three terms that are usually used interchangeably but not of the same meaning are explained. These include preterm LBW infants, term but LBW babies and babies born after term (post term) LBW (Valero de Bernabe´ et al. 2004).

Critical statistical estimation of preterm delivery as well as knowing the actual causes or predisposing factors both locally and internationally is of utmost importance in curbing neonatal death resulting from prematurity. About 28% of babies that die within the first 7 days of life are as a result of prematurity (Beck et al. 2010). Even though there has been some achievement globally and locally in the survival rate of about 70% of infants born between 22-26 weeks of gestation such as in Sweden (EXPRESS Group, 2009), the rate of prematurity keeps increasing. For instance in the US, from 1961 to 1985, the number of pregnant women working at the later part of their pregnancies has increased from 52% to 78% with a correspondent increase in the incidence of preterm deliveries from 8.8% in

1980 to 11% in 1996 (Mozurkewich et al. 2000). Besides, studies have shown that, prematurity has negative implications on life course health events. Indeed, it is estimated that LBW including premature infants are 40 times higher at risk of neonatal mortality as compared to those with the optimal birth weight (3.5 to 4.0kg) with degenerative disorders and other handicaps being common in survivors (Barasi 2003). Apart from the negative health implications of prematurity throughout life, the monetary cost of it is very alarming with America alone spending over 26.2 billion US dollars on medical and educational interventions in addition to the cost of productivity loss (Beck et al. 2010). The cost is as a result of extensive stay in the hospital and probably due to the elaborate nature of the care of preterm babies. For instance the average length of stay in a hospital among 3,600 infants, those with birth weight of 1,500 to 2000g was 31 days as against 5 days for those whose birth weight were 2500g or more (Rowland et al. 1995). Many factors have been attributed to premature delivery among which is excessive physical activity. Although, it is recommended that pregnant women should undertake some level of physical activity, excess can lead to adverse pregnancy outcomes such as premature delivery.

Over the years there have been several attempts at both local and international levels to ensure gender equality in employment. The International Labour Organization (ILO) which is internationally recognized body to ensure that all citizens in various countries are entitled to decent work, has come out with different strategies to make sure women are streamlined in their countries formal and informal employment sector through interventions like the ILO Action Plan for Gender Equality (ILO 2011). All these efforts mean the roles of women are dramatically changing leading to more women getting employed now as compared to previously. According to the World Bank (2001), between 1960 and 1997, the global labour force of women has increased by 126% and the International Labour Office in Geneva estimated that by 2010, women will contribute close to 42% of the world´s working population (ILO 2001). The roles of women in societies has changed dramatically as today´s woman has the highest chance or great opportunity of going to school and getting employed outside home than her mother (Mozurkewichn et al 2000). Within the last 40 years, the number of employed women has been tripled in the US from 23.2 million in 1960 to 62 million in 1996 (Mozurkewich et al. 2000). More women, including pregnant women in the employment sector means, more women been exposed to work related risks or hazards as well. Although there are country specific arrangements to allow pregnant women to go on paid maternity leave, in most instances, they have to work for some months before they begin their maternity leave.

In 2002, it was recognized by the WHO advisory group on maternal nutrition and LBW that, a reduction in work load during pregnancy appears to be a good measure for the prevention of prematurity. Long working hours and lifting of heavy loads are associated with preterm delivery (Croteau et al. 2007). There is the need to investigate social factors that can result in adverse effects on the mother and the unborn child and the interventions that can be carried out to offset these effects including giving the necessary health information to the pregnant woman. Patient education and information strategies have been shown to improve treatment outcomes (Overgaard 2009). However, their value for people with risk of adverse pregnancy outcomes is unclear even though it remains one of the important strategies utilized by health professionals. It is therefore important to evaluate which interventions are effective in supporting behavioural change that could yield to successful completion of pregnancies. Besides, results from existing studies are inconclusive as to whether the avoidance of heavy lifting during pregnancy does have positive impact on gestational age thereby justifying the need of a randomized controlled trial.

# 2 LITERATURE REVIEW

Besides the systematic search that yielded no randomized trials, there are some already known studies that claim or refute an association between heavy lifting and prematurity which are found to contain useful information and most of these studies have been the basis of legislation and guidelines in some countries like France (Simpson 1993) and the United Kingdom (Sheikh et al. 2009). However, the methods these studies do not meet the inclusion criteria of this review.

## 2.1 Systematic Reviews Showing or Refuting a Relationship between Heavy Lifting and Preterm Birth

Among the relatively high quality studies that resulted in establishing or refuting an existing causality between heavy lifting and premature delivery includes a meta-analysis conducted by Mozurkewich et al. 2000). Included in their analysis were 160,988 women from 29 studies that assessed the effects of certain work exposures including physically demanding work which was defined as "heavy and/or repetitive lifting or load carrying, manual labour, or significant physical exertion" on preterm birth as one of the outcomes of interests. A pooled estimate from 21 studies (146,457 women) resulted in an odds ratio of 1.22, 95% CI of 1.16, 1.29 indicating statistically significant association between prematurity and physically demanding work. Another review that was suggestive of a possible association between lifting and prematurity was carried out by Sheikh et al. (2009) for the Royal College of Physicians. The authors noted in a review of mainly observational studies that, there is a small risk or no significant association between lifting as an occupational exposure and preterm birth. Among 14 studies that were identified, 9 studies showed no statistically significant relation whilst 6 studies yielded mild elevated risk. The reviewers also reported that, a high quality review of seven studies had 6 studies resulting in a relative risk less than 1.15. Two other studies having a risk estimates between 1.3 and 1.49 had a confidence interval of 95% including 1 signifying no statistical significance. On the other hand, a recent review that produced a contrary results, Bonzini et al. (2007) examined the association between lifting especially during the first trimester and premature delivery using 12 studies, the association between prematurity and lifting was less positive with a relative risk below 1.5 but at the same time recommended that, given the inconclusive nature of the current evidence, caregivers must educate their clients against heavy physical workload (including lifting) especially during the 3rd trimester.

## 2.2 Prospective Studies Showing Relationship between Heavy Lifting & Preterm Birth

In Orebro-Sweden, a prospective study done by Ahlborg and colleagues (1990) investigated the effects of heavy lifting on the length of pregnancy among 3,906 women who were active in their various occupations. Women who reported lifting were compared with others who did not and the results did not show significant difference in preterm birth between the two groups. However, the risk was more common in some categories of occupations than others. Also if a woman stopped working prior to 32nd week of gestation and was exposed to lifting >12kg, 50 times in a week, odd ratio was estimated to be 1.7. In a related study, Koemeester et al. (1995) studied the effects of physical activity on gestational age among 116 qualified nurses working in 12 general hospitals in the Netherlands between August 1989 and May 1990. Questionnaires were sent to participants at 15 and 20 weeks of gestation to verify their physical activities including lifting among 8 other activities. The age of the pregnancies were calculated with ultrasound scan or last menstrual period from their prenatal records. Taking into account the duration of the exposure to high physical work load (stopping, lifting, standing, walking), they concluded that a combination of these were highly significant with the incidence of preterm birth thereby necessitating the need to reduce physical work load in the course of pregnancy. A salutary nature of the study is its prospective design which reduces the risk of recall bias and also having participants of a uniformed socioeconomic status of same occupation and they also considered potential confounders such as maternal age and health problems however, the data was subjective in nature.

Another study relevant to the issue of negative consequences of maternal heavy lifting on gestational age was a prospective cohort by Tuntiseranee et al. (1998) in southern Thailand. A sample of 1,797 women in their respective occupations was followed up during antenatal visits to 2 hospitals in the south of Thailand. The women were interviewed twice in the course of pregnancy during the 17 and 32 weeks of gestation. In the analysis, the percentage of preterm birth among the 933 women who were not exposed to heavy lifting was 4.9%, as compared to 5.8% preterm birth among 175 women whose work involved lifting less than or equal to 10kg in a day as well as 7.7% among13 women who lifted more than 11kg in a day thereby indicating significant difference.

### 2.2.1 Retrospective Studies Showing Relationship between Heavy Lifting & Preterm Birth

One of the French baseline studies was done by Mamelle et al. in 1984 within the city of Lyon, a relatively large city and Haguenau, a small town in 1977 to 1978 with a total number of 3,437 women included in the survey after delivery. Out of the total, 1,928 women were working outside home and they were assigned a fatigue score ranging 0 -5. It was observed that the rate of prematurity was high (8.3%) in occupations with highest fatigue scores such as shop keepers, unskilled staff and cleaners as compared to 2.7% among occupations with low fatigue scores such as teachers, executive staff and skilled workers and the relationship remained significant even after correcting confounders.

In testament to the above study was a French national study that was conducted by Saurel-Cubizolles and Kaminski in 1987 based on a previous data by the Institut National de la Sante et de la Recherche Medicale from a nationwide birth sampling in 1981.The main objective was to determine whether indeed strenuous physical conditions have negative impact on pregnancy outcomes like preterm and LBW. In their analysis, 39% of the 2,387 women who had worked beyond the first trimester were mainly manual workers including 21% of production workers, 12% service workers and 6% of shop assistants. The remaining 61% were professionals, teachers, clerical and managerial workers. The most common working conditions for the former group were standing, assembly line work, carrying heavy loads and physical efforts. Whilst the rate of preterm delivery was 7% among manual occupation workers, preterm rate was 3% in the other group of workers. When specific working conditions were analyzed, assembly line workers had the highest preterm rate of 8%, 6.6% in production, service and shop workers followed by heavy load carrying workers with 6.1%. One of the strengths of the study was that women who had worked only during the first trimester were excluded in order to avoid modification of the relation by "sick woman effect" however; the retrospective data collection was a weakness of the study.

A retrospective cohort design in Canada by McDonald et al. (1988) took into account 11 non-occupational confounding factors and determined the association between prematurity by gestational age and prematurity by weight and some selected maternal occupational exposures including heavy lifting (> or = 15kg per day). Results from the final analysis showed that, live preterm births to working women was 1,688 (7.4%) out of the total of

22,761 and 928 (4.1%) in both preterm and low birth weight (LBW). Out of the six sectors included in the study, lifting was consistently related to preterm birth in five sectors with the observed and expected ratio at 1.25 (P = 0.02). The incidence of preterm birth as well as lifting heavy loads were common among employees in the health services (psychiatric nurses, O/E =2.47, P < 0.01) and those in the manufacturing sector (food and beverage services, O/E = 1.29, P = 0.03). A probable pitfall of the study is the possibility of subject and observer bias during the interview however, the large sample size and similarity in results with others like Mamelle et al. (1984) makes it an important study. In relation to this, Saurel-Cubizolles et al. (1991) studied 875 women delivered of live preterm infants in 4 government owned maternity units in France between 1987-1988 through interview and some data accessed from patients' medical records after delivery. Finally they concluded that occupation rather than exposure to working conditions affect the occurrence of preterm birth. Like many other observational studies, the study is limited by recall bias.

### 2.2.2 A Case-Control Study Showing Relationship between Heavy Lifting & Preterm Birth

The policy of the US Army prohibits the reassignment of women enlisted during pregnancy therefore; a case-control design was used by Ramirez et al. (1990) to ascertain the relation between occupational physical activity and the incidence of preterm birth among first time pregnant US Army active-duty women from 1981 to 1984. After making adjustment for certain known risk factors such as race, pay grade, age, marital status, education and type of military unit, women within the heavy and very heavy physical activity levels had high odds ratio of 1.69 to 1.75 as compared to 1.0 odd ratio in low physical activity levels.

### 2.2.3 Prospective Studies Showing no Relationship between Heavy Lifting & Preterm Birth

In a prospective cohort plus nested case-control study, Pompeii and colleagues (2005) assessed the effects of repeated heavy lifting on gestational age (prematurity) by comparing the rate of preterm births among 1,908 pregnant working women who lifted >11kg more than 13 times per week, 1-12 times per week and those who did not lift at all during the first, second and the third trimesters. For the non-exposed, the relative risk was 1.0 throughout the pregnancy, women who lifted >11kg, 1-12 times a week had a relative risk of 0.8 (0.6-1.1), 0.9 (0.7-1.2) and 1.0 (0.6-1.5) respectively for the three exposure periods and for women who repeatedly lifted > 13 times per week, their relative risk was 1.3 (0.9-1.8), 1.3 (0.8-2.1) and 1.3 (0.6-2.9) respectively during the 3 trimesters. In effect, regardless of the exposure periods and the frequency of lifting, there was no significant association between heavy lifting and preterm birth. Even though the result can be subject to recall bias given the length of time between delivery and data collection (within one year after delivery) through mailed questionnaire.

In the Netherlands, Snijder and colleagues (2012) did a population-based prospective cohort study. Using the Dutch Musculoskeletal Questionnaire, information on the physical workload of 4,608 pregnant women was obtained with a 77% response rate. In the final analysis, they concluded that the association between prematurity and physical workload was not consistent. Strengths of this study were lack of recall bias due to the prospective data collection, adjusting for potential confounders such as ethnicity, maternal age, parity, educational level, folic acid, alcohol and cigarette use during pregnancy. However, selecting women in paid employment who are likely to be wealthier and healthier with less participation from ethnic minorities with poor socioeconomic status was a limitation to the study. Again, failure to account for other sources of physical activities besides occupational activities such as activities at home can limit the results of the study. In a related study, Hartikainen-Sorri and Sorri (1989) compared 284 women who delivered prematurely with some controls in Oulu, Finland and concluded that, women in paid employment were not exposed to risk of preterm labour.

A common phenomenon identified in all the existing observational studies is the lack of consistency in the definition of the independent variable (lifting). The summary of exposure to lifting as used by the various authors can be found on the table from the next page.

### 2.2.4 Table 1: Summary of how various authors described the exposure to lifting.

| Author | Study design | Subjects | Weight lifted (in kilos) | How often | Form of data collection | Outcome |
|---|---|---|---|---|---|---|
| **Ahlborg et al. 1990** | Prospective cohort | 3,906 | >12 | 50 times per week | Self reported | Lifting was associated with preterm birth |
| **Koemeester et al.1995** | Prospective cohort | 116 | Not specified | 0-8 hours per day | Self reported | Heavy workload is associated with preterm delivery |
| **Tuntiseranee et al. 1998** | Prospective cohort | 1,797 | < or = 10 & >11 | Daily | Self reported | Heavy lifting is associated with preterm birth |
| **Mamelle et al.1984** | Retrospective cohort | 3,437 | Not specified | Not specified | Self reported | High fatigue score is associated with preterm birth |
| **Saurel-Cubizolles and Kaminski 1987** | Retrospective cohort (National sample) | 2,387 | Not specified | Yes/No | Self reported | Lifting is associated with preterm (gestation less than 37 weeks) |
| **McDonald et al.1988** | Retrospective cohort | 22,761 | >or =15 | Once a day | Self reported (Interview) | Preterm (less than 37 weeks gestation**)** & LBW |
| **Saurel-Cubizolles et al. 1991** | Retrospective survey | 875 | Not specified | Not exposed, sometimes, often or always | Self reported & medical records | Lifting in some occupation negatively affect preterm incidence |
| **Ramirez et al.1990** | Case-control | 22,450 | 9-45 | Occasional - < 20% of the time Frequent | Hospital registers | Association between heavy physical activity and |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | - > 20% but < 80% of the time Constant - > 80% of the time | | preterm ( Gestation less than 37 weeks) |
| **Pompeii and colleagues 2005** | Prospective cohort with nested case-control | 1,908 | 11 | >or = 13 times per week, 1-12 times per week and none. | Self reported (telephone interview) | No association between repeated lifting and preterm delivery |
| **Snijder and colleagues 2012** | Population-based Prospective cohort | 4,608 | >25 | Occasionally or often | Self reported (questionnaire) | No association between lifting and prematurity |

### 2.2.5 Aim of Review

The review is aimed at gathering all available information about the effectiveness of health education to off-set the consequences of heavy lifting during pregnancy in relation to preterm delivery in a concise form. The results of this review will have the potential to assist and give the needed assurance to caregivers to offer evidence-based care and women alike in making decisions about the management of pregnancies to reduce preterm birth.

**Hypothesis:**

Increase in knowledge on the part of a working pregnant woman to avoid heavy lifting may have positive impact on pregnancy outcomes especially by preventing preterm births.

# 3 METHODS

## 3.1 CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

**Types of studies & Participants**

We included randomized controlled trials without language restriction comparing the outcomes in working pregnant women that received health information/education as intervention and the outcomes in pregnant women who did not receive such intervention.

The review includes studies having women of childbearing age with a confirmed pregnancy of less than 37 weeks, not in labour and whose work is related to lifting heavy loads as participants.

**Types of intervention & Outcome Measures**

Routine health education or information given before the 37 weeks of gestation by health professionals aimed at the reduction or avoidance of heavy lifting. For the purposes of this review, health education or information as defined by the WHO would be used, that is, "any combination of learning experiences designed to help individuals and communities to improve their health, by increasing their knowledge or influencing their attitudes". The content of the intervention will include explaining the meaning of heavy lifting, the possible risks associated with lifting heavy loads during pregnancy, encouraging them to avoid lifting, and which measures are available to avoid lifting. Provision of the education will be done using various tools including written and electronic resources and telephone support. In order to change the thinking and behaviour of the clients, theoretical basis such as cognitive behavioural therapy in which identification and solution of the problem would be done together with clients. The health education will be based on assessment of the women's working conditions.

The initial plan was to include studies that collect outcome measures relating to the baby in terms of gestational age as a result of the intervention.

Primary outcome is prematurity, which is defined as delivery of a baby before the 37 completed weeks of gestation.

Secondary outcome is exposure to lifting task and being on light duty.

## 3.2 SEARCH METHODS FOR IDENTIFICATION OF STUDIES

A search was conducted for studies published in different languages that studied prematurity as a primary outcome. The databases that were searched are Pub Med, Scopus and Cumulative Index to Nursing and Allied Health Literature (CINAHL) up to 28 June 2012. The main concepts or terms used for the search or a combination of them using the Boolean method were, 'premature' , 'preterm', 'lifting', 'RCTs', 'physical activity', 'motor activity', 'pregnancy', 'parturition', and 'childbirth'. Reference lists of relevant studies identified by search were assessed to see if they meet the eligibility criteria. We also searched cited references from retrieved articles and reviewed abstracts but none of the retrieved articles met the inclusion criteria.

### 3.2.1 Electronic searches

The under listed electronic databases were searched:

- Pub Med – accessed on 8 June 2012 and secondly on 18 June 2012
- CINAHL - accessed on 8 June 2012
- Scopus - accessed on 28 June 2012

**Table 2:** PubMed search strategy.

History — Clear history

| Search | Add to builder | Query | Items found | Time |
|---|---|---|---|---|
| #17 | Add | Search ("Motor Activity"[Mesh]) AND #13 AND prematur* Filters: Humans; Randomized Controlled Trial | 3 | 01:55:50 |
| #16 | Add | Search ("Motor Activity"[Mesh]) AND #13 AND prematur* Filters: Humans | 94 | 01:55:18 |
| #15 | Add | Search ("Motor Activity"[Mesh]) AND #13 AND prematur* | 107 | 01:55:09 |
| #14 | Add | Search ("Motor Activity"[Mesh]) AND #13 | 3678 | 01:54:06 |
| #13 | Add | Search "Pregnancy"[Mesh] | 663737 | 01:53:46 |
| #4 | Add | Search (physical activity) AND (prematurity OR premature) AND (childbirth OR pregnancy OR parturition) | 212 | 01:48:06 |
| #2 | Add | Search lifting AND prematu* AND childbirth | 1 | 01:44:54 |
| #1 | Add | Search lifting AND prematu* | 41 | 01:43:29 |

### Searching other resources

Reference lists of relevant studies identified by search were assessed to see if they meet the eligibility criteria. There was also a search through cited references from retrieved articles and reviewed abstracts but none of the articles met the inclusion criteria.

## 3.3 DATA COLLECTION AND ANALYSIS - Selection of studies

Potentially relevant studies were to be assessed to ascertain their appropriate inclusion against pre-specified criteria in duplicate. In case of a disagreement a third person was to be consulted however, this did not happen as no study met our inclusion criteria.

## 3.4 DATA EXTRACTION AND MANAGEMENT

The plan was to extract data in duplicate on standardized pre-developed forms in case of more than one study being included and if the studies were found homogenous, the plan was to carry out a random effect meta-analysis using RevMan 5 (Review Manager 2011). No data was extracted as none of the identified articles met the pre-specified inclusion criteria.

## 3.5 ASSESSMENT OF RISK OF BIAS IN INCLUDED STUDIES

The intention was to use the Cochrane risk of bias tool (Higgins & Green, 2011) to assess the risk of bias and adapting it to the review question. It was not feasible to carry out assessment of the possibility of risk of bias because none of the articles retrieved was included in the review due to their failure of meeting the inclusion criteria.

## 3.6 MEASURES OF TREATMENT EFFECT

The plan was to calculate risk ratios (RRs) with 95% confidence intervals (CI) for dichotomous data and standardized mean difference (SMD) for continuous outcomes.

## 3.7 DEALING WITH MISSING DATA

There was an intention to present the results of the studies individually using an available case analysis. There was an intention to conduct a best and worst case scenario to explore the effect of any missing data (losses to follow-up) on the results for the only reported primary outcome but this was not possible due to the fact that, no article was included in the study.

## 3.8 ASSESSMENT OF HETEROGENEITY& REPORTING BIASES

The plan to assess heterogeneity by comparing patient and trial characteristics was not feasible because no study met the pre-specified criteria.

The statistical assessment of potential publication bias could not be done. The intention was to carry out assessment of small study bias and publication bias by observing Funnel Plot asymmetry (Cochrane Handbook for Systematic Review, 2011) if more than 10 studies were included.

## 3.9 DATA SYNTHESIS

Data analysis was to be conducted using the Cochrane Review Manager software (RevMan 2011) but because there was no study, there was no data synthesis.

## 3.10 SUBGROUP AND INVESTIGATION OF HETEROGENEITY

Subgroup analysis was to be performed, with subgroups defined by the frequency and the amount of lifting heavy weight (0 - 5kg, 6 - 10kg and more than 10kg once a day, 3 times a day or more than 4 times in a day) and intensity of health education/information as well as the gestational period.

### Sensitivity analysis

The methodological quality of included studies was to be used in the sensitivity analysis to test the assumption that low quality studies produce bigger effect levels.

# 4 RESULTS

## 4.1 RESULTS OF THE SEARCH

Three searches were done independently by two authors resulting in the retrieval of 412 abstracts from the Pub Med, CINAHL and the Scopus databases. Out of the 412 were a total of 229 abstracts retrieved from the Scopus database. Two different searches done in the Pub Med database resulted in 179 articles and 4 studies from the CINAHL database. One author then screened all abstracts identified through the search strategies for potentially eligible studies by reading all the retrieved abstracts without duplication. During the reading, abstracts that appeared relevant by having women working during pregnancy as subjects were highlighted red by using the titles and abstracts of the identified studies to exclude trials that clearly did not meet the inclusion criteria. In total 6 citations were found relevant for their full text to be obtained. 4 from Scopus search, one (1) from the CINAHL and one (1) from the Pub Med database. We independently assessed the full text of 4 articles of these potentially relevant studies using a pre-specified review inclusion criteria based on the study design features, type of participants, and features of interventions and controls. However, the full text of 2 articles could not be obtained. After reading the 4 articles, all of them were excluded because they did not meet the inclusion criteria.  Thus, a search through Pub Med, Scopus and CINAHL did not yield any relevant study for the review. The PRISMA diagram illustrating the search process can be found on the next page.

## 4.2 INCLUDED STUDIES & EXCLUDED STUDIES

No study was included.

Six relevant studies were excluded after their full text assessment. The studies along with reasons for exclusion are presented in table of characteristics of excluded studies on page 40 (Appendix 1).

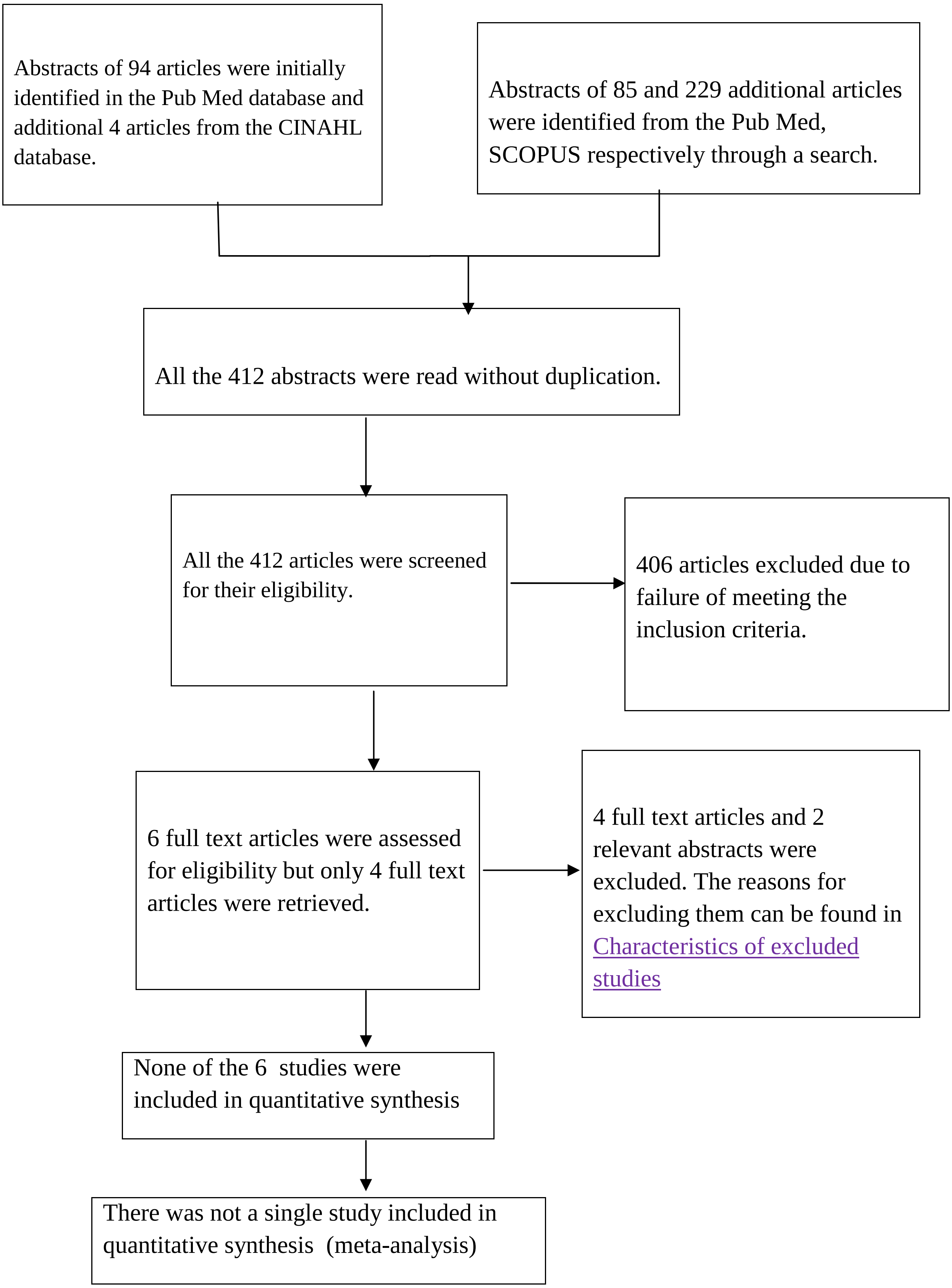


**Figure 1:** PRISMA diagram illustrating searched studies in the review.

## 4.3 RISK OF BIAS IN INCLUDED STUDIES

The assessment o f the risk of bias could not be applied as there was no study identified.

## 4.5 EFFECTS OF INTERVENTIONS

There was no randomized controlled trial that used health education against heavy lifting to prevent premature delivery

# 5 DISCUSSION

Our hypothesis was that increase in knowledge on the part of a pregnant woman may have positive impact on pregnancy outcomes especially by preventing preterm births among working pregnant women. This could not be proven right or wrong due to the fact that there was no study that met the pre-specified inclusion criteria. We did not find a randomized controlled trial that evaluated the differences in the pregnancy outcomes between pregnant working women who received health education to avoid heavy lifting and those who did not receive such intervention. We strictly went in for randomized controlled trial because of its quality in terms of study design (Evans 2002) as rigorous procedures are carried out to establish the cause and effect relationship between an outcome and intervention being it preventive or therapeutic. Possible explanations for the absence of such high quality studies to support practice include the following:

1. Generally, there is lack of evaluation of specific health educational interventions carried out during the antenatal period. In the case of heavy lifting during pregnancy which is found to be common among women in developing countries, health educational interventions against this presumed hazard is barely not evaluated to ascertain their usefulness or otherwise.

2. Financial ability is a major pushing or drawback factor in every research. A substantial amount of money is required to conduct a high quality study on a large scale to yield quality results. Within developing countries where strenuous physical activity and premature birth are common occurrences (Stacy et al. 2010), finances to conduct research is always a challenge as evidenced by the 10/90 Gap which indicates that only 10% of the global resources are earmarked for health research addressing 90% of global disease burden (WHO 2004).

3. Ethical considerations can also be a limiting factor. Human lives are involved and there may be the likelihood of ethical issues as to who should be advised to avoid heavy lifting and who should not be given considering the current uncertainty about the evidence that lifting during pregnancy can be harmful and therefore the need to apply all precautionary measures, (Mozurkewich et al. 2000).

4. Again, a high quality randomized controlled trial will require that participants should be recruited from the first trimester to determine the consequences of exposure to physically demanding work at the 3 different trimesters however, the chances of attrition can be high due to length of the study

5. In developed countries where health research are mostly undertaken, there are stringent enforcement of legislation on maternity leave that protect pregnant women and therefore researchers do not have enough motivation to carry out such studies.

Till date, the few existing systematic review on the subject matter have given conflicting results. For instance, in 2000 Mozurkewich carried out a meta-analysis that indicated that there is significant relationship between physically demanding work and prematurity. Similar result was achieved by The Royal College of Physicians (Sheikh et al. 2009). A systematic review done by the College established a statistically significant relationship between lifting and prematurity. In contrast to the above two studies, in 2007 Bonzini carried out a review that showed a less positive relationship between preterm birth and lifting.

Among the 6 citations that appeared relevant for their full text scrutiny was a Cochrane systematic review by Sosa and colleagues (2010).The reviewers sought to investigate the effects of bed rest in hospital or at home as a preventive measure of preterm birth versus no intervention among high risk singleton pregnant women. Their search for published, ongoing and unpublished randomized controlled trial retrieved a lone trial that met the inclusion criteria. The only included study sought to prospectively assess the benefits of preventive education in addition to frequent antenatal visits as compared with placebo in the prevention of preterm delivery. Although bed rest was a secondary objective, combining it with either health education and frequent antenatal visit did show added benefit of preterm rate of 7.4% within the intervention group as against 9.1% in the control group. The importance of this review to our current review was the use of bed rest as an intervention which is an extreme form of restricting physical activities like heavy lifting during pregnancy to prevent preterm birth. However, recruiting only English and Spanish speaking women can affect the generalization of the results of the only included study in the review to women who do not find themselves in that category. Again, failure to control confounders such as parity, gravidity, and educational status affects the quality of the results. Based on these limitations and lack of reporting, suggestions by the reviewers support our call for an appropriate study on the subject matter. Besides it being a review, other reasons for excluding it from the current review include their consideration of only high risk pregnant women as against our working pregnant women. Their intervention was bed rest whilst ours was health education.

Contradicting the deleterious effects of strenuous physical activities on gestational age as anticipated by Sosa and colleagues was a retrospective cohort study carried out in Berlin as part of the European Occupational Risk and Pregnancy Outcome (EUROPOP) project. Seven hundred and seven (707) mothers were interviewed soon after delivery by Henrich and colleagues (2003). The aim was to ascertain whether working during pregnancy is a risk factor for premature birth. From the analysis, the researchers concluded that there were no difference between those whose occupation were sedentary and the physically active in terms of premature birth. Based on their result, they concluded that, further research may not be needed in an environment where there are enough laws to protect women. However, the results also showed that premature rupture of membranes was 30% among pregnant working women as compared with 23% in mothers who were not working which is a justification that, the causes must be investigated further. Given that a ruptured membrane exposes both mother and the unborn child to ascending and genital tract infections which are known predisposing factors to premature birth. Again, the number of participants whose job was physically demanding used in the final analysis was not enough to make conclusive statement on the subject. Besides, the retrospective and subjective nature of data collection can affect the results due to possible recall bias and this emphasizes the need for a randomized trial as basis for evidence A promising feature of this study for the current review is that, where there are appropriate laws to protect pregnant women and where there is implementation of antenatal leave system, the probability of carrying pregnancies to term is high. Improved working environment and advancement in technology as in Germany may not be the same in developing countries. This gives credence to the call for an ideal study within a less advanced setting as evidence to convince policy makers to adopt protective measures. The study was excluded due to its methodological quality.

In support of Henrich and colleagues, the causal link between prematurity and physical activity was shown to be poor by a literature review conducted by Domingues and colleagues (2009). Their focus was to ascertain the relation between preterm birth and 3 categories of activities including occupational activity, leisure-time activity and all-domain physical activity or a combination of them. Of the 47 articles that were reviewed, 41 were about the relationship between exposure to various occupational physical activities and preterm birth. Six of the articles assessed effects of lifting different weights at various frequencies with contrasting results as to whether lifting during different stages of pregnancy influences prematurity. Based on the results, the inference drawn by the researchers was that lifting does not relate to prematurity. As a result, they suggested that systematically taking pregnant women from physical activity to reduce the risk of preterm birth may not be necessary. However, overly relying on their results can be dangerous looking at the limitations of the reviewed studies. The results of the studies have the tendency to be affected by the different definitions assigned to the exposure variables by the various authors. In addition, many confounders were not adjusted for in majority of the reviewed studies thereby limiting their applicability. In effect, conducting an ideal study will help clear the uncertainties hovering around the subject matter. This literature review was not included in the review due to the aforementioned methodological defects.

In a related study, Simpson (1993) examined the causal relationship between physical activity and preterm birth with the result somehow conflicting that of Domingues and colleagues. The author speculates that there is an unknown basis for preterm birth that is yet to come to light given the numerous approaches geared towards its prevention without much improvement. Simpson sought to investigate whether a reduced physical activity during pregnancy correlate with preterm birth. He did so by conducting a review of published case-control and cohort studies. In the end, some studies showed either negative or positive relationship between preterm birth and strenuous physical activities. Most of the studies indicated a correlation between strenuous physical activity and prematurity. Salient among them is one of the French baseline studies by Mamelle and colleagues in 1984 which has been the bedrock for maternity leave legislature in France (Simpson 1993). That notwithstanding, the author believes that due to the inconclusive results from epidemiological studies, the implementation of maternity leave is baseless and premature. The study was excluded because the method did not meet the inclusion criteria.

Occupational physical exertion has been implicated as a risk for preterm birth. A case control study by Agbla (2006) indicates that, occupational exposure to strenuous physical activities especially lifting heavy load have negative impact on gestational age. Retrospective data collection through interview and review of birth records were done after which the analysis indicated lifting heavy load more than 5 times in a week, was profoundly associated with preterm birth. The adjusted odds ratio was 5.0 with CI of 1.38-18.8 and a P value of 0.018. The importance of this study to the current review was the setting within which it was carried out. The Republic of Benin is a developing country with a probability of lack of laws protecting women in general and pregnant women in particular in various occupations. As compared to the utilization of advanced technology at work in Germany (Henrich 2003), pregnant employees in Benin and their unborn babies are most likely to be exposed to occupational hazards because physical labour is common. Even though adjustment were made for potential confounders such as maternal education, age and health status, the application of the results can be limited by the retrospective nature of data collection. This justifies the need to carry out an ideal study within a seemingly "unprotected environment" to inform policy. The full text could not be assessed and a request sent to the author has not yet been responded to. The study was however excluded due to its design which was clear from the abstract.

One of the excluded studies (Biernacka et al. 2007) reports a significant relationship between physical stress and preterm birth. By the use of a standardized questionnaire, data was gathered from women who delivered1st January 1999 to 30th June 2000 concerning psychosocial features of employment. Participants evaluated the stressful nature of their work on a 1-5 point scale after which it was realized that, preterm birth was common among mothers whose occupational stress scores were above 50 points. Significance of this study is that," insufficient equipment for the work performed" (Biernacka et al. 2007) was one of the sources of stress to the participants. By inference, unavailability of working equipment predisposes workers to undertake all occupational activities including lifting loads manually. Similar to many other epidemiological studies, the result of the study is likely to be limited by recall and subject biases. The study was excluded from the current review because it was not a randomized study.

Even though these and many other epidemiological studies exist but they provide a weak evidence for a causal role of lifting in the occurrence of premature delivery. Besides, there are discrepancies in the results of various studies (Simpson 1993) which can be attributed to the inability or failure on the part of researchers to control all known risk factors of preterm birth that have the potential to confound the outcome of the various studies. Again, there is also a possibility that explanations to other factors that are influential within the causal pathways have not yet been verified by science. Other factors like the mental state of the pregnant woman can be a contributory factor to preterm birth as suggested by Mamelle and colleagues (1984) as a component of occupational fatigue index in their study.

## 5.1 SUMMARY OF MAIN RESULTS

The role of health education against heavy lifting in the prevention of preterm labour is unknown.

## 5.2 OVERALL COMPLETENESS AND APPLICABILITY OF EVIDENCE

There was no randomized study that currently seeks to evaluate the effectiveness of health education against heavy lifting for the prevention of preterm birth. Thus, this current review does not show the effectiveness of the intervention.

## 5.3 POTENTIAL BIASES IN THE REVIEW PROCESS

In order to avoid bias in this review, there was no language restriction in the search for studies. However, in the end, no study met the pre-specify inclusion criteria.

## 5.4 AGREEMENTS AND DISAGREEMENTS WITH OTHER STUDIES OR REVIEWS

There was no study that met the inclusion criteria set for this current review thereby making it difficult to ascertain the review’s agreement or disagreement with other reviews

# 6 CONCLUSION

## 6.1 IMPLICATION FOR PRACTICE

Although health education is a common intervention carried out to improve patients' outcome and for the prevention of unwanted occurrence such as prematurity (Overgaard 2009, Sosa et al. 2010), there is currently no evidence to support or refute this practice. Due to the above described inconclusive nature and the methodological weaknesses of available studies, caregivers can discuss the possible effects of heavy lifting on preterm birth with clients to enable them to decide what option to take. In the unlikely event that a client may opt for lifting during pregnancy, the client must be aware of the possible hazards.

## 6.2 IMPLICATION FOR RESEARCH

The extant data about working conditions and adverse pregnancy outcomes have resulted from observational studies. Observational studies are susceptible to limitations in inferring causality. For lifting and premature birth, particular limitations of studies are the invalid measurement of exposure which might have lead to non-differential misclassification. It can be argued that this usually leads to an underestimation of the relation between exposure and outcome. Then there are a few observational intervention studies. However, non-randomized studies do not ensure equal distribution of potential confounding or prognostic factors among study participants. (Evans 2002, Evidence-Based Nursing 2006). As a result, differences observed between treatment and control group cannot be solely attributed to the intervention. In addition, there are no randomized studies to the best of our knowledge that evaluated the effectiveness of health education as an intervention against heavy lifting during pregnancy for the prevention of premature birth. Also other researchers have found that most antenatal interventions are not evaluated (Sosa et al. 2010). Therefore, there is a need for a randomized controlled trial to evaluate the effects of the intervention to prevent heavy lifting during pregnancy. An RCT will provide both evidence concerning the effectiveness of the intervention and will allow making inferences about the causal influence of lifting on prematurity (Evans 2002).

The hypothesis for the ideal future study is that, there would be a reduction in the incidence of preterm birth among pregnant women who receive health education to avoid heavy lifting. The study should be a prospective two arm randomized trial that is parallel and pragmatic to ascertain the effectiveness of the intervention. Looking at the global trends of premature birth, our suggestion is that, the appropriate trial must be multi-centered within Asia and Africa which have the highest concentration of preterm birth of 54% and 31% respectively in the world (Stacy et al. 2010). Recruitment of participants (pregnant working women) can be done with the assistance of staff of ante-natal clinics. Eligibility criteria for participants would be: women pregnant not longer than 12 weeks who are exposed to lifting heavy loads daily either at home or at work. Heavy loads are defined as more than 10 kilos at least ten times per day.

Eligible participants must be assigned to either experimental or control group at different antenatal clinics using appropriate randomization method. Proper randomization will generate two groups that are equal in known and unknown extraneous variables with the exception of the intervention. However, it will be difficult to realize randomization at the individual level in developing countries. It will also be difficult to prevent contamination of the control group with the treatment of the intervention group when they are both attending the same clinic. Therefore, we propose randomization of antenatal clinics with their patients to either the intervention or the control group in a cluster randomized design.

Sufficiently varied intensity of health education intervention should be given to the treatment group during ante-natal sessions and the contents focusing on the meaning of heavy lifting, the possible implications of heavy lifting during pregnancy, encouraging them to avoid lifting, and which measures are available to avoid lifting. The intervention should be elaborated further to ensure that this advice can also be implemented into practice. Examples are seeking the assistance of extended family members in the performance of strenuous house chores and reassignment at the workplace among others. On the other hand, the control group should receive routine health education during their ante-natal sessions. It is important to monitor the level of exposure to heavy lifting in the intervention and the control group to be able to show that the intervention has indeed led to a decrease in exposure to heavy lifting in the intervention group. To this end, the measurement of exposure should be further elaborated.

For the outcome, the future study should measure the length of pregnancy according to the 4 subgroups of gestational age described by Goldenberg et al. (2008). Births that occur less than the 28 weeks of gestation (extreme prematurity), between 28-31 weeks (severe prematurity), between 32-33 weeks (moderate prematurity) and 34-36 weeks (near term). The measurement of the gestational age should preferably be based on methods such as calculation of the expected date of delivery (EDD) by using the woman's last menstrual period (LMP), abdominal examination and ultra-sonography which are all feasible in developing countries.

The effect of the intervention can then be measured as the mean difference in the length of pregnancy in days among mothers in the intervention group compared to those in the control group. The resultant mean difference of gestational age between the two arms will then determine the advantageous effects or otherwise of the intervention for the intervention group over the control group. The effect should be adjusted for the clustering effect of the ante-natal clinics. When the exposure to lifting is measured appropriately, it can be measured if the intervention effect varies with the level of exposure. This would be an additional argument for the causal effect of lifting on prematurity.

The sample size of the trial should be large enough to be able to find a relevant difference of two weeks.

We anticipate that getting stronger evidence to inform recommendation and policy direction is essential. Taking into account the fact that reassigning an employee or providing a paid maternity leave will negatively affect productivity, employers must be convinced as to why they need to grant their pregnant employees these benefits.

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**APPENDICES**

**APPENDIX 1:** Characteristics of Excluded Studies

| Study | Study design | Outcome | Reasons for exclusion |
|---|---|---|---|
| **Sosa 2010** | Systematic review | Preterm birth | The main objective of the reviewers was to compare the effectiveness of bed rest with no intervention in the prevention of preterm birth among high risk women. |
| **Domingue 2009** | Literature review | Preterm birth | The objective was to do a literature review of studies between 1987 to 2007 to investigate the relationship between physical activity and preterm delivery. Particular emphasis was to identify the contrast between the physiology of leisure time and occupational activities. |
| **Simpson 1993** | Literature review | Preterm delivery<br>Low birth weight | The focus of the study was to review studies that assessed the influence of modifying physical activity to reduce prematurity and low birth weight. |
| **Henrich 2003** | Retrospective cohort | Preterm birth | A retrospective study that investigated the effects that both the physical and psychological factors of occupation have on the probability of preterm birth. |
| **Agbla 2006** | Case-control | Preterm labour | Although the full text could not be assessed, the abstract indicates a case-control study that sought to determine the relationship between maternal physical exertion and preterm birth. |
| **Biernacka 2007** | Retrospective cohort | Preterm delivery | Abstract of the study was about a retrospective study to find out the implications of occupational psychosocial factors on pregnancy outcome (preterm delivery) among women who stopped working after the 22nd week of gestation. However, the full text could not be assessed |