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## Low Back Pain and Associated Factors among Obstetrics Care providers in Public Hospitals of Amhara Regional State, Ethiopia: A Cross-sectional Study

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## Abstract

**Objectives:** Although the study of low back pain among health care workers in Ethiopia is becoming common, it mainly focused on nurses leaving obstetrics care providers aside. This study aimed to assess the prevalence and associated factors of LBP among obstetrics care providers in public hospitals in Amhara Regional State, Ethiopia.

**Design:** An institution-based cross-sectional study.

**Settings:** nine public hospitals in Amhara Region.

**Participants:** Randomly selected 416 obstetrics care providers working in public hospitals of Amhara Region, Ethiopia.

**Outcomes:** The prevalence of low back pain and its associated factors were investigated.

**Results:** Overall, the prevalence of low back pain was 65.6% (95%CI: 61.5%-70.2%) among obstetrics care providers in the last 12 months. Being female [AOR: 2.33, 95%CI: 1.344-4.038], didn't have regular physical exercise habits [AOR: 8.26, 95%CI: 4.36- 15.66], job stress [AOR: 2.21, 95%CI: 1.24-3.92], standing longer while doing procedures [AOR: 2.04 95%CI: 1.14-3.66], and working more than 40 hours a week [AOR 2.20, 95%CI: 1.09-4.45] were significantly associated with lower back pain.

**Conclusion:** About two-thirds of obstetrics care providers working in public hospitals in the Amhara region were suffering from low back pain. The prevalence of low back pain was higher among those who didn't have regular physical exercise habits, had job stress, stand longer than one hour while doing procedures, worked more than 40 hours a week, and female obstetrics care providers. Providing resting periods, decreasing the working hours of obstetrics care providers in a week, and counseling the importance of doing regular physical exercise helps to reduce the prevalence of LBP.

**Keywords:** low back pain, obstetrics care providers, public hospitals, Ethiopia

## Strengths and limitation of the study

- To our knowledge this is the first study on obstetrics care providers in Ethiopia
- This is a multicenter study.
- Since the information on the experience of LBP for the last 12 months is highly depends on the participants' memory, there might be under or overestimation due to recall bias.

## Introduction

Currently, musculoskeletal disorders have become one of the main issues in health care workers. They are the second most cause of physical disability worldwide[1, 2]. Of musculoskeletal disorders, Low Back Pain(LBP) is the most disabling cause and widespread in the workplaces [1]. LBP refers to pain or discomfort in the spinal area localized between the 12<sup>th</sup> rib and the inferior gluteal folds with or without radiation to the lower extremities[3]. It's categorized as mild, moderate, and severe based on visual analog scale measurement ranges from 0 to 10 and experienced as aching, stabbing, sharp or dull, specified [3].

Given the rapid transition to the industrialized world, LBP inflicts a significant economic burden on health care resources, lost working days, loss of productivity, and increased disability[4, 5]. LBP cause 10.7% of total years lost due to disability. And work-related LBP causes 818,000 disability-adjusted life years lost[6, 7]. In addition, LBP results abstain from work, functional limitation, and shortage of staff among obstetrics care providers. A study in Australian midwives reported that annual sick leave prevalence rate of 24% and functional incapacity (unable to continue working activities) were 59% due to LBP [8]

The overall prevalence of LBP was 24% among populations and 58% among health care workers worldwide [9]. LBP is the most prevalent musculoskeletal disorder (MSD) that affects 70%-85% of the adult population at some point in their lifetime[10]. In the low and middle-income countries, 80% of the population experienced LBP at some period during their lifetime [11]. Musculoskeletal disorders are a significant health problem at work among obstetrics care providers. Among 729 midwives with musculoskeletal disorders in

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3 Australia, 61% had LBP[8]. The United Kingdom reported that the prevalence of LBP  
4 among midwives was 70%[12].  
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Obstetrics care providers give care for women during pregnancy, childbirth, and after birth [13]. Obstetrics care providers transfer women frequently and keep sustained periods of stooping. They also work in an awkward posture, bending, and trunk flexion, while giving care during labor [14]. Due to these extreme postures or positions and heavy workload during the childbirth process, obstetrics care providers are subject to physical constraints leading to LBP[14, 15]. Work-related factors (pulling, pushing, and working in extreme positions to handle patients: women and baby at the same time), psychological factors (job stress), and organizational factors (lack of improved equipment support) reported as factors leading to LBP of obstetrics care providers [14, 16, 17].

To date, all studies in Ethiopia[18-21] and several studies around the globe [22-25] about LBP on health care workers focus mainly on nurses, while others on physicians [26, 27]. Given the variations in practice and environment within health care professionals[28], such studies failed to include the perspectives of obstetrics care providers. Therefore, the objective of this study was to assess the prevalence and associated factors of LBP among obstetrics care providers in public hospitals in Amhara Regional State, Ethiopia.

## Methods

### Study design and settings

An institution-based cross-sectional study design was conducted from January 2 to February 15, 2021. The study was conducted in nine public hospitals of Amhara Regional State, Ethiopia: Debre Birhan, Felegehiwot, Tibebe Ghion, Debre Markos, Gondar, Dessie and Injibara, Debre Tabor, and Woldiya Hospitals. Amhara regional state is one of the ten regional states of Ethiopia. Its capital city is Bahir Dar, which is 551km from the capital city of Ethiopia.

### Participants

The source populations were obstetrics care providers who are working in public hospitals of the Amhara region. The study populations were obstetrics care providers available in selected public hospitals in the Amhara region during the study period. Obstetrics cares

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3 providers of the selected public hospitals, except those who were pregnant and gave birth in  
4 the last 12 months, participated in the study.

### 6 **Sample Size and Sampling technique**

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9 A single population proportion formula with the assumptions of a 95% of confidence  
10 interval, a 5% margin of error, and a 50% proportion of LPB, was used to calculate the  
11 sample size. By adding a 10% non-response rate, the final sample size became 422. There  
12 were 815 obstetrics care providers in selected hospitals. The individual samples were  
13 allocated proportionally to each hospital. Lists of obstetrics care providers were obtained  
14 from the human resource department of each hospital and used as a sampling frame. Then,  
15 individual samples were selected using a computer-assisted random generator.

### 22 **Data collection tool and procedure**

23  
24 Self-administered a pre-tested structured questionnaire adapted from Standard Nordic  
25 Musculoskeletal Questionnaire used for this study [29]. The questionnaire was consists of  
26 socio-demographic characteristics, low back pain-related questions, organizational factors,  
27 work-related factors, and personal and psychosocial factors. Data were collected through  
28 self-administered technique by giving the questionnaires to the study participants to fill and  
29 return on the next day. The training was given for data collectors and supervisors on study  
30 tools and data collection approaches. Filled questionnaires were checked for consistencies  
31 and completeness, and corrections were made accordingly.

### 39 **Data measurement and study variables**

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41 **Low back pain:** any pain felt in the low back region for at least one day in the last twelve  
42 months [18, 21].

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44 **Mild LBP:**-pain intensity on visual analogue scale scores 1-3 [18].

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46 **Moderate LBP:**- pain intensity on visual analogue scale scores 4-6[18].

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48 **Severe LBP:**- pain intensity on visual analogue scale scores 7-10 [18].

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51 **Job stress:** An obstetrics care provider who scores the workplace stress scale of 21 or above  
52 [30].



## Data management and analysis

Data were cleaned and entered into EpiData 3.1, and exported it to SPSS 25 for analysis. Frequency tables and mean were used to describe the characteristics of the study participants for categorical and continuous variables, respectively. Bivariate analysis was computed to identify potential variables for multivariable logistic regression model. Variables with  $p$ -value of  $\leq 0.25$  in the bivariate analysis were considered for the multivariable logistic regression model. Both crude odds ratio and adjusted-odds ratio with 95% confidence intervals (CI) were calculated to measure the strength of association. Multivariable logistic regression analysis was done, to control the possible effects of confounders. Model goodness of fitness was tested by Hosmer-Lemeshow statistic (0.475). Finally,  $p$ -value  $< 0.05$  was considered as a cut-off point to declare a significant statistical association.

## Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

## Results

### Socio-demographic characteristics

A total of 416 obstetrics care providers completed the questionnaire with a response rate of 98.6%. The mean age  $\pm$  SD of participants was  $30.04 \pm 3.61$  years. Two hundred thirty (55.3%) were females, 238 (57.2%) were married (57.2%), and the majority of study participants were orthodox 70.9% (Table 1).

Table 1: Socio-demographic characteristics of obstetrics care providers working in public hospitals of Amhara Regional State, Ethiopia, 2021(n=416).

| Variable           | Category          | Frequency | Percent |
|--------------------|-------------------|-----------|---------|
| Age                | 20-29             | 11        | 2.6     |
|                    | 30-39             | 368       | 88.5    |
|                    | ≥40               | 37        | 8.9     |
| Sex                | Female            | 230       | 55.3    |
|                    | Male              | 186       | 44.7    |
| Marital status     | Married           | 238       | 57.2    |
|                    | Divorced          | 12        | 2.9     |
|                    | Single            | 166       | 39.9    |
| Educational status | Diploma           | 55        | 13.2    |
|                    | Degree            | 303       | 72.9    |
|                    | Masters and above | 58        | 13.9    |
| Religion           | Orthodox          | 295       | 70.9    |
|                    | Muslim            | 59        | 14.2    |
|                    | Protestant        | 57        | 13.7    |
|                    | Catholic          | 5         | 1.2     |

### Personal and psychosocial characteristics

Overall, 59.1% of obstetrics care providers worked more than 40 hours a week, 68.8% slept less than 8 hours per day. Of the study participants, 170 (40.7%) do have a habit of alcohol drinking. One hundred fifty-six (37.5%) participants had job stress, 21(5%) of participants had a body mass index greater than or equal to 25kg/m<sup>2</sup>. And only one-half (50.7%) of

obstetrics care providers did have regular physical exercise habits at least three times per week for 30 minutes (Table 2).

Table 2: Personal and psychosocial characteristics of obstetrics care providers working in public hospitals of Amhara Regional State, Ethiopia, 2021(n=416).

| Variable                             | Category  | Frequency | Percent |
|--------------------------------------|-----------|-----------|---------|
| Working>40hrs/week.                  | No        | 246       | 59.1    |
|                                      | Yes       | 170       | 40.9    |
| Body mass index                      | <18.5     | 67        | 16.1    |
|                                      | 18.5-24.9 | 328       | 78.8    |
|                                      | >25       | 21        | 5.0     |
| Pattern of sleep per day             | <8hrs     | 286       | 68.8    |
|                                      | ≥8hrs     | 130       | 31.3    |
| Job stress                           | No        | 260       | 62.5    |
|                                      | Yes       | 156       | 37.5    |
| Alcohol drinking habit               | No        | 246       | 59.1    |
|                                      | Yes       | 170       | 40.9    |
| Regular physical exercise≥3days/week | No        | 205       | 49.3    |
|                                      | Yes       | 211       | 50.7    |
| Work experience                      | < 2 years | 75        | 18.0    |
|                                      | 2-5 years | 219       | 52.6    |
|                                      | ≥ 5 years | 122       | 29.3    |

## Organizational and Work-related Characteristics

The majority, 83% of participants bent or twisted while working in their unit, whereas 70.2% were standing longer than one hour while performing obstetrics procedures. Three-fourth (75.7%) of study participants lifted heavyweight greater than 10kg, and 72.6% of participants transferred patients frequently (Table 3).

Table 3: Organizational and Work-related characteristics of obstetrics care providers working in public hospitals of Amhara Regional State, Ethiopia, 2021(n=416).

| Variables                           | Category | Frequency | Percent |
|-------------------------------------|----------|-----------|---------|
| Bending/twisting while working      | Yes      | 353       | 84.9    |
|                                     | No       | 63        | 15.1    |
| Standing >1hr during procedure      | No       | 124       | 29.8    |
|                                     | Yes      | 292       | 70.2    |
| Lifting manually heavy weight >10kg | No       | 101       | 24.3    |
|                                     | Yes      | 315       | 75.7    |
| Frequently transfer patients        | No       | 114       | 27.4    |
|                                     | Yes      | 302       | 72.6    |
| Working while physically fatigue    | No       | 291       | 70.0    |
|                                     | Yes      | 125       | 30.0    |
| Assistive device availability       | No       | 228       | 54.8    |
|                                     | Yes      | 188       | 45.2    |
| Back-care training                  | No       | 333       | 80.0    |
|                                     | Yes      | 83        | 20.0    |

### Prevalence LBP and related characteristics

A total of 273 (65.6%; 95%CI: 61.5%-70.2%) obstetrics care providers reported that they experienced LBP in the last 12 months. Of those with low back pain, 177 (64.8%) were females. More than half, 163 (59.7%) of participants who experienced LBP reported that they experienced moderate pain intensity and 74 (27.1%) experienced severe pain. Of these with LBP, 171 (62.6%) of participants' pain occurred every three to five days a week. Sixty-nine (25.3%) obstetrics care providers reported they experienced LBP radiate to their extremities (Table 4).

Table 4: Low back pain experience among obstetrics care providers working in public hospitals of Amhara Regional State, Ethiopia, 2021

| Variables                         | Category                                   | Frequency | Percent |
|-----------------------------------|--|-----------|---------|
| LBP in the last 12 months (n=416) | Yes  | 273       | 65.6    |
|                                   | No   | 143       | 34.4    |
| Pattern of radiation (n=273)      | No radiation                               | 204       | 74.7    |
|                                   | Radiate to extremities                     | 69        | 25.3    |
| Frequency of LBP (n=273)          | Infrequent (less than three days per week) | 86        | 31.6    |
|                                   | Frequent three to five days per week)      | 171       | 62.6    |
|                                   | Daily pain                                 | 16        | 5.9     |
| Intensity of pain (n=273)         | Mild                                       | 36        | 13.2    |
|                                   | Moderate                                   | 163       | 59.7    |
|                                   | Severe                                     | 74        | 27.1    |

### Factors associated with LBP

Being female, not having regular physical exercise habits, job stress, standing longer than one hour during procedures, and working more than 40 hours a week were significantly associated with LBP in multivariable logistic regression. Female obstetrics care providers were 2.33 [AOR: 2.33, 95%CI: 1.344-4.038] times more likely to have LBP than males. Not

having regular physical exercise habits were 8.26 [AOR: 8.26, 95%CI: 4.36- 15.66] times more likely to have LBP. The odds of experiencing LBP were higher [AOR: 2.21, 95%CI: 1.24-3.92] among obstetrics care providers who had job stress. The odds of LBP also higher [AOR: 2.04 95%CI: 1.14 -3.66] among obstetrics care providers who stand longer than one hour while doing procedures. In addition, obstetrics care providers who work greater than 40 hours per week were 2.20 [AOR 2.20, 95%CI: 1.09-4.45] more likely to have LBP than their counterparts (Table 5).

Table 5: Factors associated with LBP among obstetrics care providers working in public hospitals in Amhara Regional State, Ethiopia 2021 (n=416).

| Variable                      | Categories | LBP |     | 95% confidence interval |                                       |
|-------------------------------|------------|-----|-----|-------------------------|---------------------------------------|
|                               |            | Yes | No  | COR                     | AOR                                   |
| Sex                           | Female     | 117 | 53  | 3.131 (2.056, 4.768)    | <b>2.33(1.34-4.04)<sup>d</sup></b>    |
|                               | Male       | 96  | 90  | 1.0                     | 1.0                                   |
| Regular exercise              | No         | 184 | 21  | 12.011 (7.086, 20.358)  | <b>8.26 (4.36- 15.66)<sup>e</sup></b> |
|                               | Yes        | 89  | 122 | 1.0                     | 1.0                                   |
| Job stress                    | Yes        | 118 | 38  | 2.104(1.353,3.271)      | <b>2.21(1.24-3.92)<sup>c</sup></b>    |
|                               | No         | 155 | 105 | 1.0                     | 1.0                                   |
| Standing>1hr during procedure | No         | 71  | 53  | 1.0                     | 1.0                                   |
|                               | Yes        | 202 | 90  | 1.675 (1.086 ,2.586)    | <b>2.04 (1.14 -3.66)<sup>b</sup></b>  |
| Working >40hrs/week           | No         | 72  | 96  | 1.0                     | 1.0                                   |
|                               | Yes        | 201 | 47  | 5.702 (3.670, 8.860)    | <b>2.20(1.09-4.45)<sup>a</sup></b>    |

COR, crude odds ratio; AOR, Adjusted odds ratio; <sup>a</sup>, p=0.029; <sup>b</sup>, p=0.016; <sup>c</sup>, p=0.007; <sup>d</sup>, p=0.003; <sup>e</sup>, p<0.001

## Discussion

We assessed the prevalence and factors associated with LBP among obstetrics care providers working in public hospitals of Amhara region. This study finding revealed that the prevalence of LBP was 65.6% (95%CI: 61.5-70.2) among obstetrics care providers in the last 12 months. Being female, not having regular physical exercise habits, job stress, standing longer than one hour during procedures, and working more than 40 hours a week were significantly associated with LBP.

The prevalence of LBP in this study is comparable with study findings among nurses in western Ethiopia (63.6%)[30] and United Kingdom (70%)[12]. The prevalence of this study is higher than studies conducted among nurses in eastern Ethiopia (38.1%) [19], Addis Ababa, Ethiopia (45.8%)[18], and Malaysia 56.9%[31]. Obstetrics care providers work in an awkward posture, sustained periods of stooping, and bending while caring for the women during labor. These subjects them to physical constraints leading to LBP[14, 15]. Evidence reported that working in an awkward posture increases the prevalence of LBP[19]. However, it is lower than study findings in Egypt (79%) [32] and Nigeria (73%) [25]. The differences might be due to the difference in pain reporting culture between the study participants, the small sample size in those studies, and lifestyle change over time.

The prevalence of LBP in this study was higher among females than males. This finding is in line with a study findings in eastern Ethiopia (65%)[19] and Nigerian and Ethiopian hospitals (65.7%)[33]. The variation could be due to physiological difference such as menstruation and pregnancy[34, 35]. It could be also anatomical differences between males and females as well as hormonal effects.

In the current study, obstetrics care providers who reported regular physical exercise habits were 8.26 times more likely to experience LBP than their counterparts. This finding is consistent with the research done among nurses in Ethiopia and Turkey [21, 36]. Regular physical exercise improves the physical fitness of individuals, prevents easy fatigability of back muscles, thereby reducing odds of LBP. Regular physical exercise also helps to normalize body mass index. Body mass index greater than or equal to 25 kg/m<sup>2</sup> was a risk for LBP [37].

Working more than 40 hours a week was associated with the experience of LBP ( $p=0.029$ ). This finding is consistent with a study in the United Kingdom[28]. Longer working hours in a week were associated with the risk of obesity due to irregular eating patterns[38, 39], which indirectly increase the prevalence of LBP. However, other study finding from western Ethiopia show no significant association between working hours and LBP[30].

In this study, participants who had job stress were 2.21 times more likely to develop LBP than obstetrics care providers who had no job stress. This finding is consistent with study findings in Addis Ababa public hospital nurses [18]. Stress increases muscle tension and physical fatigue. Fatigue negatively influences muscle receptors and finally on pain receptor area sensation, thereby increasing odds of LBP. On the other hand, job stress was not significantly associated with LBP from study in western Ethiopia [30]. Since the information on the experience of LBP for the last 12 months is highly depends on the participants' memory, there might be under or overestimation due to recall bias.

## Conclusion

Two-thirds of obstetrics care providers working in public hospitals in the Amhara region experienced LBP. Being female, didn't have regular physical exercise habits, job stress, standing longer while doing procedures, and working more than 40 hours a week were significantly associated with low back pain. Providing resting periods, decreasing the working hours of obstetrics care providers in a week and counseling the importance of doing regular physical exercise helps to reduce the prevalence of LBP.

## Declarations

## Acknowledgments

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## Funding statement

There was no fund for this study.

## Ethical approval and informed consent

The Research Ethical Review Board of the College of Medicine and Health Sciences, Wolkite University, Ethiopia the College of Medical and Health Sciences, Wolkite



University in Ethiopia (Ref no. RERB/412/2021) approved this study. We submitted a support letter to each participating hospital and got permission. We also obtained Voluntary informed consent from each study participant. Data collection was anonymous to maintain the confidentiality of participants. Verbal informed consent was obtained from each study participant after explaining the purpose the study.

### Authors' contribution

BTZ, SG, and YM conceived the study. BTZ and SGT wrote the original draft of the manuscript. Analysis and interpretation of data were done by BTZ, SG, and YM. YM, MA, and BC reviewed the draft manuscript for intellectual content and participated in the revision. All authors approved the final version of the manuscript.

### Declaration of conflict of interest

The authors declared no conflict of interest concerning to the research, authorship, and publication of this article.

### Availability of data and materials

The data set used or analyzed during this study is available from the corresponding author on reasonable request.

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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies**

| Section/Topic                | Item # | Recommendation   | Reported on page # |
|------------------------------|--------|--|--------------------|
| <b>Title and abstract</b>    | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract   | 1                  |
|                              |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found  | 2                  |
| <b>Introduction</b>          |        |  |                    |
| Background/rationale         | 2      | Explain the scientific background and rationale for the investigation being reported   | 3-4                |
| Objectives                   | 3      | State specific objectives, including any prespecified hypotheses   | 4                  |
| <b>Methods</b>               |        |  |                    |
| Study design                 | 4      | Present key elements of study design early in the paper  | 4                  |
| Setting                      | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection  | 4                  |
| Participants                 | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants  | 4                  |
| Variables                    | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable   | 5                  |
| Data sources/<br>measurement | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5                  |
| Bias                         | 9      | Describe any efforts to address potential sources of bias  | na                 |
| Study size                   | 10     | Explain how the study size was arrived at  | 4                  |
| Quantitative variables       | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why   | 5                  |
| Statistical methods          | 12     | (a) Describe all statistical methods, including those used to control for confounding  | 5                  |
|                              |        | (b) Describe any methods used to examine subgroups and interactions  | na                 |
|                              |        | (c) Explain how missing data were addressed  | na                 |
|                              |        | (d) If applicable, describe analytical methods taking account of sampling strategy   | na                 |
|                              |        | (e) Describe any sensitivity analyses  | na                 |
| <b>Results</b>               |        |  |                    |

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|--------------------------|-----|--|-------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed            | 6     |
|                          |     | (b) Give reasons for non-participation at each stage   | 6     |
|                          |     | (c) Consider use of a flow diagram   | na    |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders   | 6-10  |
|                          |     | (b) Indicate number of participants with missing data for each variable of interest  | na    |
| Outcome data             | 15* | Report numbers of outcome events or summary measures   | 10-11 |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 11    |
|                          |     | (b) Report category boundaries when continuous variables were categorized  | na    |
|                          |     | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | na    |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | na    |
| <b>Discussion</b>        |     |  |       |
| Key results              | 18  | Summarise key results with reference to study objectives   | 12-13 |
| Limitations              | 19  | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias   | 13    |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                   | 13    |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results  | 13    |
| <b>Other information</b> |     |  |       |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based  | 13    |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Low Back Pain and Associated Factors among Obstetrics Care providers in Public Hospitals of Amhara Regional State, Ethiopia: A Cross-sectional Study

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| Keywords:                       | OBSTETRICS, Back pain < ORTHOPAEDIC & TRAUMA SURGERY, Musculoskeletal disorders < ORTHOPAEDIC & TRAUMA SURGERY  |
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## Abstract

**Objectives:** Although the study of low back pain (LBP) among health care workers in Ethiopia is becoming common, it mainly focused on nurses leaving obstetrics care providers aside. The objective of this study was to assess the prevalence and associated factors of LBP among obstetrics care providers in public hospitals in Amhara Regional State, Ethiopia.

**Design:** An institution-based cross-sectional study.

**Settings:** The study settings were nine public hospitals in Amhara Region.

**Participants:** Randomly selected 416 obstetrics care providers working in public hospitals in Amhara Region, Ethiopia.

**Outcomes:** The outcomes of this study were the prevalence of low back pain in the last 12 months among obstetrics care providers and its associated factors.

**Results:** Overall, the prevalence of low back pain was 65.6% (95%CI: 61.5%-70.2%) among obstetrics care providers in the last 12 months.

Female gender [AOR: 2.33, 95%CI: 1.344-4.038], not having regular physical exercise habits [AOR: 8.26, 95%CI: 4.36- 15.66], job stress [AOR: 2.21, 95%CI: 1.24-3.92], standing longer while doing procedures [AOR: 2.04 95%CI: 1.14-3.66], and working more than 40 hours a week [AOR 2.20, 95%CI: 1.09-4.45] were significantly associated with lower back pain.

**Conclusion:** About two-thirds of obstetrics care providers working in public hospitals in the Amhara region reported low back pain. The prevalence of low back pain was higher among those who didn't have regular physical exercise habits, had job stress, stood longer than one hour while doing procedures, worked more than 40 hours a week, and female obstetrics care providers. Providing resting periods, decreasing the working hours of obstetrics care providers in a week, and counseling on the importance of doing regular physical exercise help to reduce the prevalence of LBP.

**Keywords:** low back pain, obstetrics care providers, public hospitals, Ethiopia

### Strengths and limitations of the study

- To our knowledge, this is the first study on obstetrics care providers in Ethiopia
- The study is a multicenter study.
- The information on the experience of LBP for the last 12 months is highly dependent on the participants' memory, as a result, there might be under or overestimation due to recall bias.

### Introduction

Currently, musculoskeletal disorders have become one of the main issues for health care workers. They are the second most cause of physical disability worldwide[1; 2]. Among musculoskeletal disorders, LBP is the most disabling cause and is widespread in the workplace[1].

LBP refers to pain or discomfort in the spinal area localized between the 12<sup>th</sup> rib and the inferior gluteal folds with or without radiation to the lower extremities[3]. It is categorized as mild, moderate, and severe based on visual analog scale measurements ranging from 0 to 10 and experienced as aching, stabbing, sharp or dull, specified [3].

Given the rapid transition to the industrialized world, LBP inflicts a significant economic burden on health care resources, lost working days, loss of productivity, and increased disability[4; 5]. LBP causes 10.7% of total years lost due to disability[6]. And work-related LBP causes 818,000 disability-adjusted life years lost annually in the world[7]. In addition, LBP results abstain from work, functional limitation, and shortage of staff among obstetrics care providers. A study of Australian midwives reported that an annual sick leave prevalence rate of 24% and functional incapacity (unable to continue working activities) were 59% due to LBP [8]

The overall prevalence of LBP was 24% among populations and 58% among health care workers worldwide [9]. Globally, LBP is the most prevalent musculoskeletal disorder

(MSD) that affects 70%-85% of the adult population at some point in their lifetime[10]. In the low and middle-income countries, 80% of the population experienced LBP during some period during their lifetime [11]. Musculoskeletal disorders are a significant health problem at work among obstetrics care providers. Among 729 midwives with musculoskeletal disorders in Australia, 61% had LBP[8]. In the United Kingdom, the prevalence of LBP among midwives was 70%[12].

Obstetrics care providers give care to women during pregnancy, childbirth, and after birth [13]. Obstetrics care providers also transfer women frequently and keep sustained periods of stooping. They work in an awkward posture, bending, and trunk flexion while giving care during labor [14]. Due to those extreme postures or positions and heavy workload during the childbirth process, obstetrics care providers are subject to physical constraints leading to LBP[14; 15].

Work-related factors (pulling, pushing, and working in extreme positions to handle patients: women and baby at the same time), psychological factors (job stress), and organizational factors (lack of improved equipment support) were predictors of LBP among obstetrics care providers[14; 16; 17].

To date, all studies in Ethiopia[17-20] and several studies around the globe [21] about LBP on health care workers focus mainly on nurses, while others on physicians [22; 23]. Given the variations in practice and environment within health care professionals[24], such studies failed to include the perspectives of obstetrics care providers. The objective of this study was to assess the prevalence and associated factors of LBP among obstetrics care providers in public hospitals in Amhara Regional State, Ethiopia.

## Methods

### Study design and settings

An institution-based cross-sectional study was conducted from January 2 to February 15, 2021. The study settings were nine public hospitals of Amhara Regional State, Ethiopia: Debre Birhan, Felegehiwot, TibebeGhion, Debre Markos, Gondar, Dessie, and Injibara, Debre Tabor, and Woldiya Hospitals. Amhara regional state is one of the ten regional states of Ethiopia. Its capital city is Bahir Dar, which is 551km from the capital city of Ethiopia.

## Participants

The source populations were obstetrics care providers working in public hospitals in the Amhara region. The study populations were obstetrics care providers available in selected public hospitals in the Amhara region during the study period. Obstetrics care providers of the selected public hospitals, except those who were pregnant and given birth in the last 12 months, participated in the study.

## Sample Size and Sampling technique

A single population proportion formula with the assumptions of a 95% of a confidence interval, a 5% margin of error, and a 50% proportion of LPB, was used to calculate the sample size. By adding a 10% non-response rate final sample size became 422. There were 815 obstetrics care providers in selected hospitals. The individual samples were allocated proportionally to each hospital. Lists of obstetrics care providers were obtained from the human resource department of each hospital and used as a sampling frame. Then, individual samples were selected using a computer-assisted random generator.

## Data collection tool and procedure

A structured pretested questionnaire was used containing six thematic categories designed to establish LBP prevalence, socio-demographic characteristics, organizational factors, work-related factors, visual analog scale, and personal and psychosocial factors. The Standardized Nordic Musculoskeletal Questionnaire [25] was used to assess the prevalence of low back pain in the last 12 months. The other parts of questioner such as Socio-demographic characteristics, organizational factors, work-related factors, visual analog scale, and personal and psychosocial factors, were adapted from previous literature[14; 16-18; 22].

The 12-month prevalence of low back pain was dichotomized according to participants' specifications of the length of time they had experienced LBP. We classified it into "Yes," if the participant experienced ache, pain, or discomfort in the low back for at least one day ( $\geq 1$  day) and "No" if the participant never (0 days) suffered from LBP. The intensity of LBP was rated using a 10-point visual analog scale [26]. Visual analog scale scores of 1-3 indicate mild LBP, 4-6 moderate LBP, and 7-10 severe LBP in accordance with the previous study[18].

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3 Data were collected through a self-administered technique by giving the questionnaires to  
4 the study participants to fill and return on the next day. The training was given to data  
5 collectors and supervisors on study tools and data collection approaches. Filled  
6 questionnaires were checked for consistencies and completeness, and corrections were made  
7 accordingly.  
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### 10 11 12 **Data measurement and study variables**

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15 **The dependent variable is Low back pain** defined as any pain felt in the low back region  
16 for at least one day in the last twelve months following previous studies[18; 27].  
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19 **Mild LBP**:-pain intensity on visual analog scale scores 1-3 [18].  
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22 **Moderate LBP**:- pain intensity on visual analog scale scores 4-6[18].  
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25 **Severe LBP**:- pain intensity on visual analog scale scores 7-10 [18].  
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27 The independent variables were (1) socio-demographic characteristics such as age, gender,  
28 marital status, and educational status (2) personal and psychosocial characteristics such as  
29 working hours per week, body mass index, a pattern of sleep per day, job stress, alcohol  
30 drinking habit, regular physical exercise, and work experience (3) organizational and work-  
31 related Characteristics such as bending/twisting while working, standing >1hr during a  
32 procedure, lifting manually heavyweight >10kg, patient transfer, working while physically  
33 fatigue, availability of the assistive device, and back-care training.  
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40 **Job stress**: The workplace stress scale [28] was used to assess participants' self-assessment  
41 on their feelings about their current work. To obtain a description of Job stress participants  
42 were asked eight questions to indicate how often they had felt in their current job. Their  
43 responses were rated on a five-point scale, from 1 to 5: 1= never, 2=rarely, 3= sometimes,  
44 4= often, and 5= very often [28]. The result scores for the workplace stress scale range  
45 between 5 and 40 points. Individuals with a workplace stress scale score above the mean  
46 ( $\geq 21$ ) were classified as having Job stress per a previous study [29].  
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## Data management and analysis

Data entry was done using EpiData 3.1 and exported to SPSS 25 for analysis. Frequency tables and mean were used to describe the characteristics of the study participants for categorical and continuous variables, respectively. Bivariate analysis, crude odds ratio with 95%CI, was used to see the association between each independent variable and neonatal sepsis. Independent variables that yield  $p$ -value  $\leq 0.25$  during bivariate analysis were included in the multivariable analysis. The strength of association was measured using an adjusted-odds ratio with a 95% confidence interval (CI). Model goodness of fitness was verified using the Hosmer-Lemeshow statistic (0.475). A  $p$ -value  $< 0.05$  was a cut-off point to declare a significant statistical association.

## Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of our research.

## Results

### Socio-demographic characteristics

A total of 416 obstetrics care providers completed the questionnaire with a response rate of 98.6%. The mean age  $\pm$  SD of participants was 30.04  $\pm$  3.61 years. In terms of gender, 230 (55.3%) of participants were females.

In terms of marital status, 238 (57.2%) participants were married, and 12 (2.9%) were divorced (Table 1).

Table 1: Socio-demographic characteristics of obstetrics care providers working in public hospitals of Amhara Regional State, Ethiopia, 2021(n=416).

| Variable           | Category          | Frequency | Percent |
|--------------------|-------------------|-----------|---------|
| Age                | 20-29             | 11        | 2.6     |
|                    | 30-39             | 368       | 88.5    |
|                    | ≥40               | 37        | 8.9     |
| Gender             | Female            | 230       | 55.3    |
|                    | Male              | 186       | 44.7    |
| Marital status     | Married           | 238       | 57.2    |
|                    | Divorced          | 12        | 2.9     |
|                    | Single            | 166       | 39.9    |
| Educational status | Diploma           | 55        | 13.2    |
|                    | Degree            | 303       | 72.9    |
|                    | Masters and above | 58        | 13.9    |

### Personal and psychosocial characteristics

Overall, 59.1% of obstetrics care providers worked more than 40 hours a week, and 68.8% slept less than 8 hours per day. Of the study participants, 170 (40.7%) do have a habit of alcohol drinking. One hundred fifty-six (37.5%) participants had job stress, and 21 (5%) had a body mass index of 25kg/m<sup>2</sup> or above. Among 416 participants, One-half (50.7%) of obstetrics care providers did have regular physical exercise habits at least three times per week for 30 minutes (Table 2).



Table 2: Personal and psychosocial characteristics of obstetrics care providers working in public hospitals of Amhara Regional State, Ethiopia, 2021(n=416).

| Variable                             | Category  | Frequency | Percent |
|--------------------------------------|-----------|-----------|---------|
| Working>40hrs/week.                  | No        | 246       | 59.1    |
|                                      | Yes       | 170       | 40.9    |
| Body mass index                      | <18.5     | 67        | 16.1    |
|                                      | 18.5-24.9 | 328       | 78.8    |
|                                      | >25       | 21        | 5.0     |
| The pattern of sleep per day         | <8hrs     | 286       | 68.8    |
|                                      | ≥8hrs     | 130       | 31.3    |
| Job stress                           | No        | 260       | 62.5    |
|                                      | Yes       | 156       | 37.5    |
| Alcohol drinking habit               | No        | 246       | 59.1    |
|                                      | Yes       | 170       | 40.9    |
| Regular physical exercise≥3days/week | No        | 205       | 49.3    |
|                                      | Yes       | 211       | 50.7    |
| Work experience                      | < 2 years | 75        | 18.0    |
|                                      | 2-5 years | 219       | 52.6    |
|                                      | ≥ 5 years | 122       | 29.3    |

### Organizational and Work-related Characteristics

The majority, 83% of participants, bent or twisted while working in their unit, whereas 70.2% stood longer than one hour while performing obstetrics procedures. Three-fourth (75.7%) of study participants lifted heavyweight greater than 10kg, and 72.6% of participants transferred patients frequently (Table 3).



Table 3: Organizational and Work-related characteristics of obstetrics care providers working in public hospitals of Amhara Regional State, Ethiopia, 2021(n=416).

| Variables                          | Category | Frequency | Percent |
|------------------------------------|----------|-----------|---------|
| Bending/twisting while working     | Yes      | 353       | 84.9    |
|                                    | No       | 63        | 15.1    |
| Standing >1hr during the procedure | No       | 124       | 29.8    |
|                                    | Yes      | 292       | 70.2    |
| Lifting manually heavyweight >10kg | No       | 101       | 24.3    |
|                                    | Yes      | 315       | 75.7    |
| Frequently transfer patients       | No       | 114       | 27.4    |
|                                    | Yes      | 302       | 72.6    |
| Working while physically fatigue   | No       | 291       | 70.0    |
|                                    | Yes      | 125       | 30.0    |
| Assistive device availability      | No       | 228       | 54.8    |
|                                    | Yes      | 188       | 45.2    |
| Back-care training                 | No       | 333       | 80.0    |
|                                    | Yes      | 83        | 20.0    |

### Prevalence of LBP and related characteristics

A total of 273 (65.6%; 95%CI: 61.5%-70.2%) obstetrics care providers reported that they experienced LBP in the last 12 months. Of those with low back pain, 177 (64.8%) were females. More than half, 163 (59.7%) of participants who experienced LBP reported that they experienced moderate pain intensity and 74 (27.1%) experienced severe pain. Of these with LBP, 171 (62.6%) of participants' pain occurred every three to five days a week. Sixty-

nine (25.3%) obstetrics care providers reported they experienced LBP radiating to their extremities (Table 4).

Table 4: Low back pain experience among obstetrics care providers working in public hospitals of Amhara Regional State, Ethiopia, 2021

| Variables                         | Category                                   | Frequency | Percent |
|-----------------------------------|--|-----------|---------|
| LBP in the last 12 months (n=416) | Yes  | 273       | 65.6    |
|                                   | No   | 143       | 34.4    |
| Pattern of radiation (n=273)      | No radiation                               | 204       | 74.7    |
|                                   | Radiate to extremities                     | 69        | 25.3    |
| Frequency of LBP (n=273)          | Infrequent (less than three days per week) | 86        | 31.6    |
|                                   | Frequent three to five days per week)      | 171       | 62.6    |
|                                   | Daily pain                                 | 16        | 5.9     |
| The intensity of the pain (n=273) | Mild                                       | 36        | 13.2    |
|                                   | Moderate                                   | 163       | 59.7    |
|                                   | Severe                                     | 74        | 27.1    |

### Factors associated with LBP

Explanatory variables included in the adjusted analysis were age, gender, regular physical exercise habit, job stress, standing longer than 1 hour, working hours per week, body mass index, patient transfer, working while physically fatigued, availability of the assistive device, and back-care training. Of those variables, female gender, not having regular physical exercise habits, job stress, standing longer than one hour during procedures, and working more than 40 hours a week were significantly associated with LBP. Female obstetrics care providers were 2.33 [AOR: 2.33, 95%CI: 1.344-4.038] times more likely to have LBP than males. Not having regular physical exercise habits were 8.26 [AOR: 8.26, 95%CI: 4.36- 15.66] times more likely to have LBP. The odds of experiencing LBP were higher [AOR: 2.21, 95%CI: 1.24-3.92] among obstetrics care providers who had job stress. The odds of LBP were also higher [AOR: 2.04 95%CI: 1.14 -3.66] among obstetrics care

providers who stand longer than one hour while doing procedures. In addition, obstetrics care providers who work greater than 40 hours per week were 2.20 [AOR 2.20, 95%CI: 1.09-4.45] more likely to have LBP than their counterparts (Table 5).

Table 5: Factors associated with LBP among obstetrics care providers working in public hospitals in Amhara Regional State, Ethiopia 2021 (n=416).

| Variable                          | Categories | LBP |     | 95% confidence interval |                                       |
|-----------------------------------|------------|-----|-----|-------------------------|---------------------------------------|
|                                   |            | Yes | No  | COR                     | AOR                                   |
| Gender                            | Female     | 117 | 53  | 3.131 (2.056, 4.768)    | <b>2.33(1.34-4.04)<sup>d</sup></b>    |
|                                   | Male       | 96  | 90  | 1.0                     | 1.0                                   |
| Regular exercise                  | No         | 184 | 21  | 12.011 (7.086, 20.358)  | <b>8.26 (4.36- 15.66)<sup>e</sup></b> |
|                                   | Yes        | 89  | 122 | 1.0                     | 1.0                                   |
| Job stress                        | Yes        | 118 | 38  | 2.104(1.353,3.271)      | <b>2.21(1.24-3.92)<sup>c</sup></b>    |
|                                   | No         | 155 | 105 | 1.0                     | 1.0                                   |
| Standing>1hr during the procedure | Yes        | 202 | 90  | 1.675 (1.086 ,2.586)    | <b>2.04 (1.14 -3.66)<sup>b</sup></b>  |
|                                   | No         | 71  | 53  | 1.0                     | 1.0                                   |
| Working >40hrs/week               | Yes        | 201 | 47  | 5.702 (3.670, 8.860)    | <b>2.20(1.09-4.45)<sup>a</sup></b>    |
|                                   | No         | 72  | 96  | 1.0                     | 1.0                                   |

COR, crude odds ratio; AOR, Adjusted odds ratio; <sup>a</sup>, p=0.029; <sup>b</sup>, p=0.016; <sup>c</sup>, p=0.007; <sup>d</sup>, p=0.003; <sup>e</sup>, p<0.001

## Discussion

We assessed the prevalence and factors associated with LBP among obstetrics care providers working in public hospitals in the Amhara region. This study finding revealed that the prevalence of LBP was 65.6% (95%CI: 61.5-70.2) among obstetrics care providers in the last 12 months. Female gender, not having regular physical exercise habits, job stress, standing longer than one hour during procedures, and working more than 40 hours a week were significantly associated with LBP.

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3 The prevalence of LBP in this study is comparable with study findings among nurses in  
4 western Ethiopia (63.6%)[29] and the United Kingdom (70%)[12].The prevalence of this  
5 study is higher than studies conducted among nurses in eastern Ethiopia (38.1%) [19], Addis  
6 Ababa, Ethiopia (45.8%)[18], and Malaysia 56.9%[30]. Obstetrics care providers work in  
7 an awkward posture, sustained periods of stooping, and bending while caring for the women  
8 during labor. These subject them to physical constraints leading to LBP[14; 15]. A previous  
9 study reported that working in an awkward posture increases the prevalence of LBP[19].The  
10 finding of this study is lower than study findings in Egypt (79%) [31] and Nigeria (73%)  
11 [32]. The differences might be due to the difference in pain reporting culture between the  
12 study participants, the small sample size in those studies, and lifestyle changes over time.  
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21 The prevalence of LBP in this study was higher among females than males. This finding is  
22 in line with studies in eastern Ethiopia (65%)[19] and Nigerian and Ethiopian hospitals  
23 (65.7%)[33]. The variation could be physiological differences such as menstruation and  
24 pregnancy[34; 35]. The variation could also be anatomical differences between males and  
25 females and hormonal effects.  
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30 In the current study, obstetrics care providers who reported regular physical exercise habits  
31 were 8.26 times more likely to experience LBP than their counterparts. This finding is  
32 consistent with the research done among nurses in Ethiopia and Turkey[27; 36]. Regular  
33 physical exercise habit improves the physical fitness of individuals and prevents easy  
34 fatigability of back muscles, thereby reducing the odds of LBP. Regular physical exercise  
35 also helps to normalize body mass index. El-Soud et al. have shown that a body mass index  
36 greater than or equal to 25 kg/m<sup>2</sup> was a risk for LBP[37].  
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44 Working more than 40 hours a week was associated with the experience of LBP (p=0.029).  
45 This finding is consistent with a study in the United Kingdom[24].Working longer hours a  
46 week was associated with the risk of obesity because of irregular eating patterns[38; 39],  
47 thereby increasing the odds of LBP. However, another study in western Ethiopia showed no  
48 significant association between working hours and LBP[29].  
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53 The odds of LBP were 2.21 times more likely among obstetrics care providers who had job  
54 stress than their counterparts. This finding is consistent with study finding in Addis Ababa  
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public hospital[18]. Stress increases muscle tension and physical fatigue. Fatigue negatively influences muscle receptors and finally on pain receptor area sensation, thereby increasing the odds of LBP. On the other hand, job stress was not significantly associated with LBP in a study in western Ethiopia [29]. Since the information on the experience of LBP for the last 12 months highly depends on the participants' memory, there might be under or overestimation due to recall bias.

## Conclusion

Two-thirds of obstetrics care providers working in public hospitals in the Amhara region experienced LBP. Female gender, not having regular physical exercise habits, having job stress, standing longer while doing procedures, and working more than 40 hours a week were significantly associated with lower back pain. Providing rest periods, decreasing the working hours of obstetrics care providers in a week, and counseling on the importance of doing regular physical exercise helps to reduce the prevalence of LBP.

## Declarations

### Acknowledgments

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### Funding statement

There was no fund for this study.

### Ethical approval and informed consent

The Research Ethical Review Board of the College of Medicine and Health Sciences, Wolkite University in Ethiopia, (Ref no HSC/R/C/SE/PG/CO/412/2021) approved this study. We have submitted a support letter to each participating hospital and got permission. We also obtained Voluntary informed consent from each study participant. Data collection was anonymous to maintain the confidence of participants. Verbal informed consent was obtained from each study participant after explaining the purpose of the study.

### Authors' contribution

Bitew Tefera Zewudie: Conceptualization; Data curation; Formal analysis; Investigation; Resource; writing original draft

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3 Bogale Chekole: Conceptualization; Formal analysis; Investigation; Methodology; Writing-  
4 review and editing  
5

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7  
8 muche Argaw Eniyew: Conceptualization; Investigation; Supervision; validation; writing-  
9 review and editing  
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11  
12 Yibeltal Mesfine: Conceptualization; Formal analysis; Investigation; Resource;  
13 Methodology; Writing-review and editing  
14

15  
16 Shegaw Geze Tenaw: Conceptualization; Investigation; Supervision; Resource; validation;  
17 writing original draft; writing-review and editing. All authors approved the final version of the  
18 manuscript.  
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21

### 22 **Declaration of conflict of interest**

23  
24 The authors declared there is no conflict of interest concerning the research, authorship, and  
25 publication of this article.  
26

### 27 **Availability of data and materials**

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29 The data set used or analyzed during this study is available from the corresponding author  
30 on reasonable request.  
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**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

| Section/Topic                | Item # | Recommendation   | Reported on page # |
|------------------------------|--------|--|--------------------|
| <b>Title and abstract</b>    | 1      | (a) Indicate the study's design with a commonly used term in the title or the abstract   | 1                  |
|                              |        | (b) Provide in the abstract an informative and balanced summary of what was done and what was found  | 2                  |
| <b>Introduction</b>          |        |  |                    |
| Background/rationale         | 2      | Explain the scientific background and rationale for the investigation being reported   | 3-4                |
| Objectives                   | 3      | State specific objectives, including any prespecified hypotheses   | 4                  |
| <b>Methods</b>               |        |  |                    |
| Study design                 | 4      | Present key elements of study design early in the paper  | 4                  |
| Setting                      | 5      | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection  | 4                  |
| Participants                 | 6      | (a) Give the eligibility criteria, and the sources and methods of selection of participants  | 5                  |
| Variables                    | 7      | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable   | 6                  |
| Data sources/<br>measurement | 8*     | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 6                  |
| Bias                         | 9      | Describe any efforts to address potential sources of bias  | 6                  |
| Study size                   | 10     | Explain how the study size was arrived at  | 5                  |
| Quantitative variables       | 11     | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why   | 7                  |
| Statistical methods          | 12     | (a) Describe all statistical methods, including those used to control for confounding  | 7                  |
|                              |        | (b) Describe any methods used to examine subgroups and interactions  | na                 |
|                              |        | (c) Explain how missing data were addressed  | na                 |
|                              |        | (d) If applicable, describe analytical methods taking account of sampling strategy   | na                 |
|                              |        | (e) Describe any sensitivity analyses  | na                 |
| <b>Results</b>               |        |  |                    |

|                          |     |  |          |
|--------------------------|-----|--|----------|
| Participants             | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed            | 7        |
|                          |     | (b) Give reasons for non-participation at each stage   | 7        |
|                          |     | (c) Consider use of a flow diagram   | na       |
| Descriptive data         | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders   | 7-11     |
|                          |     | (b) Indicate number of participants with missing data for each variable of interest  | Na       |
| Outcome data             | 15* | Report numbers of outcome events or summary measures   | 17-11    |
| Main results             | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 11       |
|                          |     | (b) Report category boundaries when continuous variables were categorized  | Na       |
|                          |     | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | Na       |
| Other analyses           | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | Na       |
| <b>Discussion</b>        |     |  |          |
| Key results              | 18  | Summarise key results with reference to study objectives   | 12-14    |
| Limitations              | 19  | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias   | 3 and 14 |
| Interpretation           | 20  | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                   | 12-14    |
| Generalisability         | 21  | Discuss the generalisability (external validity) of the study results  | 14       |
| <b>Other information</b> |     |  |          |
| Funding                  | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based  | 14       |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).