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Bio-mechanical risk factors for uterine prolapse among women living in the hills of west Nepal: A case-control study

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Abstract

Objective: To investigate whether heavy load carrying, wearing a patuka, and body position at work are risk factors for uterine prolapse among Nepali women.

Methods: Community-based case-control study of 448 women (170 cases of uterine prolapse; 278 controls) aged 18–60 years in Kaski district, Nepal was conducted. Women diagnosed with uterine prolapse were cases. Two controls were recruited for each case, frequency-matched by residential area and age. Multivariate logistic regression was used to investigate associations between outcome and exposures.

Results: No association of heavy load carrying with uterine prolapse was observed; women who never used a patuka had lower odds of uterine prolapse (odds ratio = 0.18, 95% confidence interval = 0.05–0.71). Women working in a sitting position had higher odds than those working in a standing position (odds ratio = 2.94, 95% confidence interval = 1.74–4.96), as did women who mainly worked in a bending position (odds ratio = 2.45, 95% confidence interval = 1.12–5.34). Housewives were more prone to uterine prolapse than women engaged in farming (odds ratio = 2.13, 95% confidence interval = 1.31–3.47).

Conclusion: Using a patuka, occupation, and body position during work were all associated with uterine prolapse. No association was found with heavy load carrying, although that might be attributable to the cross-sectional nature of study recruitment.

Keywords

case-control study, heavy-load carrying, Nepal, patuka, uterine prolapse, work position

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Introduction

Uterine prolapse (UP) results from a weakness in the supporting structures of the pelvic floor, allowing the uterus to descend down the vaginal canal.[1] Usually it is not life threatening, but prolapse contributes to bladder, bowel, and sexual dysfunction in women.[2]

World Health Organization[3] estimates suggest that the global prevalence of UP is between 2% and 20% among women under the age of 45. A combination of anatomical, physiological, genetic, lifestyle, and reproductive factors interacting throughout women's lifespans can contribute to pelvic floor dysfunction.[2,4] Commonly reported risk factors include multiparity, excess intra-abdominal pressure, tissue atrophy secondary to aging and estrogen loss, joint hypermobility, and congenital ligament weakness;[5,6] direct

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and indirect injuries to muscles, ligaments, and nerves related to the pelvic organ/floor also appear to be a cause of UP.[7] Age and high parity are the most commonly reported risk factors among women;[6] obesity, cigarette smoking/chronic cough, constipation, and estrogen deficiency have also been reported.[8,9]

Studies have shown that women who had work that was physically demanding or involved heavy lifting were more likely to experience pelvic organ prolapse than those who did not engage in such exertions.[10] Obesity and co-morbidities, such as constipation, chronic cough, and metabolic disorders (e.g. diabetes mellitus), are reported to be risk factors. Studies have also found family history, race, and ethnicity correlated with UP.[8,9,11,12]

The Nepal Institute of Medicine and United Nations Population Fund (UNFPA)[13] reported the prevalence of UP in Nepal at 10%, but other studies have shown prevalences ranging from 6% to 37%.[14–16] The practice of wearing a patuka, a wide sash of cloth about five meters long wrapped tightly around the waist while carrying loads is widespread in Nepal, by both men and women,[17] and is perceived to be a risk factor for UP.[13,15]

This study aimed to identify physical and behavioral risk factors for UP. We hypothesized that heavy load carrying by Nepali women, wearing a patuka, and squatting at work would be independent risk factors for UP.

Materials and methods

A community-based, case-control study, examining the differences in exposures between cases with UP and non-prolapsed controls was carried out in the Kaski district of Nepal between mid-January and mid-July 2018.

Cases were women, aged 18–60 years, clinically diagnosed as having UP—grade one or higher, following the Baden–Walker half way system of classification[18]—among those attending the camps. Controls were selected from the same areas of residence as the cases corresponding to approximately twice the number of cases from each area, with a 5-year age-band frequency matching to the corresponding cases. Pregnant women and women who had a hysterectomy were excluded.

Gynecologists, using a speculum, undertook the clinical examinations to determine pre-existing medical conditions, including UP, following a standard protocol that involved a pelvic examination, including inspection of the position of the uterus and condition of the pelvic floor. They also examined the controls to confirm they were without UP. Height and weight were measured using a measuring tape and weighing scale.

Participant data on socio-demographics, type of work and working positions, reproductive history, symptoms indicative of pelvic problems, and load carriage information were collected using a standardized questionnaire, set up on tablet computers with Qualtrics® software, and administered in Nepali by trained female data collectors. The questionnaire was first developed in English, translated into Nepali by two bilingual Nepalis and field-tested for acceptability and comprehension among the population in which it was to be used. On average, administration of the questionnaire took 32 min.

Table 1 shows definitions of the outcome, exposures, and covariates used in the study.

Analysis was done after data collected in Qualtrics software were transferred into SPSS (version 16.0 for Windows). Descriptive statistics and associations between the outcome and main exposure measures and potential covariates were examined using bivariate odds ratios (ORs) and 95% confidence intervals (CIs). Due to the binary nature of the dependent variable, unconditional logistic regression was used. Confounding was investigated by multivariate analysis, separately examining associations of potential covariates with both the outcome and the three key exposure variables (load carrying, wearing a patuka, and position at work). Any variables associated with both the outcome and an exposure variable with a p-value $\leqslant 0.2$ and not determined to be on the causal pathway or a collider were treated as potential confounders for the analysis. The covariates meeting these criteria were included in a multivariate logistic regression model, with the three exposure variables.

The Committee for Protection of Human Subjects at the University of California, Berkeley (CPHS # 2017-08-10205), and the Nepal Health Research Council approved this study. Before fieldwork began, verbal and signed informed consent was obtained from all participants before interviews, anthropometric measurements, and the pelvic examinations.

Results

Among the total 802 women who attended the camps, 492 were recruited, of whom 170 were cases and 322 controls. Figure 1 shows the process of recruitment.

Characteristics of the participants

Table 2 shows the socio-demographic characteristics of the study participants with bivariate ORs. Of the originally selected controls, 34 were dropped because pelvic examination revealed cystocele or rectocele, which could share a common etiology with UP, and 10 were dropped because of incomplete information, leaving a total of 278 controls for the analysis. Over 75% of the cases were diagnosed as having first degree prolapse while the remainder had second- or third-degree prolapse. The participation rates in the study were 100% for cases and 84% for controls. The mean age of the participants was similar for cases and controls. Table 2 shows that the frequency matching process was quite successful, as age distributions are similar.

Table 1. Variables and their descriptions.

Measures/variables	Definition
Outcome variable	
Uterine prolapse	Uterine prolapse of any degree diagnosed in gynecologic screening camps
Exposure variables	
Load lifting/ carrying	Any type of load lifting or carrying was reported as a regular activity (at least 12 h a week) (1) ever in the past, and (2) at the time of survey.
Patuka	Practice of wrapping a cloth band around the waist while working, lifting loads, during pregnancy, or puerperium
Position at work	Position most of the time at work (e.g. squatting, standing, etc)
Covariates	
Age	Completed age in years of woman at the time of interview
Parity	Number of live births
Age at first child	Age in years of woman at the time of first delivery
Place of delivery	home or health facility
Caste/ethnicity	Self-reported caste/ethnic group
Education	Number of years of education completed
Occupation	Occupation of the respondent at the time of interview
Income source	Main source of family income
Family history of uterine prolapse	Any one of the respondent's immediate family members (Grand-mother, mother or sister) with reported history of uterine prolapse.
Chronic cough	Coughing for 3 months or longer within 1-year period before the interview
Constipation	Constipation for 3 months or longer within 1-year period before the interview
Body mass index (BMI)	Using height in meters and weight in kilograms at the time of clinical examination, BMI = weight/(height)^2 (normal BMI = 18.5–24.9; underweight $\leqslant$ 18.5; overweight = 25–29.9; obesity = BMI $\geqslant$ 30)
Injury	Any injury affecting reproductive organs

Table 2 shows respondents' castes and occupations to be significantly associated with UP ($p < 0.05$). The odds for Jana Jaati (indigenous) women were 0.46 (95% CI = 0.28–0.78) relative to Brahmin/Chhetri (higher caste) women, while they were 2.29 (95% CI = 1.51–3.48) for housewives relative to women who reported their occupation as farmers. Women whose main source of income was remittances from abroad also had higher odds of UP, relative to women whose main source of income was farming. Higher education tended to be protective, as was older age at marriage. There were no clear associations with parity or body mass index (BMI).

Table 3 shows behavioral and obstetric factors and their bivariate relationships with UP (all degrees of prolapse combined). There was no evidence of an association with load carrying. Wearing a patuka, position at work, duration of labor, and mode of delivery were all found to be associated with UP. Women who never used a patuka had lower odds compared with those who regularly used one (OR = 0.20, 95% CI = 0.06–0.67). Similarly, women who did not always give birth vaginally had lower odds compared with those who delivered only vaginally (OR = 0.13, 95% CI = 0.03–0.56). Women having a long labor during childbirth (>12 h) had higher odds of UP (OR = 1.77, 95% CI = 1.07–2.92) compared with the women with shorter labor (<6 h). Injuries affecting the reproductive organs and both persistent cough and constipation were found to be positively associated with UP.

We also ran model 2 restricting the cases to those with stages 2 or 3 prolapse, compared with all controls. The fact that there were only 41 such cases was quite limiting. No meaningful results were obtained for wearing a patuka, but when the main position at work was sitting (compared with standing), the OR was 3.77 (95% CI = 1.60–8.86), which tended to confirm the result obtained using all cases of prolapse, irrespective of degree. The OR for bending was 1.29 (0.25–6.70) and there was no meaningful result for squatting. Not presently carrying a load had an OR of 2.07 (0.82–5.24), relative to often carrying, likely reflecting reverse causation.

Table 4 shows the three hypothesized risk factors and potential confounders in three multivariate logistic regression models, all of which are adjusted for age. The first model contains only the three hypothesized risk factors and the second also contains the potential confounders of the three risk factors and can be considered the final model of this study. The third model contains all the apparent risk factors from Tables 2 and 3. We included the third model, even though it provides no substantive additional information on the hypotheses associated with this article, because there is little published epidemiologic information on UP risk factors in Nepal. Cough and constipation were excluded because they may, respectively, be on the causal pathway or a consequence of prolapse, which would not be true risk factors.

Heavy load carrying was not associated with UP in any of the models. However, wearing a patuka was a risk factor

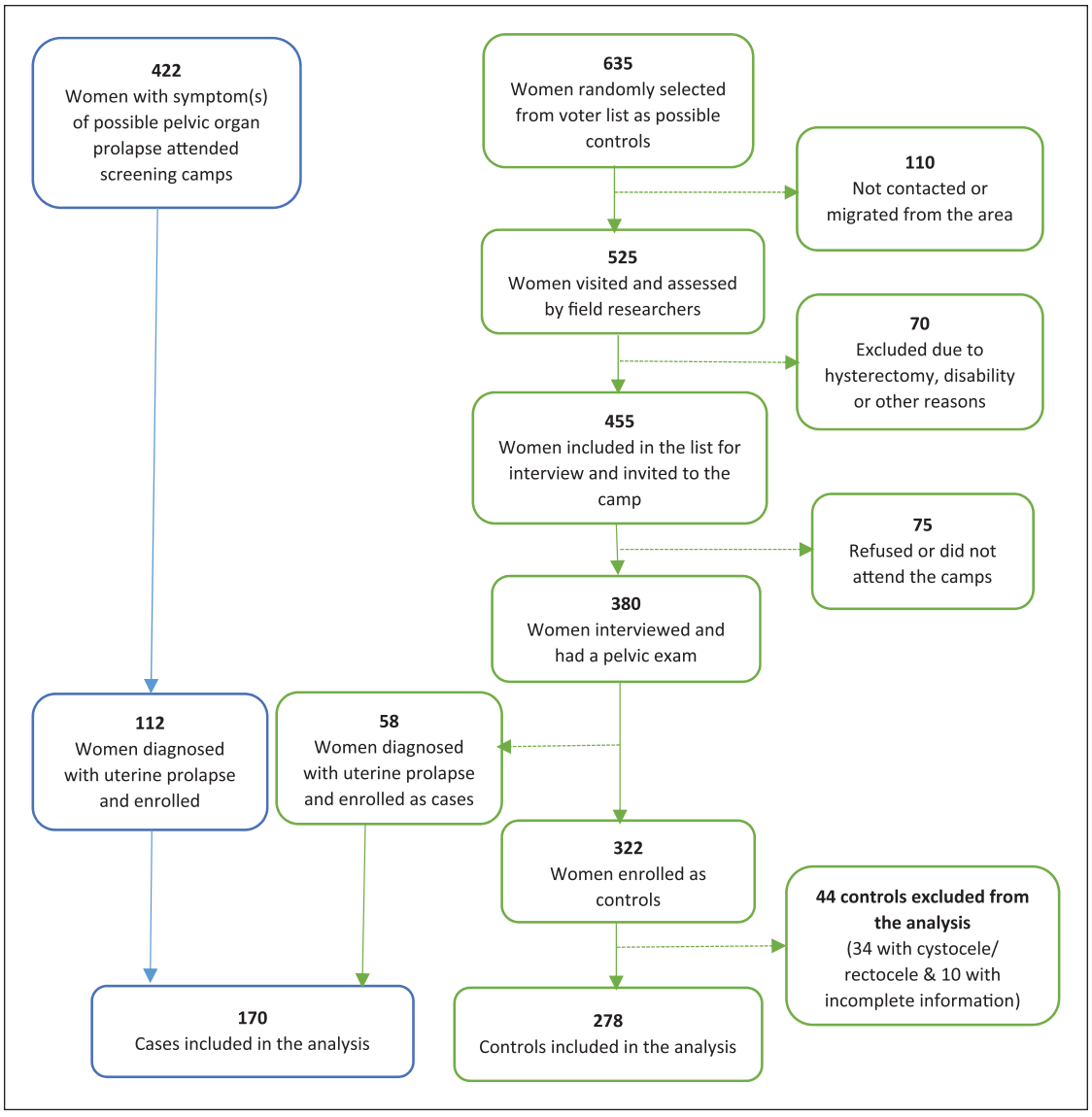

Figure 1. Flowchart of the sampling design and subject enrollment in the study.

in all three models. Our prior hypothesis that squatting at work would be a risk factor was not confirmed, but women who worked mostly in either a sitting position (OR = 2.94, 95% CI = 1.74–4.96) or bending (OR = 2.45, 95% CI = 1.12–5.34) had higher odds of UP than women who worked mainly in a standing position.

Housewives were found to have more than double the odds of UP compared with women whose occupation was farming (OR = 2.13, 95% CI = 1.31–3.47). Also, women who were married at 21 or later had lower odds (OR = 0.38, 95% CI = 0.18–0.78) compared with those married at the age 15 or below.

In Model 3, women from the Jana Jaati (OR = 0.49, 95% CI = 0.27–0.90) and Dalit (OR = 0.48, 95% CI = 0.26–0.90) caste/ethnic groups were less likely to have UP compared with women from the Brahmin/Chhetri castes. Women whose babies had all been delivered vaginally had higher prolapse odds than women who had at least one delivered by caesarian section. The OR for this was 9.09 (95% CI = 1.96–50; calculated from Model 3 results in Table 4). Women who had had an injury affecting the reproductive organs had higher odds of UP than women without such injury.

Discussion

To the best of our knowledge, this is the first epidemiology study conducted in Nepal with a focus on biomechanical (ergonomic) aspects of UP. While studies from Ethiopia,[19] Denmark,[10] and Germany[8] found that women involved in heavy lifting and load carrying were more likely to have UP, we did not observe such an association.

Table 2. Socio-demographic characteristics of the participants and bivariate associations with uterine prolapse.

Characteristics	Total, n = 448 (%)	Controls, n = 278 (%)	Cases, n = 170 (%)	OR	95% CI	p-value
UP status of the cases						
First degree			129 (75.9)			
Second degree			29 (17.1)			
Third degree			12 (7.1)			
Age[a]						
51–60 years	167 (37.3)	105 (37.8)	62 (36.5)			
41–50 years	137 (30.6)	81 (29.1)	56 (32.9)			
31–40 years	113 (25.2)	71 (25.5)	42 (24.7)			
18–30 years	31 (6.9)	21 (7.6)	10 (5.9)			
Caste/ethnicity						
Brahmin and Chhetri	233 (52.0)	131 (47.1)	102 (60.0)	1.00		
Jana Jaati	98 (21.9)	72 (25.9)	26 (15.3)	0.46	0.28–0.78	<0.01
Dalit	117 (26.1)	75 (27.0)	42 (24.7)	0.72	0.46–1.14	0.16
Education						
Illiterate and no formal education	238 (53.1)	139 (50.0)	99 (58.2)	1.00		
Primary education (1–5 Grade)	98 (21.9)	63 (22.7)	35 (20.6)	0.78	0.48–1.29	0.32
Secondary or higher education	112 (25.0)	76 (27.3)	36 (21.2)	0.67	0.41–1.07	0.09
Occupation						
Farmer	237 (52.9)	163 (58.6)	74 (43.5)	1.00		
Housewife	155 (34.6)	76 (27.3)	79 (46.5)	2.29	1.51–3.48	<.01
Other	56 (12.5)	39 (14.0)	17 (10.0)	0.96	0.51–1.81	0.90
Main source of income						
Farming (agriculture/live stock)	154 (34.4)	104 (37.4)	50 (29.4)	1.00		
Wage labor	36 (8.0)	20 (7.2)	16 (9.4)	1.66	0.80–3.48	0.18
Small trade/business	35 (7.8)	22 (7.9)	13 (7.6)	1.23	0.57–2.64	0.60
Service/employment	39 (8.7)	21 (7.6)	18 (10.6)	1.78	0.87–3.64	0.11
Remittances	95 (21.2)	52 (18.7)	43 (25.3)	1.72	1.02–2.91	0.04
Mixed source of income	89 (19.9)	59 (21.2)	30 (17.6)	1.05	0.61–1.84	0.84
Age at marriage						
9–15	109 (24.8)	57 (21.0)	52 (30.8)	1.00		
16–20	266 (60.5)	166 (61.3)	100 (59.2)	0.66	0.42–1.04	0.07
21 and above	65 (14.8)	48 (17.7)	17 (10.1)	0.39	0.20–0.76	0.01
Age at first pregnancy						
19 and below	220 (50.2)	131 (48.5)	89 (53.0)	1.00		
20–24	190 (43.4)	120 (44.4)	70 (41.7)	0.86	0.58–1.28	0.45
25 and above	28 (6.4)	19 (7.0)	9 (5.4)	0.70	0.30–1.61	0.40
Parity/delivery[b]						
1–2	115 (26.3)	68 (25.2)	47 (28.0)	1.00		
3–4	216 (49.3)	138 (51.1)	78 (46.4)	0.82	0.51–1.30	0.40
>5	107 (24.4)	64 (23.7)	43 (25.6)	0.97	0.57–1.66	0.92
Body mass index (BMI)						
Normal (18.5–24.9)	245 (54.7)	149 (53.6)	96 (56.5)	1.00		
Overweight (25+)	181 (40.4)	113 (40.6)	68 (40)	0.93	0.63–1.39	0.74
Underweight (<18.5)	22 (4.9)	16 (5.8)	6 (3.5)	0.58	0.22–1.54	0.24

OR: odds ratio; CI: confidence interval; UP: uterine prolapse.
[a]Odds ratios and confidence intervals not shown for age, as this was a frequency matching factor.
[b]10 women with no children.

This difference in results might be attributable to the variation in modalities of heavy load carrying in the different countries. In Nepal, the common method of load carriage is with a namlo—a band around the forehead and looped around the load carried on the back. This method of carriage is fairly distinctive to Nepal, although not unknown in other developing countries.

Supporting one of our hypotheses, the study found an association of UP with wearing a patuka while working. A previous study in Nepal also suggested such an

Table 3. Behavioral- and obstetric-related characteristics of the participants and their bivariate associations with uterine prolapse.

Characteristics	Total, n = 448 (%)	Control, n = 278 (%)	Case, n = 170 (%)	OR	95% CI	p-value
Load carrying/lifting						
At the time of survey	358 (79.9)	226 (81.3)	132 (77.6)	1.00		
Ever in the past	84 (18.8)	47 (16.9)	37 (21.8)	1.35	0.83–2.18	0.22
Never	6 (1.3)	5 (1.8)	1 (0.6)	0.34	0.04–2.96	0.33
Present load carrying/lifting frequency						
Yes/almost everyday	327 (73.0)	206 (74.1)	121 (71.2)	1.00		
Sometimes	31 (6.9)	20 (7.2)	11 (6.5)	0.94	0.43–2.02	0.87
Not at all	90 (20.1)	52 (18.7)	38 (22.4)	1.24	0.77–2.00	0.37
Use of Patuka						
Regularly	321 (71.7)	190 (68.3)	131 (77.1)	1.00		
Occasionally	102 (22.8)	66 (23.7)	36 (21.2)	0.79	0.50–1.26	0.32
Never	25 (5.6)	22 (7.9)	3 (1.8)	0.20	0.06–0.67	0.01
Primary position at work						
Standing	281 (62.7)	195 (70.1)	86 (50.6)	1.00		
Sitting	106 (23.7)	48 (17.3)	58 (34.1)	2.74	1.73–4.34	<0.01
Bending	32 (7.1)	15 (5.4)	17 (10.0)	2.57	1.23–5.38	0.01
Squatting	29 (6.5)	20 (7.2)	9 (5.3)	1.02	0.45–2.33	0.96
Place of first delivery						
Home	347 (79.2)	212 (78.5)	135 (80.4)	1.00		
Health facility	91 (20.8)	58 (21.5)	33 (19.6)	0.89	0.55–1.44	0.65
Duration of last labor						
5 h or less	224 (51.1)	150 (55.6)	74 (44.0)	1.00		
6–12 h	126 (28.8)	73 (27.0)	53 (31.5)	1.47	0.94–2.31	0.09
13 h or more	88 (20.1)	47 (17.4)	41 (24.4)	1.77	1.07–2.92	0.03
Modes of delivery						
All vaginal	413 (94.3)	247 (91.5)	166 (98.8)	1.00		
Not all vaginal	25 (5.7)	23 (8.5)	2 (1.2)	0.13	0.03–0.56	0.01
Injury affecting reproductive organ						
Never	305 (68.1)	203 (73.0)	102 (60.0)	1.00		
Yes	130 (29.0)	68 (24.5)	62 (36.5)	1.82	1.19–2.76	0.01
Don't know	13 (2.9)	7 (2.5)	6 (3.5)	1.71	0.56–5.21	0.35
Persistent cough						
No	229 (51.1)	163 (58.6)	66 (38.8)	1.00		
Yes	219 (48.9)	115 (41.4)	104 (61.2)	2.23	1.51–3.30	<0.01
Constipation						
Not at all	233 (52.0)	159 (57.2)	74 (43.5)	1.00		
Yes often	215 (48.0)	119 (42.8)	96 (56.5)	1.73	1.18–2.55	0.01

OR: odds ratio; CI: confidence interval.

association, although that study presented little data in support of it.[15]

Partially supporting the third of our hypotheses, women who worked most of the time in a sitting or bending position were found to have two to three times greater odds of UP than those working mainly in a standing position. Contrary to our primary hypothesis, squatting at work did not appear to be a risk factor.

Apart from our major hypotheses, several other factors appeared to be risk factors for UP. Two in particular are worth discussing. One of these was occupation. This finding is consistent with a previous study conducted in Nepal[20] and another in Italy[5] that indicated housewives to be at higher risk of developing UP than other professional women. The reason for higher vulnerability among housewives could in part be due to a sitting position while working or resting at home. However, in our analysis, sitting appeared to be an independent risk factor and so there may be other risk factors associated with being a housewife. The other factor was ethnicity. Socio-cultural and life style factors might have influenced these differences. Women's roles differ within the complex social and caste system in South Asia, including in Nepal. There is some evidence that at least Jana Jaati women tend to be treated in a more egalitarian way and enjoy more control over their lives, compared with women from other castes and ethnic

Table 4. Factors associated with uterine prolapse: multivariate logistic regression models with adjusted odds ratios and 95% confidence intervals.

Independent variables	Model 1[a]		Model 2[b]		Model 3[c]	
	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Load carrying/lifting (⩾12 h/week)						
Yes/almost everyday	1.00		1.00		1.00	
Sometimes	0.90	0.39–2.07	0.68	0.28–1.61	0.76	0.30–1.89
Not at all	1.31	0.77–2.20	1.13	0.64–1.99	0.99	0.54–1.83
Use of Patuka						
Regularly	1.00		1.00		1.00	
Occasionally	0.73	0.43–1.25	0.85	0.48–1.50	0.75	0.41–1.36
Never	0.12	0.03–0.43	0.18	0.05–0.71	0.25	0.06–1.07
Primary position at work						
Standing	1.00		1.00		1.00	
Sitting	3.31	2.02–5.44	2.94	1.74–4.96	3.09	1.77–5.37
Bending	2.51	1.18–5.31	2.45	1.12–5.34	2.43	1.07–5.50
Squatting	1.10	0.47–2.59	1.09	0.45–2.64	1.03	0.41–2.58
Occupation						
Farmer			1.00		1.00	
Housewife			2.13	1.31–3.47	2.21	1.29–3.79
Other			0.91	0.44–1.87	0.97	0.43–2.16
Age at marriage						
9–15			1.00		1.00	
16–20			0.66	0.40–1.08	0.71	0.42–1.21
21 and above			0.38	0.18–0.78	0.47	0.22–1.03
Respondent's education						
Illiterate and no formal education			1.00		1.00	
Primary education			0.70	0.39–1.25	0.64	0.34–1.20
Secondary or higher education			0.82	0.42–1.60	0.69	0.33–1.47
Caste/ethnicity						
Brahmin and Chhetri					1.00	
Jana Jaati					0.49	0.27–0.90
Dalit					0.48	0.26–0.90
Main source of income						
Farming (agriculture/live stock)					1.00	
Wage labor					1.52	0.62–3.76
Small trade/business					1.59	0.62–4.09
Service/employment					1.42	0.61–3.28
Remittances					2.42	1.27–4.61
Mixed source of income					1.19	0.63–2.27
Duration of labor						
5 h or less					1.00	
6–12 h					1.43	0.85–2.40
13 h or more					1.35	0.75–2.45
Mode of deliveries						
Vaginally					1.00	
Not all vaginal					0.11	0.02–0.53
Injury affecting reproductive organs						
Never					1.00	
Yes					1.75	1.07–2.85
Don't know					1.87	0.50–7.07

CI: confidence interval.
[a]Model with the three risk factors of interest, adjusted only for age.
[b]Model with the three risk factors adjusted for confounding, including age.
[c]Model with all identified risk factors in this study, including age.

groups.[21] This might have protected them against UP, perhaps by alleviating their work burden. Socio-cultural factors and gender discrimination are reported as root causes of high rates of UP in Nepal;[22] however, these factors were not included in this study. Other studies, conducted in developed and developing countries, have also found ethnicity to be associated with UP.[8,19,23]

The main limitation of this study was that it was essentially cross-sectional in its recruitment. Although questions were asked about women's histories, the sample was necessarily of "survivors," or women who had not been diagnosed with and treated for UP. The result was that we had difficulty recruiting cases of degree 2 or above. This likely reflects the success of Nepal government programs in identifying and treating UP. Consequently, most cases in the study had first degree prolapse. This may have reduced the power of the study to find strong associations with UP. At the same time, the cross-sectional nature of the study limits inferences that can be drawn about the temporal sequence of prolapse and lifestyle factors. Uncertainties, such as the following, remain: were cases more likely to be housewives because prolapse made it more difficult for them to work outside the home? Similarly, did UP reduce the likelihood of load carrying? That seems likely, given the results of the analysis when we restricted the analysis to just second- and third-degree cases. Related also to the cross-sectional nature of the study, memories are fallible and some misclassification of past events is likely.

One of the most striking findings of this study was the association of UP with wearing a patuka. Although very plausible and possibly due to a mechanism involving increased pressure within the pelvic cavity, further study in a larger population sample to confirm this association is warranted. An association with wearing a patuka would possibly be more amenable to intervention than would be load carrying (if it were a risk factor). Confirmation of the patuka finding would provide a basis for either discouraging the use of a patuka when working or load carrying, or for designing a more ergonomically suitable patuka. The intended purpose of the patuka is to prevent back pain.[17] In addition, making more widely available information and education about risk factors and promotion of strategies that encourage women to adjust their position at work may help to reduce the incidence and prevalence of UP.

In conclusion, we found no evidence that carrying heavy loads was in itself a risk factor for UP in Nepali women, although this might be attributable to the cross-sectional nature of study recruitment. The practice of using a patuka by Nepali women, their occupation, position at work, and caste/ethnicity were found to be associated with UP.

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Author contributions

H.R.D., N.P., C.H., D.G., and M.B. conceived and designed the study. H.R.D., D.G., and M.B. obtained the funding. H.R.D. implemented the study in the field with mentoring support from M.B., D.G., T.S., and N.P. H.R.D. with the help of M.B., analyzed the data and prepared the manuscript, and D.G., N.P., C.H., and T.S. commented and provided their inputs for finalization of manuscript. All authors reviewed and approved the final version of the manuscript.

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