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RESEARCH ARTICLE

# Impact of Socioeconomic Disparities, General Health, Reproductive, and Exercise Status in Indian Women with Lumbopelvic Pain

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**Abstract:**

***Background:***

Evidence suggests links between several health conditions and lumbopelvic pain (LPP) in women beyond the commonly associated musculoskeletal origins of LPP.

***Objective:***

This study explored the association of LPP with general health conditions, stress, exercise, and socioeconomic status in Indian women.

***Methods:***

In a cross-sectional study, 500 urban women from diverse socioeconomic backgrounds were asked to fill out a self-report questionnaire that sampled their health and reproductive status.

***Results:***

Women sampled were in the age range of 18-62 years. Overall, the prevalence of LPP was found to be 76.8% and was predominantly observed in women from the lower socioeconomic strata (70.5%), compared to women from the higher strata (29.4%). Multivariate logistic regression identified gynecological issues, such as menstrual problems (O.R.= 472.86, p<0.0001); polycystic ovarian syndrome (O.R.= 125.04, p=0.010); and health issues, such as urinary incontinence (O.R.=3078.24, p=0.001); chronic cough (O.R.= 84.97, p<0.0001); stress (O.R.= 474.27, p<0.0001) as being significantly related to LPP. Additionally, '*no exercise'* (O.R.= 360.15, p <0.0001) was also strongly associated with LPP.

***Conclusion:***

Our data suggest that LPP is a significant problem in Indian women, with a greater prevalence in women from the lower strata of society. Importantly, given that several general, gynecological health issues, psychological stress, and a lack of exercise are associated with it, there is a need for LPP sensitization at a community and public health level. Regarding its prevention and long-term management, it is important to rule out and consider the impact of these factors on LPP, beyond its musculoskeletal origins.

**Keywords:** Lumbopelvic pain, General health, Gynecological health, Stress, Exercise, Indian women.

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|---|---|---|---|

## 1. INTRODUCTION

Pain in the lumbar spine and/ or pelvic region; described as Lumbopelvic pain (LPP) has become a significant health concern for women in all societies [1 - 7]. The exact pathology behind the cause of LPP is still not known [1 - 7]. However, its increasing predominance among women is majorly due to its association with parturition since it involves alterations in lumbopelvic structures [3]. Similarly, abnormal stresses to the abdominal and pelvic structures also increase the risk of LPP. These observations are common in women with urinary incontinence, breathing disorders, *etc* [8, 9]. Hence, women are disproportionately vulnerable to LPP disorders [1 - 7].

The prognosis of LPP is poor among women, which severely deteriorates their psychological well-being [10 - 12]. Evidence suggests that in response to general stress, people either indulge in health-promoting or health-inhibiting habits [13]. When psychological stress coexists with LPP irrespective

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of what occurred first, it negatively influences lifestyle habits like lack of exercise, unhealthy diet, and subsequent weight gain. Health-inhibiting activities in turn mediate several lifestyle-related conditions that are widely recognized to interfere with the general and reproductive health of women [1, 14, 15]. One such common disorder prevailing among reproductive women is Polycystic Ovarian Syndrome (PCOS), which further escalates the risk of other health ailments like hypertension (HTN) and diabetes mellitus (DM type 2) [16 - 18].

Lack/low physical activity also involves a mechanism that accounts for endocrine alterations which again is a frequent observation among women experiencing LPP [18 - 20]. A common endocrine disorder among women is osteoporosis which severely accelerates the rate of lumbar vertebral disc degeneration once a woman attains menopause [21 - 23]. Low bone health, however, is prevalent among young premenopausal women as well [15]. Disrupted lifestyles owing to urbanization significantly disturb metabolic homeostasis giving rise to several health issues in women such as gastrointestinal diseases, delayed menarche, *etc.* where an alteration in the thyroid stimulating hormones(TSH) is most common [15, 24]. This is noteworthy since endocrine alterations are particularly associated with lumbar spine pathology in women, and routine exercises are frequent recommendations for good endocrine balance [16].

Physical activity is considered to be a protective factor in preventing LPP. The World Health Organization (WHO) has recommended at least 2.5 hours of moderate endurance activities for achieving significant health benefits for adults, even for those with chronic health conditions [25]. *"Straighten up and move"* was one such evidence-based program promoted by the WHO that aimed to create sensitization about the importance of daily exercises in the prevention of LPP and associated disabilities in economically deprived communities [26]. Conversely, functional disability secondary to LPP has socioeconomic consequences in terms of decreased productivity in work and increased treatment costs [27, 28].

It is known that only 25% of an individual's health is determined by his/her genes and health-caring behaviors and the rest 75% is influenced by the environment, medical care, and social factors, and these factors are largely framed by the socioeconomic status of a person [29]. It is believed that populations with relatively low socioeconomic classes are vulnerable to physical illness since socioeconomic disparities come in the way of good healthcare services for poor families [30, 31]. India is a country where socioeconomic barriers to health don't merely mean poor monetary status but also comprise caste(hierarchy in Indian society) [32], geographical region (rural/urban) [31], and even the unsupportive family [33, 34]. It has been noticed that under such circumstances, heath is never a priority of concern in women's life [34]. Thus, the socioeconomically deprived Indian women are marginalized by structural as well as social barriers in seeking health care even if they recognize their illness. Whereas, the middle socioeconomic class Indian women weakly perceive their health and therefore don't realize the need to seek health care [31]. They rather sought self-care and took over-the-counter pain medicines for LPP [31, 33, 35]. As a result, suffering from LPP continues to be elusive among women [31, 33, 35]. Surprisingly, in several communities, women are reluctant to engage in health screening initiatives owing to *health illiteracy*. Illiteracy or insufficient education doesn't make them recognize the risks to their physical health [30, 31, 34, 36 - 41] and they end up adopting wrong lifestyle choices like reduced physical activities. Low physical activity, if maintained for a long time, eventually leads to musculoskeletal deconditioning and the development of LPP [39, 42 - 47]. A challenge in studying socioeconomic disparities in health and LPP is that the related components are often correlated with one another. We aimed to gather data on the direct linkage between socioeconomic status, general health, reproductive and exercise status, and LPP in Indian women. As a first step, the purpose of this study was to determine the frequency or percentage occurrence of these factors in women with LPP.

## 2. MATERIALS AND METHODS

### 2. 1. Study Design and Participants

This cross-sectional research study complied with the 'strengthening and reporting of observational studies in epidemiology (STROBE)' guidelines [48], and was conducted following ethical approval. The sample population was collected following the multi-stage sampling criteria. The sampling design was carried out at two levels. Since the study took place in Delhi, the area was divided into 4 strata as per the population census (2011). Among each stratum, the selection of households was done using systematic random sampling and probability proportional to size. Post-selection of households, women from these houses were invited to the camps, located in their specific areas. At these camps, detailed assessments of the women participants were conducted. Five hundred (500) women above 18 years of age were recruited as volunteers from free health camps that were organized in several regions of Delhi, India. Pregnant and postpartum (up to 6 months) women, and or women suffering from neurological disorders were excluded from the study. All participants provided written informed consent for participation in the study.

### 2.2. Procedure

Women attending the camps were screened for LPP. Women suffering from pain in the lumbar spine and/or pelvic regions, irrespective of duration, were documented as LPP and asked to sign a consent form. A self-report questionnaire was administered to all participants. The questionnaire was based on a comprehensive literature search on the biological and psychological risks of LPP [9,14,22,1,48-50]. It was divided into three sections: (1) general health status, (2) reproductive status, (3) general psychological stress, and (4) exercise status. The socioeconomic strata of the participants were assessed through the Modified Kuppuswamy scale [25].

### 2.3. Statistical Analysis

The analysis included profiling the study participants on socio-demographics, LPP, health, reproductive, and exercise status. Categorical study variables were reported as frequency distributions and percentages. Cross tables were generated and

the difference between health and exercise status with LPP was determined through Pearson's Chi-square test. Multivariate logistic regression (forward likelihood ratio (LR) method) was carried out to ascertain the association of health and exercise status with LPP. $p < 0.05$ was considered significant for all statistical analyses.

## 3. RESULTS

### 3.1. Participant's Characteristics

Five hundred (500) urban women, with a mean age of 32.6(±13.1)years, ranging from 18 to 62 participated in the study. There were about 140 participants who were between 21-30 years old, 76 participants between 31-40, 114 participants between 41-50, and 48 participants above 50 years of age. As seen in Table **1**, 42.6% of the participants belonged to the upper strata, whilst 57.4% belonged to the lower strata. Overall, the majority of the participants had, at minimum, received primary education.

### 3.2. Prevalence

Overall, 384 study participants presented with LPP in the current study, with a prevalence of 76.8%. The mean age of women suffering from LPP was 35.1 (±13.2), while women without LPP were, on average, 24.1 (±8.5) years old (t=10.653, p <0.0001).

It was observed that a majority of the women with LPP were from the low economic strata (70.5%), as compared to only 29.4% from the upper socioeconomic strata (Table **2**).

**Table 1. Participant characteristics (n=500).**

| - | n (%) |
|---|---|
| **Age (years)** | |
| Mean ± SD (Range) | 32.6 ± 13.1 (18 – 62) |
| **Education Level** | |
| Illiterate | 90 (18%) |
| Primary | 114 (22.8%) |
| At least an intermediate /diploma | 100 (20%) |
| Graduate or more | 196 (39.2%) |
| **Socioeconomic Status** | |
| Upper | 213 (42.6%) |
| Lower | 287 (57.4%) |

**Table 2. Frequency distribution and comparison of study parameters in participants with and without LPP.**

| - | No LPP (n=116) | LPP (n=384) | Total | Chi-Square Statistic | p-value |
|---|---|---|---|---|---|
| | - | - | | | |
| | n(%) | n(%) | | | |
| **Socioeconomic Status** | | | | | |
| Upper | 100 (86.2%) | 113 (29.4%) | 213 (42.6%) | - | - |
| Lower | 16 (13.8%) | 271 (70.6%) | 287 (57.4%) | 118.904 | <0.0001* |
| **Pain in Other Regions** | | | | | |
| Neck/upper back pain | 6 (5.2%) | 116 (30.2%) | 122 (24.4%) | - | - |
| Knee/foot pain | 2 (1.7%) | 220 (57.3%) | 222 (44.4%) | 270.353 | <0.0001* |
| None | 108 (93.1%) | 48 (12.5%) | 156 (31.2%) | - | - |
| **Gynecological Conditions** | | | | | |
| Dysmenorrhea/irregular menses/heavy menses | 6 (5.2%) | 194 (50.5%) | 200 (40%) | 76.337 | <0.0001 |
| Menopause | 3 (2.6%) | 121 (31.5%) | 124 (24.8%) | 39.964 | <0.0001 |
| Hysterectomy | 2 (1.7%) | 19 (4.9%) | 21 (4.2%) | 2.301 | 0.129 |
| Amenorrhea | 5 (4.3%) | 7 (1.8%) | 12 (2.4%) | 2.353 | 0.125 |
| PCOS | 6 (5.2%) | 51 (13.3%) | 57 (11.4%) | 5.8 | 0.016* |
| Leucorrhea | 4 (3.4%) | 76 (19.8%) | 80 (16%) | 17.705 | <0.0001* |
| Abnormal vaginal discharge | 7 (6%) | 48 (12.5%) | 55 (11%) | 3.804 | 0.051 |
| **General Health Conditions** | | | | | |
| Urinary incontinence | 4 (3.4%) | 184 (47.9%) | 188 (37.6%) | 75.084 | <0.0001* |
| Chronic constipation | 4 (3.4%) | 311 (81%) | 315 (63%) | 229.796 | <0.0001* |
| Kidney problems | 5 (4.3%) | 49 (12.8%) | 54 (10.8%) | 6.603 | 0.010* |
| Diabetes | 4 (3.4%) | 20 (5.2%) | 20 (4%) | 0.604 | 0.437 |
| Chronic cough | 5 (4.3%) | 341 (88.8%) | 346 (69.2%) | 298.395 | <0.0001* |

*(Table 2) contd.....*

| - | No LPP (n=116) | LPP (n=384) | Total | Chi-Square Statistic | p-value |
|---|---|---|---|---|---|
| Thyroid issues | 1 (0.9%) | 128 (33.3%) | 129 (25.8%) | 49.068 | <0.0001* |
| Osteoporosis | 4 (3.4%) | 132 (34.4%) | 136 (27.2%) | 43.032 | <0.0001* |
| Hypertension | 5 (4.3%) | 26 (6.8%) | 31 (6.2%) | 0.927 | 0.336 |
| **General Psychological Stress** | | | | | |
| Sometimes stressed | 25 (21.6%) | 92 (24%) | 117 (23.4%) | 275.252 | <0.0001* |
| Often stressed | 12 (10.3%) | 282 (73.4%) | 294 (58.8%) | | |
| Never/rarely stressed | 79 (68.1%) | 10 (2.6%) | 89 (17.8%) | | |
| **Exercise (hours/week)** | | | | | |
| < 2.5 hours | 30 (25.9%) | 23 (6%) | 53 (10.6%) | 174.674 | <0.0001* |
| At least 2.5 hours | 34 (29.3%) | 32 (8.3%) | 66 (13.2%) | | |
| > 2.5 hours | 42 (36.2%) | 34 (8.9%) | 76 (15.2%) | | |
| None | 10 (8.6%) | 295 (76.8%) | 305 (61%) | | |
| **Ever Gave Birth?** | | | | | |
| Yes (parous) | 27 (23.3%) | 216 (56.3%) | 243 (48.6%) | 38.776 | <0.0001* |
| No (nulliparous) | 89 (76.70%) | 168 (43.80%) | 257 (51.40%) | | |
| **Among Parous Participants:** | | | | | |
| Had a history of LPP during pregnancy | 0 (0%) | 203 (94%) | 203 (83.5%) | 154.153 | <0.0001* |
| No history of LPP during pregnancy | 27 (100%) | 13 (6%) | 40 (16.5%) | | |
| Had NVD | 27 (100%) | 142 (65.7%) | 169 (69.5%) | 13.3 | <0.0001* |
| Had c-section delivery | 0 (0%) | 74 (34.3%) | 74 (30.5%) | | |
| Had one child | 17 (63%) | 28 (13%) | 45 (18.5%) | 42.902 | <0.0001* |
| Had two children | 8 (29.6%) | 74 (34.3%) | 82 (33.7%) | | |
| Had ≥3 children | 2 (7.4%) | 114 (52.8%) | 113 (47.7%) | | |

**Note**: *p<0.05; statistically significant.
PCOS- Polycystic ovarian syndrome.
NVD- Normal vaginal delivery.
LPP- Lumbopelvic pain.

**Table 3. Multivariable Logistic Regression (Forward LR Method) for LPP.**

| - | Odds Ratio (O.R.) | 95% C.I. for O.R | | p-value |
|---|---|---|---|---|
| | | Lower | Upper | |
| **Gynecological Issues** | | | | |
| Dysmenorrhea/irregular menses/heavy menses | 472.86 | 35.97 | 6216 | <0.0001* |
| PCOS | 125.04 | 3.18 | 4924.02 | 0.010* |
| **Health Issues** | | | | |
| Urinary incontinence | 3078.24 | 24.91 | 380340.11 | 0.001* |
| Chronic cough | 84.97 | 11.39 | 633.80 | <0.0001* |
| **Stress?** | | | | |
| Sometimes stressed | 237.65 | 14.33 | 3941.94 | <0.0001* |
| Often stressed | 474.27 | 21.30 | 10562.68 | <0.0001* |
| **Exercise (hours/week)** | | | | |
| < 2.5 hours | 18.03 | 1.90 | 170.82 | 0.012* |
| None | 360.15 | 31.91 | 4064.21 | <0.0001* |

**Note**: *p-value < 0.05, statistically significant.
*PCOS- Polycystic ovarian syndrome.

### 3.3. Distribution of Factors according to LPP *versus* no LPP

#### *3.3.1. Association between LPP and General Health Conditions*

As seen in Table **2**, frequency analysis of the data revealed that there were significantly more women with LPP, compared to women without LPP, that suffered from chronic constipation (LPP *vs.* no LPP: 81% *vs.* 3.4%), chronic cough (LPP *vs.* no LPP: 88.8% *vs.* 4.3%), urinary incontinence (LPP vs no LPP: 47.9% vs 3.4%), thyroid issues (LPP *vs.* no LPP: 33.3% *vs.* 0.9%), kidney problems (LPP *vs.* no LPP: 12.8% *vs.* 4.3%), osteoporosis (LPP *vs.* no LPP: 34.4% *vs*. 3.4%). However, the differences in the number of women suffering from HTN (LPP

*vs.* no LPP: 6.8% *vs.* 4.3%) and diabetes (LPP *vs.* no LPP: 5.2% *vs.* 3.4%) failed to achieve significance.

A multivariate logistic regression analysis, however, revealed that urinary incontinence (OR= 3078.24; p=0.001) and chronic cough (OR = 84.97; p<0.0001) were the health-related factors associated with LPP. In addition, general psychological stress 'sometimes' (OR= 237.65; p <0.0001) at 95% C.I. was associated with LPP (Table **3**).

#### *3.3.2. Association between LPP and Gynecological Conditions*

Significantly more women with LPP suffered from menstrual problems (dysmenorrhea/irregular menses/heavy menses) (LPP *vs.* no LPP: 50.5% *vs.* 5.2%), leucorrhoea (LPP *vs.* no LPP: 19.8% *vs.* 3.4%), PCOS (LPP *vs.* no LPP: 13.3% *vs.* 5.2%) and menopause (LPP *vs.* no LPP: 31.5% *vs.* 2.6%) in comparison to women without LPP. However, abnormal vaginal discharge (LPP *vs.* no LPP: 12.5% *vs.* 6%), hysterectomy (LPP *vs.* no LPP: 4.9% *vs.* 1.7%) and amenorrhea (LPP *vs.* no LPP: 12.5% *vs.* 6%) couldn't achieve significant association with LPP (Table **2**).

With multivariate logistic regression, menstrual problems(dysmenorrhea/irregular menses/heavy menses) (OR=472.86; p<0.0001) and PCOS(OR=125.04; p=0.010) at 95% C.I. were identified as gynecological related factors associated with LPP (Table **3**).

#### *3.3.3. Asso+ciation between LPP and General Psychological Stress*

For general psychological well-being, stress was significantly reported more among women with LPP, compared to women without LPP ('often stressed': LPP *vs.* no LPP, 73.4% *vs.* 10.3%) and ('sometimes stressed': LPP *vs.* no LPP, 24% *vs.* 21.6%) (Table **2**).

Being stressed 'often' (OR=474.27; p<0.0001) and 'sometimes' (OR=237.65; p <0.0001) at 95% C.I. were independent general health factors associated with LPP (Table **3**).

#### *3.3.4. Association between LPP and Exercise Status*

Routine exercises were significantly observed more among women who didn't have LPP compared to those who suffered from LPP (<2.5 hours/week: LPP *vs.* no LPP, 6% *vs.* 25.9%), (at least 2.5 hours/week: LPP *vs.* no LPP, 8.3% *vs.* 29.3%) and (>2.5 hours/week: LPP *vs.* no LPP, 8.9% *vs.* 36.2%) (Table **2**).

Exercising for < 2.5 hours/week (OR=18.03; p=0.012) and 'no exercise' (OR=360.15; p<0.0001) at 95% C.I. were exercise-related factors associated with LPP (Table **3**).

### 3.4. Association between LPP and Pain in other Regions

Women with LPP suffered significantly more musculoskeletal pains compared to women without LPP (neck/upper back pain: LPP *vs.* no LPP, 30.2% *vs.* 5.2%), (knee/foot pain: LPP *vs.* no LPP, 57.3% *vs.* 1.7%) (Table **3**). However, musculoskeletal pains in other regions were not associated with LPP on multivariate logistic regression analysis (Table **3**).

### 3.5. Association between LPP and Childbirth

It was observed that there were significantly more women with LPP compared to those without LPP who had given childbirth (LPP *vs.* no LPP: 56.3% *vs.* 23.3%) irrespective of the mode of childbirth {Normal vaginal delivery (NVD): LPP *vs.* no LPP: 65.7 % (n=142) *vs.* 100 % (n=27)}, (Cesarean delivery (c-section): LPP *vs.* no LPP: 34.3% *vs.* 0%). Additionally, more such women with LPP compared to those without LPP were observed to have previously suffered from LPP during their pregnancy period (LPP *vs.* no LPP: 94% *vs.* 0%), had 3 or more children (LPP *vs.* no LPP: 52.8% *vs.* 7.4%), had 2 children (LPP *vs.* no LPP: 34.3% *vs.* 29.6%) and one child (LPP *vs.* no LPP: 13% (n=28) *vs.* 63% (n=17) (Table **3**). However, the multivariate logistic regression did not reveal any significant association between LPP and childbirth-related factors (Table **3**).

### 3.6. Distribution in Women with LPP of Various Conditions According to Socioeconomic Strata

#### *3.6.1. Distribution of General Health Conditions in Women with LPP According to SES*

Several health conditions, such as Urinary incontinence (UI) (Lower SES: 64.57%, Upper SES: 7.9%), chronic constipation (Lower SES: 83.3%, Upper SES: 75.2%), chronic cough (Lower SES: 94.8%, Upper SES: 74.3%), diabetes (Lower SES: 7.3%, Upper SES: 0%), thyroid issues (Lower SES: 38%, Upper SES: 22.1%), and osteoporosis (Lower SES: 43.9%, Upper SES: 11.5%) were observed to be more in the lower socioeconomic strata than participants in the Upper strata. There were no significant differences between participants from the upper and lower strata suffering from hypertension (HTN) (Lower SES: 5.53%, Upper SES: 9.7%).

#### *3.6.2. Distribution of General Psychological well-being in Women with LPP According to SES*

More participants in the lower socioeconomic strata 'often' perceived general psychological stress (Lower SES: 89.2%, Upper SES: 35.3%) in comparison to participants in the upper socioeconomic strata. While more participants in the upper socioeconomic strata 'sometimes' perceived general psychological stress (Upper SES: 54.8%, Lower SES: 11%) in comparison to participants in the lower socioeconomic strata.

#### *3.6.3. Distribution of Gynecological Conditions in Women with LPP According to SES*

Gynecological covariates, such as menstrual problems (dysmenorrhea/irregular menses/heavy menses) (Upper SES: 73.4%, Lower SES: 40.95%), amenorrhea (Upper SES: 6.19%, Lower SES: 0%) and PCOS (Upper SES: 38%, Lower SES: 2.95%) were observed more in the upper socioeconomic strata in comparison to participants with lower SES. While leucorrhea (Lower SES: 26.5%, Upper SES: 3.5%) and abnormal vaginal discharges (Lower SES: 17.34%, Upper SES: 1%) were observed more among participants from lower socioeconomic strata as compared to participants from upper socioeconomic strata. Hysterectomy (Lower SES: 6.2%, Upper SES: 1.7%) was a common gynecological procedure in the

lower socioeconomic strata in comparison to participants in the upper socioeconomic strata. Menopause (Lower SES: 43.17%, Upper SES: 3.5%) was observed more in participants from lower SES in comparison to participants in the upper SES.

### *3.6.4. Distribution of Exercise Status in Women with LPP According to SES*

More participants in the upper socioeconomic strata indulged in routine exercises for at least 2.5 hours/week (Upper SES: 15.9%, Lower SES: 5.1%) and less than 2.5 hours/week (Upper SES: 13.2%, Lower SES: 2.9%) than in comparison to participants in the lower socioeconomic strata.

### *3.6.5. Distribution of Pain in other Areas that Women with LPP Suffered According to SES*

Musculoskeletal pains in the lower extremities such as knee and/or heel pain (Lower SES: 66.4%, Upper SES: 35.3%) were observed to be more in the lower socioeconomic strata in comparison to the participants in the upper socioeconomic strata. There were no significant differences between participants from the upper and lower strata suffering from neck or upper back pain (Lower SES: 29.8%, Upper SES: 30.9%).

### *3.6.6. Distribution of Childbirth in Women with LPP According to SES*

Normal vaginal delivery (Lower SES: 66.7%, Upper SES: 55.5%) and history of LPP during pregnancy (Lower SES: 98.5%, Upper SES: 44.4%) were observed more in the lower socioeconomic strata compared to participants in upper socioeconomic strata. While cesarean section delivery (Upper SES: 44.4%, Lower SES: 33.3%) was observed more among participants from upper SES compared to participants from lower SES. Participants in the lower socioeconomic strata had three or more children (Lower SES: 57%, Upper SES: 5.5%) in comparison to participants in the upper socioeconomic strata. While the percentage of participants having one child (Upper SES: 67%, Lower SES: 8%) was observed more in the upper socioeconomic strata compared to lower socioeconomic strata. There were no differences between participants in the upper and lower socioeconomic strata with two children (Upper SES: 39%, Lower SES: 35%) (Table **4**).

**Table 4. Socioeconomic disparities in health, reproductive and exercise status among LPP participants.**

| LPP =384 (76.8%) | | | Total n(%) |
|---|---|---|---|
| | Upper SES n(%) 113(29.4%) | Lower SES n (%) 271(70.5%) | |
| **Gynecological Issues** | | | |
| Dysmenorrhea/irregular menses/heavy menses | 83 (73.4%) | 111(40.95%) | 194 (50.5%) |
| Menopause | 4 (3.5%) | 117 (43.17%) | 121 (31.5%) |
| Hysterectomy | 2 (1.76%) | 17 (6.2%) | 19 (4.9%) |
| Amenorrhea | 7 (6.19%) | 0 (0%) | 7 (1.8%) |
| PCOS | 43 (38%) | 8 (2.95%) | 51 (13.3%) |
| Leucorrhea | 4 (3.5%) | 72 (26.56%) | 76 (19.8%) |
| Abnormal vaginal discharge | 1 (1%) | 47(17.34%) | 48 (12.5%) |
| **Health Issues** | | | |
| Urinary incontinence | 9(7.9%) | 175 (64.57%) | 184 (47.9%) |
| Chronic constipation | 85 (75.2%) | 226 (83.3%) | 311 (81%) |
| Kidney problems | 15 (13.2%) | 34 (12.5%) | 49 (12.8%) |
| Diabetes | 0 (0%) | 20 (7.3%) | 20 (5.2%) |
| Chronic cough | 84 (74.3%) | 257 (94.8%) | 341 (88.8%) |
| Thyroid issues | 25 (22.1%) | 103 (38%) | 128 (33.3%) |
| Osteoporosis | 13 (11.5%) | 119 (43.9%) | 132 (34.4%) |
| HTN | 11 (9.7%) | 15 (5.53%) | 26 (6.8%) |
| **General Psychological Stress** | | | |
| Sometimes stressed | 62 (54.8%) | 30 (11%) | 92 (24%) |
| Often stressed | 40 (35.3%) | 242 (89.2%) | 282 (73.4%) |
| Never/rarely stressed | 10 (8.8%) | 0 (0%) | 10 (2.6%) |
| **Exercise (hours/week)** | | | |
| < 2.5 hours | 15 (13.2%) | 8 (2.95%) | 23 (6%) |
| At least 2.5 hours | 18 (15.9%) | 14 (5.1%) | 32 (8.3%) |
| > 2.5 hours | 34 (30%) | 0 (0%) | 34 (8.9%) |
| None | 88 (77.8%) | 207 (76.38%) | 295(76.8%) |
| **Ever Gave Birth?** | | | |
| Yes (parous) | 18 (15.9%) | 198 (73.1%) | 216(56.3%) |
| No (nulliparous) | 95 (84.1%) | 73 (26.9%) | 168(43.8%) |
| **Among Parous Participants:** | | | |

*(Table 4) contd.....*

| | LPP =384 (76.8%) | | Total n(%) |
|---|---|---|---|
| | **Upper SES n(%) 113(29.4%)** | **Lower SES n (%) 271(70.5%)** | |
| Had a history of LPP during pregnancy | 8 (44.4%) | 195(98.5%) | 203 (94%) |
| No history of LPP during pregnancy | 10 (55.5%) | 3 (1.5%) | 13 (6%) |
| Had NVD | 10 (55.5%) | 132 (66.7%) | 142 (65.7%) |
| Had c-section delivery | 8 (44.4%) | 66 (33.3%) | 74 (34.3%) |
| Had one child | 12 (67%) | 16 (8%) | 28 (13%) |
| Had two children | 5 (39%) | 69 (35%) | 74 (34.3%) |
| Had ≥3 children | 1 (5.5%) | 113(57%) | 114 (52.8%) |
| **Pain in Other Regions** | | | |
| Neck/upper back pain | 35 (30.9%) | 81 (29.8%) | 116(30.2%) |
| Knee/foot pain | 40 (35.3%) | 180 (66.4%) | 220(57.3%) |
| None | 38 (33.6%) | 10 (3.6%) | 48 (12.5%) |

## 4. DISCUSSION

LPP is a predominant musculoskeletal condition that is strongly linked with women's reproductive function [3, 14, 51, 52]. In our research sample, about 76.8% of participants reported LPP at the time of recruitment, implying a high prevalence rate in Indian women.

Among the studied gynecological covariates, PCOS and other menstrual issues (dysmenorrhea/ irregular or heavy menses) were found to have a strong association with LPP in the reproductive participants of our study. The mean age of attaining menopause in Indian women is 46.2 years, which is way less when compared to Western women [53]. About 24.8% of participants in our study were post-menopausal, among which 121 participants had LPP. This can be related to the literature stating that estrogen level deficits lead to the degeneration of lumbar intervertebral discs in post-menopausal women [22]. A notable observation in our study was that 4.2% of our participants reported undergoing a hysterectomy, among which 19 participants had LPP. This implies that hysterectomy is common among Indian women and is indeed a matter of concern for women's health.

Disturbances in menstrual cycles have often been linked to over/under-active thyroid [54]. 33.3% of our study participants with LPP had hypo or hyperthyroidism. Further, UI, respiratory and gastrointestinal symptoms have been previously evaluated as risk factors for the development of LPP among women [9, 50]. The presence of premorbid health ailments predicts LPP with a predominantly higher risk among women [55]. We found several health issues in our study participants coexisting with LPP like diabetes, osteoporosis, hypertension, thyroid problems, UI, chronic cough, and chronic constipation. However, following multivariate regression analysis only UI (O.R.=3078.2) and chronic cough (O.R.=84.97) showed high odds for LPP. Compromised lumbopelvic control observed among patients with UI and respiratory issues could provide a physiological explanation for such associations [51, 56]. Hysterectomy has been significantly associated with UI in previous studies [8]. Since a substantial number of middle-aged women in our study had a hysterectomy, we can establish a possible link between UI, hysterectomy, and LPP. Further, a repetitive increase in intraabdominal pressure as observed during chronic cough, has been found to result in irreversible damage to the intervertebral disc in the long run. Moreover, the concurrent contraction of trunk flexors and extensors along with rapid forward trunk flexion during chronic coughing places an undue load on the lumbar spine structures, thereby increasing the risk of LPP [56 - 60]. Similarly, 81% of LPP participants in our study were suffering from chronic constipation. Straining during constipation too increases the intraabdominal pressure and can develop into LPP involving the same mechanism as that of chronic cough [56 - 58]. Therefore, it can be ascertained that any health condition that increases the intradiscal pressure will also augment the risk for LPP since the trunk musculature along with the respiratory diaphragm, transversus abdominis, and pelvic floor muscles provide mechanical stability to the lumbopelvic joints [9, 50, 59].

Even the transition to motherhood could be a risk to LPP as the physical strain directly sustained by the pelvic structures during parturition can alter lumbopelvic biomechanics; hence, often gives rise to certain LPP disorders [3, 56]. Parturition also disrupts the activity of pelvic floor muscles; hence LPP is a frequent symptom among women with urinary incontinence [50, 60]. The biomechanical consequences associated with parturition could also explain the high prevalence of LPP among parous participants (n=216) compared to nulliparous participants (n=168) in our study. Overall, 66.2% of participants in our study reported a history of LPP and could recall the number of times they experienced LPP in the past year. A previous history of LPP during the pregnancy phase was also strongly associated with current LPP in our study. History of LPP at the time of pregnancy is a strong risk for postpartum LPP that could persist for years [58, 10, 61]. Further, a previous history of LPP has also been found to be a risk factor for LPP during pregnancy for primiparous women as well [62, 63]. Another notable observation among the parous participants was concerning the mode of parturition in our study as well, where a history of c-section delivery (n=74) was strongly associated with current LPP. This can be justified as a consequence of muscle disruption that takes place during the surgical procedure, which can persist for years after the c-section delivery [64]. However, LPP was also evident among our participants who had previously undergone NVD (n=142). The percentage of LPP was high among participants who had ≥ 3 children of their own (52.8%). Possibly the number of times a woman goes through the process of parturition and subsequent changes in lumbopelvic musculoskeletal makes

them vulnerable to LPP. We however did not assess the mode of each delivery among multiparous participants. Based on our study findings, it is evident that alteration in lumbopelvic stability can also be an indirect consequence of health ailments, subsequently leading to LPP. Further, the LPP risks differ from the reproductive status of women.

LPP that commences during parturition sometimes progresses to chronicity for as long as twelve years, severely deteriorating the psychological well-being among women [10 - 12]. We included general psychological stress as part of health status in our study. A shorter duration like one month, has been considered to be enough for assessing general psychological stress levels [65]. Hence, we asked our participants about how often they felt stressed in the past month as we did not intend to assess any specific cause of psychological distress. A direct link between psychological stress and musculoskeletal pain disorders is not established in the literature [66, 67]. However, hindrances in work and social life due to LPP succumbs an individual to poor psychological health [66]. Women have recognized stressful environments like a load of domestic responsibilities to be worsening their pre-existing LPP symptoms [68]. Physiologically, how people emotionally perceive chronic musculoskeletal pains relies on their psychological health status and varies between individuals. The intrinsic neuromodulatory system in the brain is activated by emotion (positive/negative), attention as well as the perception of pain. Hence, pain perception can alter the activity of descending pain and afferent pathways. This possibly explains why chronic musculoskeletal pain leads to psychological distress and *vice versa* [69, 70].

Poor psychological well-being can engender poor lifestyle habits like sedentarism [1, 65]. The consequences of continuous sitting/standing for occupational demands have been explored in several studies; however, the impact of habitual physical activities on LPP is not well documented [71]. Hence, we identified the duration of regular exercises in our study where about 61% (n=305) of participants reported that exercise was not part of their daily routine, not even 150 minutes/week, which is the WHO recommendation. However, on multivariate logistic regression, we also found high odds (OR=360.15) of LPP for participants who were not at all involved in exercises in their everyday routine. The WHO has long emphasized maintaining the strength and flexibility of the spine by implementing exercises in daily routines [26]. Therefore, exercises have a crucial role even in LPP rehabilitation as well [72, 73]. Still, women are less likely involved in exercise habits possibly because they are less enthusiastic about exercise [74, 75]. Being aware of the benefits of exercising is one such significant measure to prevent LPP among women. Hence, we strongly recommend that healthcare stakeholders take the initiative by developing public health policies focusing on women's health and sensitizing them about the role of regular exercise in preventing LPP.

Contrastingly, in terms of socioeconomic disparities, we also found that 30% of LPP participants in the upper SES indulged in more than 2.5 hours of weekly exercises. We did not assess the type of exercises among our study participants. Since we recruited participants from the general population, there is a high possibility that these participants were involved in vigorous exercises and/or unguided exercises which could have resulted in LPP. Unawareness about non-pharmacological measures for musculoskeletal LPP like physiotherapy has been observed in rural Indian communities, where the majority of the population is socioeconomically deprived [76]. Though the current study took place in an urban Indian city, most of the study participants reporting LPP belonged to upper-lower SES (n=106). Hence, the impact of LPP is huge from an individual as well as a socio-economic perspective [2]. Unawareness could be thought of as one of the possible reasons for the high prevalence of LPP among participants from lower SES because, unlike rural areas, urban populations have access to healthcare facilities. Further, adapting self-help strategies is a common practice among Indian women to cope with LPP, where the underprivileged opt for home measures while the privileged women self-medicate [31, 33]. Menstrual issues like dysmenorrhea/ irregular or heavy menses were prevalent among our LPP participants in both upper and lower SES. We can't associate SES with these menstrual issues since it was common in both socioeconomic strata. The only thing common among our participants was the urban environment. Since these menstrual issues could result from metabolic disturbances, which are known to be influenced by poor lifestyle habits like decreased physical activity, psychological stress, and improper dietary habits [15, 20]. Another possible reason could be the occupations commonly observed among the population with low SES as a majority of them are involved in physically strenuous jobs that increase the risk of injury in the lumbopelvic complex [30, 77 - 79]. However, LPP risk is about 25% higher among women compared to male workers for a similar amount of exposure to strenuous physical tasks [48] as ergonomically the strength and anthropometrics of women are not the same as for male workers [80].

### 4.1. Strengths and Limitations of the Study

This is the first study that has documented the impact of LPP on health, reproductive, and exercise status in a large sample of women residing in urban India. Further, this is the first Indian study that has explored the gynecological and obstetrics covariates and their possible association with LPP from a biomechanical perspective.

Statistically, the strength of the study was opting for multivariate logistic regressions which overcome the risk of rejecting potential factors in univariate analysis. Since study variables that are identified as non-significant in the univariate or bivariate analysis may turn out to be significant in multivariate regression [81, 82].

Furthermore, researchers encourage the incorporation of biological and psychosocial approaches in LPP rehabilitation; however, it is seldom practiced by healthcare professionals [83, 84]. Whilst this study established an association of general health and exercise status with LPP; however, we couldn't establish if LPP occurrence was independent or was a result of premorbid health conditions due to the limitation of our research design as cross-sectional research doesn't determine relationships between factors. However, we have drawn attention to the percentage of LPP co-existing with other health-related symptoms in our sample. Another limitation of the study was that the sample size was non-comparable by age

group. Future research could do more to connect the influence of LPP and SES.

## CONCLUSION

UI, chronic cough, PCOS, dysmenorrhea/irregular and/or heavy menses, general psychological stress, and noninvolvement in exercises were identified to be highly associated with LPP among Indian women. Noteworthily, many lifestyle-related conditions were found to be strongly associated with LPP, like hypo/hyperthyroidism and chronic constipation. Hence, there is an alarming need for sensitization among women about inculcating health-promoting lifestyle habits like exercise and a good diet. Since a poor lifestyle is not only a risk for LPP but several health ailments interrelated to women's reproductive status. Formative information has been provided through the current study findings, which can be used to plan empirical strategies to engage women in LPP rehabilitation. It is also evident from the study findings that women presenting with LPP should be screened for health and reproductive status. Further, the amalgamation of this study data strengthens the association between socioeconomic class and health influences of women with LPP and suggests significant inferences for healthcare practice and research. A healthcare professional needs to be aware of the potential general health-related risks beyond the musculoskeletal origin, to reduce LPP suffering among women.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study received ethical approval from the institutional ethical committee of Amity University, Noida, Uttar Pradesh, India (AUUP/IEC/2021-JAN/02).

## HUMAN AND ANIMAL RIGHTS

No animals were used in this study. The study recruited human participants following the principles stated in the Helsinki Declaration for studies.

## CONSENT FOR PUBLICATION

Prior written informed consent was obtained from every study participant.

## STANDARDS OF REPORTING

STROBE guidelines were followed.

## AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author, [J.K.C.], on special request.

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None.

## CONFLICT OF INTERESTS

The authors declare no conflict of interest, financial or otherwise.

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