RESEARCH ARTICLE

Prevalence and risk factors for low back pain among university teaching staff in Nairobi, Kenya: a cross-sectional study [version 1; peer review: 1 approved, 2 approved with reservations]

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Abstract

Background: To date, there are few studies carried out on low back pain (LBP) among university teaching staff in developing countries despite academics being a high-risk group for LBP. In Kenya, to the best of our knowledge, there are no published studies that have investigated risk factors for LBP among teaching staff. The objectives of this study were to estimate the prevalence of LBP among teaching staff of the University of Nairobi (UoN), during the period June 2016 – May 2017, and to identify its socio-demographic and work-related risk factors.

Methods: An analytical cross-sectional study design was used to estimate the prevalence and investigate the risk factors for LBP among 136 teaching staff of UoN. A semi-structured questionnaire was used to collect data on LBP history, work-related and socio-demographic characteristics of the study participants. The 12-month prevalence of LBP and its associated 95% exact binomial confidence interval were estimated. A mixed-effects logistic regression model was used to evaluate the relationship between the predictors and LBP.

Results: The estimated 12-month prevalence of LBP was 64% (95% CI: 55.3%–72.0%). From the multivariable analysis, physical inactivity (aOR: 6.0; 95% CI: 1.2–29.6), office chairs without lumbar supports (aOR: 3.3; 95% CI: 0.1–0.9) and high workplace stress (aOR: 4.4; 95% CI: 1.1–17.5) were identified as significant risk factors for LBP among the respondents.

Conclusions: This study has revealed a high burden of LBP among teaching staff of the UoN and undoubtedly mimics the situation in other higher learning institutions in Kenya. Physical inactivity, sitting

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on chairs without lumbar supports and workplace stress have been identified as modifiable risk factors for LBP among teaching staff. This suggests a need to strengthen advocacy for regular physical activity, team-building activities and investment in office infrastructure to mitigate the effects of LBP within learning institutions.

Keywords
low back pain, prevalence, risk factors, University teaching staff.

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1. Introduction

Disorders of the musculoskeletal system (MSDs) constitute the second most common cause of disability worldwide – accounting for 169,624,000 disability-adjusted life years (DALYs) as of 2010 which is a 45.5% increase over 10 years[1,2]. Of all work-related MSDs, low back pain (LBP) remains the most frequently diagnosed condition since the low back vertebral discs are subject to the greatest mechanical stress, compression force and degenerative changes[3–5]. LBP is defined as pain localised between the lower margin of the twelfth ribs and the lower gluteal folds with or without leg pain that lasts at least one day[6,7].

LBP was ranked as the first contributing factor to global disability out of 291 conditions investigated in 2010 and the third in Eastern Sub-Saharan Africa, measured in years lived with disability[7]. LBP prevalence was found to be 50% among physicians and dentists in India[5], 61.9% among Ugandan nurses[4] and 77.2% in theatre nurses in Nigeria[3]. It is estimated that more than 80% of people end up suffering from LBP at some point in their lifetimes[8]. Only 5–15% of LBP cases have a specific cause such as an osteoporotic fracture, neoplasm or infection[9].

LBP arises from several contributing factors, namely: socio-demographic, ergonomic and psychosocial predictors[10]. Low back injuries leading to LBP are associated with occupational risk factors, with 11% to 80% of them being attributable to ergonomic factors such as prolonged sitting, lifting, bending and twisting[10–13]. Psychosocial factors account for 14% to 63% of low back injuries, mainly high job demands, job dissatisfaction and stress at the workplace[10–12,14]. Socio-demographic factors equally play an important role in LBP occurrence and comprise both individual and lifestyle factors. Of these, the most commonly identified are lack of physical exercise, old age, female gender, obesity and smoking[11–15].

The job description for teachers comprises a broad range of duties and responsibilities which may predispose teachers to LBP. For instance, while preparing teaching materials, teachers may experience prolonged sitting either in the office or at home. When delivering lectures, they may be upstanding for long hours, or may adopt awkward postures like bending, reaching and twisting. They may have to use inappropriate furniture such as immobile chairs without back support and non-mechanized tables. These varying postures may trigger back pain owing to the continuous loading of back muscles[12,16,17]. In Kenya, little has been published on LBP. However, the few available studies showed high prevalence of the condition in Nairobi: 76.5% among sedentary office workers[18] and 90.5% among hospital employees[19]. With a considerable proportion of teaching staff in Kenya being past the age of 50 years, it is anticipated that the magnitude of LBP would be high with attendant productivity losses and financial burden to the University community.

The objectives of this study were to estimate the prevalence of LBP among the teaching staff of the College of Health Sciences, University of Nairobi, during the period June 2016-May 2017, and to identify its socio-demographic and work-related risk factors with a view to informing the formulation of effective prevention and control strategies for LBP within teaching institutions in Kenya.

2. Methods

2.1 Study area and design

The study was conducted at the University of Nairobi (UoN), College of Health Sciences (CHS) – one of the six constituent colleges of the UoN. Notably, UoN is the largest higher learning institution in Kenya, whose working conditions closely mimic those of other public tertiary institutions in the country. The CHS consists of five schools (Medicine [SOM], Dental Sciences [SDS], Pharmacy [SOPharm], Nursing Sciences [SON], and Public Health [SPH]) and four institutes (Tropical and Infectious Diseases [UNITID], Kenya AIDS Vaccine Initiative [KAVI], East African Kidney Institute [EAKI] and the Centre for HIV Prevention and Research [CHIVPR]).

An analytical cross-sectional study design was employed to estimate the prevalence and investigate the risk factors for LBP among the college teaching staff of UoN from June 2016 to May 2017. The study was reported as per the STROBE guidelines for reporting observational studies[20].

2.2 Study population, eligibility and selection of participants

The study population consisted of all teaching staff of the CHS eligible to participate in the study. To be eligible for participation, a staff member had to have been employed for at least 12 months prior to the commencement date of the study (May 2017) and have given informed written consent for participation. Moreover, those having LBP due to trauma, infection or tumour were excluded from the study. The sampling frame of teaching staff was secured from the college registry. To obtain the study sample, a stratified random sampling technique (with strata being the constituent Schools and Institutes of the CHS) was used. Within each stratum, a simple random sample was selected, such that the number sampled per stratum was proportional to the size of the stratum. Arguably, stratified random sampling ensures that all strata are represented in the sample and further improves precision of the estimates by removing the between-strata variation[21]. A flow chart of the sampling strategy is shown in Figure 1.

2.3 Outcome defnition

An LBP case was defined as a staff member who had a history of pain localised in the lower back (as previously defined) lasting for at least 24 hours within the 12-month study period, had been physically examined by a physician at a health facility and further undergone a diagnostic imaging examination revealing lumbar disc degeneration. Contrastingly, a non-case was a study participant without a previous history of LBP within the same study period.

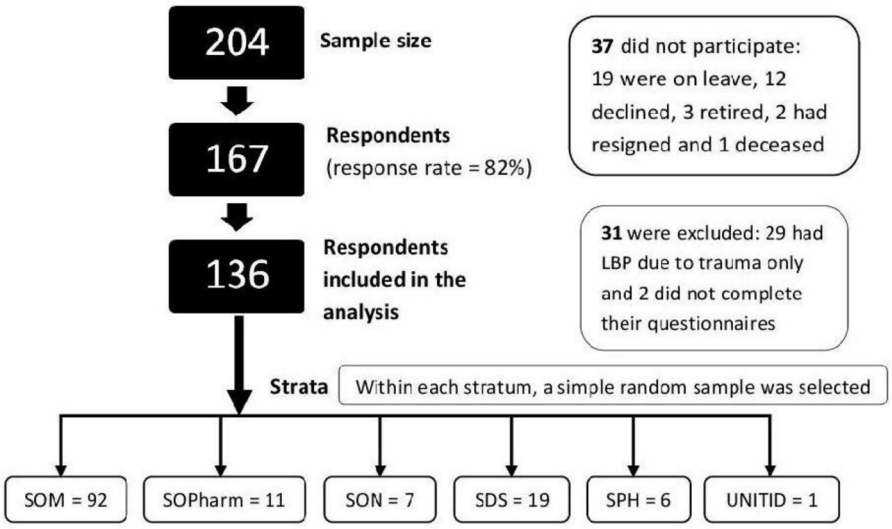

Figure 1. Flow chart of the stratified random sampling strategy.

2.4 Sample size determination

The required sample size was determined as specified by Kelsey, JL *et al.*[22] for cross-sectional studies:

$$n_1 = \frac{(Z_\alpha + Z_\beta)^2 \, \overline{pq}(r+1)}{r(p_1 - p_2)^2}$$

$$\overline{q} = 1 - \overline{p} \qquad n_2 = rn_1$$

$$p_1 = \frac{p_2 OR}{1 + p_2(OR - 1)}$$

$$\overline{p} = \frac{p_1 + rp_2}{r+1}$$

Where:

n_1 is the number of cases and n_2 is the number of non-cases; p_1 is the proportion of individuals who did not exercise and had LBP; p_2 is the proportion of individuals who exercised and had LBP – estimated to be 43.1% based on a previous study[14]. Notably, $Z_{\alpha/2}$ (1.96) and Z_β (-0.84) are the values which specify the desired 2-tailed confidence level (95%) and statistical power (80%) respectively. The odds ratio (*OR*) for the effect of the primary exposure (lack of physical exercise) was hypothesised to be 2.2[14]. The ratio (*r*) of unexposed to exposed individuals was set at 1. Given these figures, a total sample size of 204 participants was derived.

2.5 Data collection and study variables

Initially, two research assistants were recruited and trained to aid with the data collection exercise that spanned a two-month period May 31st–July 31st 2017. As for the data collection, a semi-structured questionnaire (see extended data[23]) was administered to the study participants capturing details of their LBP history, and predictors: work-related (length of working day, office chair design, stress, social support and job satisfaction) and socio-demographic characteristics (age, sex, marital status, body mass index (BMI), level of education, school (including department), physical activity engagement, tobacco use and level of alcohol intake). The predictors were assessed as given in Table 1. A conceptual framework depicting the predictor-outcome relationship is displayed in Figure 2.

2.6 Ethical considerations

The study respondents provided written informed consent expressing their willingness to take part in the study. Approval for the study was granted by the Kenyatta National Hospital and University of Nairobi joint Ethics and Research Committee (KNH-ERC/A/171).

2.7 Minimisation of biases

Granted that cross-sectional studies are prone to a range of biases that may invalidate study results, deliberate attempts were made to minimize their occurrence. Ergonomic and lifestyle factors are readily modified once individuals are diagnosed with LBP. As such, to reduce the possibility of reverse causality involving these set of factors, specific questions targeted the period preceding the onset of symptoms characteristic of LBP for case respondents. To standardise the interview process and thus minimize interviewer bias, the research assistants were trained on sound interviewing techniques. As non-response may introduce selection bias in cross-sectional studies, non-responders were aggressively followed up with reminders to achieve a reasonable response rate.

2.8 Data processing and statistical analysis

Prior to data entry, questionnaire responses capturing qualitative variables were coded. The data were then double-entered in an EpiData v3.1 spreadsheet by two independent data entry clerks to minimize errors. The validated dataset was then

Table 1. Predictor variables and their measurements.

Variable (type)	Measurement
Age (continuous)	Captured in years.
Sex (nominal)	Entered as male or female.
Marital status (nominal)	Assessed in three levels: single, married or others (widowed, divorced and separated).
BMI (continuous)	The body mass index (BMI) was determined by dividing weight in kilogrammes by height in metres squared.
School (nominal)	The institutional entity of the CHS where the teaching staff is based (including the specific department). Grouped into five levels: SOM (+UNITID & EAKI), SOPharm, SON, SDS, SPH (+CHIVPR).
Level of education (ordinal)	The level of university training attained by the teaching staff. Assessed in three levels: Bachelors, Masters or PhD.
Physical exercise (ordinal)	Physical exercise entails engaging in any of the following activities by the teaching staff: walking, running, cycling, swimming, jogging, back exercise and playing games e.g. football. This was graded in three levels according to the duration of continuous activity per day and frequency per week[24]: grade 1 or never (frequency less than once a week); grade 2/rare (1 or 2 days per week for a minimum of 30 minutes each day); grade 3/regular (at least 3 days per week for a minimum of 30 min each day).
Tobacco use (nominal)	Either by smoking or chewing and assessed either as user or non-user
Level of alcohol intake (ordinal)	This represents the amount of alcohol that is consumed by the teaching staff per week. Classified into three categories based on the frequency of intake per week[24]: grade 1 or non-consumer (less than once a week); grade 2/rare consumer (1-3 times in a week); grade 3/regular consumer (4-7 times per week).
Length of working day (continuous)	This constitutes the time during which the teaching staff is performing work-related duties.
Office chair design (nominal)	Assessed in two levels: with or without lumbar support.
Level of workplace stress (ordinal)	This refers to an uncomfortable feeling of nervousness or great worry caused by any difficult situation related to one's work. Therefore, a stressor may be any physical or psychological threat to safety, status, or well-being; physical or psychological demands that exceed available resources; any unpredictable change in the work environment; or any inconsistency between expectations and outcomes. It was scaled into three levels: 1 = low; 2 = medium; 3 = high.
Workplace social support (ordinal)	The degree to which the teaching staff perceives that his/her well-being is valued by his colleagues (can be in form of material, emotional or informational support). It was categorized into four levels: 0 = absent, 1 = poor, 2 = ok/satisfactory or 3 = good.
Job satisfaction (ordinal)	The feeling of pleasure and achievement that the teaching staff experiences in his/her job when he/she knows that his/her work is worth doing, or the degree to which his/her work gives him/her this feeling. It was categorized into three levels: 1 = dissatisfied, 2 = neutral or 3 = satisfied.

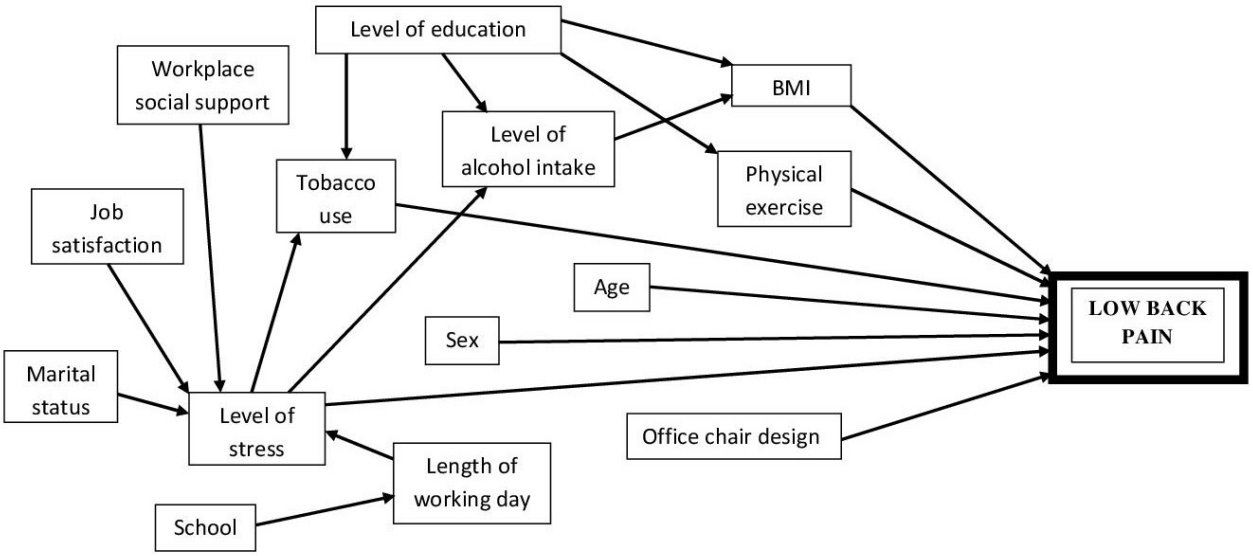

Figure 2. Causal diagram of factors thought to influence Low back pain occurrence among teaching staff of the College of Health Sciences, University of Nairobi.

exported to Stata v13 software for data cleaning and analyses. Continuous variables were summarized using the median and inter-quartile range (IQR) as well as histograms and boxplots. For categorical variables, proportions were computed. The prevalence of LBP and its associated 95% exact binomial confidence interval were estimated. Code for analysis is available as extended data[25].

For univariable analyses, a mixed-effects logistic regression model was used to evaluate the effect of each predictor on LBP, with the variable *department* included as a random effect to account for clustering of the outcome within departments. The significance of each of the predictors at this stage was evaluated at a liberal $P \leq 0.20$. As inclusion of *age*, *BMI* and *length of working day* as continuous predictors in the univariable models yielded insignificant results, these were categorised and reassessed for significance. In particular, *age* was grouped into three categories: ≤43yrs; 44–57yrs; ≥58yrs, *BMI* was classified into the four BMI categories[26]: Underweight(<18.5), Normal weight (18.5–24.9), Overweight (25.0–29.9) or Obese (≥ 30.0) and *length of working day* was categorised into: ≤8hrs or >8hrs.

Variables that were found to be significant in the univariable analyses were then offered to a multivariable model where a backward step-wise approach was used to eliminate variables at $P \geq 0.05$. To minimize confounding, elimination of non-significant predictors was only considered when their exclusion from the model did not result in a more than 30% change in the effects of the remaining variables[21]. Two-way interactions were fitted between the remaining variables of the final model and assessed for significance.

3. Results

3.1 Descriptive statistics

A total of 204 teaching staff of the CHS were invited to participate in the study, from whom 167 consented to participating in the survey, giving a response rate of 81.9%. However, of the 167 participants, 31 were excluded from the analyses for reporting trauma and/or infection as the reason(s) for their back pain. Therefore, 136 participants were considered in the analyses [see underlying data].

Descriptive statistics for the predictors of LBP are displayed in Table 2. Notably, the median age for the participants was 51 years (Range: 31–81yrs). A typical working day was 10 hours long (range: 4–18hrs). Only 44.9% (n=61) of the participants regularly exercised. Participants with office chairs that had lumbar support represented 41.9% (n=57) of the total. The estimated 12-month period prevalence of LBP was 64% (95% CI: 55.3%–72.0%).

3.2 Logistic regression analyses

Based on results of the univariable analyses, the variables: *sex, age, school*, *physical exercise, office chair design* and *level of workplace stress*, were significantly associated with LBP at P 0.20 (Table 3). These were subsequently offered to the multivariable model. In the multivariable analysis, only *physical exercise*, *office chair design* and *level of workplace stress* were shown to be significant predictors of LBP at the 5% of significance level (Table 4).

Compared to respondents who regularly exercised, participants who rarely and never exercised had respectively about three (aOR: 2.8; 95% CI: 0.9–8.4) and six times (aOR: 6.0; 95% CI: 1.2–29.6) the odds of LBP controlling for their office chair design and workplace stress level. Participants who sat on chairs with lumbar support had a third (aOR: 0.3; 95% CI: 0.1–0.9) the odds of LBP as those who did not regardless of their level of physical activity and stress at their workplace. Irrespective of their level of physical activity and design of their office chair, respondents who experienced high and low stress levels at their workplace had roughly four times (aOR: 4.4; 95% CI: 1.1–17.5) and three-fifths (aOR: 0.6; 95% CI: 0.2–1.9) the odds of LBP respectively, as those whose perception of stress was medium.

4. Discussion

4.1 Prevalence of LBP

The prevalence of LBP among teaching staff of the CHS, UoN was estimated to be 64.0%. This is a higher prevalence than demonstrated by most studies conducted among teachers in which LBP prevalence ranged between 22.3% (Thailand) and 57.5% (Ethiopia)[12–15]. This variation could be attributable to age differences between the study participants, with those in the mentioned studies being on average younger (mean age: 34.7–38yrs) than those included in the present study (mean age: 50.9yrs). An age-LBP association has been demonstrated, with LBP being more prevalent among individuals over 40 years[12,14,27].

4.2 Risk factors for LBP

This study has shown that teachers who either do not exercise or do so infrequently, have higher odds of experiencing LBP than their counterparts who exercise regularly. This finding is consistent with study observations made in Israel, Iran, India, South Korea and Ethiopia[11,14,15]. Regular physical exercise has been shown to strengthen lower back muscles and maintain the spine in proper alignment for optimal function. Furthermore, routine exercises increase blood supply to the spine muscles, joints and intervertebral discs minimizing injury and enhancing their repair[14,28,29]. It has been suggested that a minimum of 30 minutes of regular exercise could increase trunk flexibility and stimulate an adequate production of endorphins that could diminish pain sensation[30,31].

Sitting on a chair with back support had the effect of lowering the odds of LBP. The use of lumbar supports has been widely advocated because of their well-known function of preserving the integrity of the low back curves, thus reducing the risk of LBP[32–34]. Additionally, the tilt of the lumbar support permits the person using it to sit with his/her upper body slightly reclined which ensures proper body weight distribution[32,35,36].

There was a noticeable association between perceived stress levels at the workplace and the reporting of LBP. High stress levels have been associated with the stimulation of the sympathetic nervous system prompting the release of stress mediators

Table 2. Descriptive statistics for the predictors of low back pain among teaching staff of the College of Health Sciences, University of Nairobi, Kenya (n=136).

Variable	Values	Median	Inter-quartile range (IQR)	Frequency n (%)
Sex	Male Female	- -		86 (63.2) 50 (36.8)
Age (years)	31.0 – 81.0	51.0	18.5	-
Marital status	Married Single Others	- - -		116 (85.3) 13 (9.6) 7 (5.2)
BMI (Kg/m^2)	16.7 - 38.1	28.0	4.9	-
School	SOM SOPharm SON SDS SPH	- - - - -		93 (68.4) 11 (8.1) 7 (5.2) 19 (14.0) 6 (4.4)
Level of education	Bachelors Masters PhD	- - -		6 (4.4) 94 (69.1) 36 (26.5)
Physical exercise	Never Rarely Regularly	- - -		29 (21.3) 46 (33.8) 61 (44.9)
Tobacco use	Non-user User	- -		133 (97.8) 03 (2.2)
Level of alcohol intake	Non-consumer Rare Regular	- - -		88 (64.7) 42 (30.9) 6 (4.4)
Office chair design	Without LS With LS	- -		79 (58.1) 57 (41.9)
Length of working day	4.0 – 18.0	10.0	3.5	-
Level of workplace stress	Low Medium High	- - -		46 (33.8) 49 (36.0) 41 (30.2)
Workplace social support	Absent Poor Satisfactory Good	- - - -		32 (23.5) 35 (25.7) 58 (42.7) 11 (8.1)
Job satisfaction	Dissatisfied Neutral Satisfied	- - -		17 (12.5) 62 (45.6) 57 (41.9)

that can strain the musculoskeletal system resulting in LBP. Our finding concurs with that reported by an Ethiopian study in which participants reporting stress had roughly two times the odds of experiencing LBP than those without stress[14]. Similar associations have also been observed elsewhere[11,28].

Our study did not suggest any evidence for the existence of a real difference in LBP prevalence between sexes. This could be partly ascribable to our study participants being generally older and hence exposed to a similar risk. Nevertheless, among younger participants, being female has been associated with an elevated risk of LBP owing to hormonal imbalances[11,14,37]. More so, during pregnancy, hormonal changes responsible for loosening the spinal ligaments coupled with the extra weight that stresses the lower back muscles heighten the risk of LBP[38,39].

Taking into account other study variables, age did not emerge as a significant predictor for LBP in the present study. A likely explanation for this would be that older participants aware of their disproportionately higher risk, engaged themselves in

Table 3. Univariable analysis of the risk factors for LBP among teaching staff of the College of Health Sciences, University of Nairobi, Kenya, using mixed-effects logistic regression with the variable *department* included as a random effect.

Variable	Values	LBP - (n=49)	LBP+ (n=87)	OR	95%CI		LRT *P*-value
		n	n		Lower	Upper	
Sex[a]	Male Female	35 14	51 36	1.0 2.0	- 0.9 – 4.5		0.098
Age (years)[b]	31-43 44-57 58-81	16 11 22	30 34 23	1.0 1.8 0.6	- 0.7 – 4.7 0.2 – 1.4		0.048
Marital status	Married Single Others	44 02 03	72 11 04	1.0 3.3 0.8	- 0.7 – 16.0 0.2 – 3.9		0.234
BMI (in Kg/m^2)	Normal-weight Over-weight Obese	10 24 15	22 43 22	1.2 1.0 0.8	0.5 – 3.2 - 0.4 – 1.9		0.720
School[c]	SOM SOPharm SON SDS SPH	33 01 02 09 04	60 10 05 10 02	1.0 5.5 1.4 0.6 0.3	- 0.7 – 44.9 0.3 – 7.5 0.2 – 1.7 0.0 – 1.6		0.109
Level of education	Bachelors Masters PhD	01 35 13	05 59 23	2.9 1.0 1.1	0.3 – 27.3 - 0.5 – 2.4		0.585
Physical exercise[d]	Never Rarely Regularly	03 14 32	26 32 29	13.3 3.3 1.0	3.2 – 55.4 1.3 – 8.8 -		0.000
Tobacco use	Non-user User	47 02	86 01	1.0 0.3	- 0.0 – 3.5		0.318
Level of alcohol intake	Non-consumer Rare consumer Regular consumer	31 14 04	57 28 02	1.0 1.1 0.3	- 0.5 – 2.4 0.0 – 1.7		0.324
Office chair design[e]	Without LS With LS	17 32	62 25	1.0 0.2	- 0.1 – 0.4		0.000
Length of Working day	≤ 8 > 8	09 40	22 65	1.6 1.0	0.6 – 4.1 -		0.301
Level of workplace stress[f]	Low Medium High	26 17 06	20 32 35	0.3 1.0 3.9	0.1 – 0.9 - 1.2 – 13.0		0.000
Workplace social support	Absent Poor Satisfactory Good	13 11 21 04	19 24 37 07	0.8 1.3 1.0 0.9	0.3 – 2.0 0.5 – 3.2 - 0.2 – 3.8		0.833
Job satisfaction	Dissatisfied Neutral Satisfied	06 18 25	11 44 32	0.7 1.0 0.5	0.2 – 2.4 - 0.2 – 1.1		0.264

[a, b, c, d, e, f] Variables eligible for inclusion in the multivariable model (P≤0.20)

regular exercises at a comparably higher frequency (as per the data: *P*=0.02) thus arguably, balancing out their LBP risk to that of their younger counterparts. Nonetheless, a number of studies have reported age as a significant risk factor for LBP; old age being associated with spine and vertebral disc degeneration as well as loss of connective tissue elasticity that can result in LBP[12,14,29].

Working at a particular school did not significantly influence a participant's likelihood of LBP. This is conceivable considering

Table 4. Multivariable analysis of the risk factors for LBP among teaching staff of the College of Health Sciences, University of Nairobi, Kenya, using mixed-effects logistic regression with the variable *department* included as a random effect.

Variable	Values	aOR[a]	95% CI		LRT *P*-value
			Lower	Upper	
Physical exercise	Never participate	6.0	1.2 – 29.6		0.031
	Rarely participate	2.8	0.9 – 8.4		
	Regularly participate	1.0	-		
Office chair design	Without lumbar support	1.0	-		0.021
	With lumbar support	0.3	0.1 – 0.9		
Level of workplace stress	Low	0.6	0.2 – 1.9		0.011
	Medium	1.0	-		
	High	4.4	1.1 – 17.5		

[a]Adjusted odds ratio

that the respondents are likely to have similar work responsibilities entailing preparation of teaching materials, lecturing, grading of students' papers, mentoring and supervision that often demand extended periods of sitting and standing. This prevalence homogeneity may also denote uniformity in the distribution of office furniture designs across schools.

A couple of limitations are inherent in the present study. Definition of the outcome was pegged on self-report which could have introduced non-differential misclassification with a potential to bias the estimated odds ratios towards null. As measurement of exposures relied on recall which could have been incomplete especially for chronic cases, this would have the potential of biasing the effect estimates. Since non-responders tend to systematically differ from responders with regards to a range of health outcomes, it is anticipated that the current study's prevalence underestimates the true burden of LBP in this study population. In light of the above-mentioned limitations, it should be borne in mind that the results of this study are merely hypothesis generators and hence, stronger study designs such as case-control or cohort studies are recommended to validate the findings.

5. Conclusions

This study has revealed a high burden of LBP among teaching staff of the University of Nairobi and undoubtedly mimics the situation in other higher learning institutions in Kenya. Lack of physical activity, seating on chairs without lumbar support and workplace stress have been identified as modifiable risk factors for LBP among teaching staff. Considering the similarity in demographics and working conditions across public institutions in Kenya, these findings are readily generalisable to other public tertiary institutions within the country. Consequently, there is a pressing need for university managements to: (1) invest in suitable office furniture, in particular, office chairs fitted with appropriate lumbar supports and (2) raise advocacy for and facilitate the implementation of regular workouts and departmental team-building activities with a view to mitigating the burden of LBP among their staff.

6. Data availability

Underlying data

The raw dataset for the study is kept under restricted access since it contains sensitive participant information. Access to the raw data is possible upon placing a formal request to the corresponding author (disykgn@gmail.com). The replication data, analysis script and questionnaire for this manuscript are available from figshare.

Figshare: LBP_UoN_CHS_2.dta. https://doi.org/10.6084/m9.figshare.8148779.v1[40]

This project contains the following underlying data:

- LBP_UoN_CHS_2.dta (Low back pain survey data)

Extended data

Figshare: LBP Study Questionnaire_UoN. https://doi.org/10.6084/m9.figshare.8197598.v1[23]

This project contains the following extended data:

- Questionnqire_LBP Study among teaching staff UoN, Kenya.pdf (Low back pain survey questionnaire)

Figshare: LBP study_CHS_UoN_Stata code. https://doi.org/10.6084/m9.figshare.8197715.v2[25]

This project contains the following extended data:

- LBP study_Kenya_UoN_CHS_Stata Code.do (Low back pain Stata code)

Grant information

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The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Acknowledgements

The authors wish to express their sincere gratitude to the study participants for contributing to the research.

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Open Peer Review

Current Peer Review Status: ✔ ? ?

Version 1

Reviewer Report 01 October 2020

https://doi.org/10.5256/f1000research.21250.r70536

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Oyelola A Adegboye
Australian Institute of Tropical Health and Medicine, James Cook University, Townsville, Qld, Australia

My comments majorly focused on the methods of this study:

1. One of the major weakness of this study is the use of "type of furniture" as a measure of sedentary behavior, this is not a sufficient risk factor. It is unclear to me why Q16 (hours of sitting) of the questionnaire was not actually explored together with the type of chair? The authors should at least acknowledge the lack of measurable factors for sedentary behavior, such as hours of sitting in their limitation. Additionally, there are several validated and standardized questionnaires for measuring some of the risk factors associated with LBP and sedentary, I am surprised that the authors did not explore this option. What is the reliability and validity of the test instrument used in this study?

2. Why was the study restricted to one college? In addition to teaching, I am assuming these staff also engaged in medical practices such as ward rounds and attending to patients, therefore it cannot be generalized to university teaching staff as the title suggests.

3. Rather than saying the significance of variables were evaluated at $p \leq 0.2$, they could have said "…predictors with $p \leq 0.2$ in the univariable analysis were included in the multivariable analysis."

4. The authors sampled exactly 204 does not make sense, the authors should have invited an additional 10% participants to account for possible refusal as we have seen in this study, an actual sample size of 167 instead of the proposed 204 (80% power).

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
No

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Biostatistics, exposure science, multi-level modelling

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 02 March 2020

https://doi.org/10.5256/f1000research.21250.r58991

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Peter R. Croft
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It is good to see original studies on low back pain (LBP) from Africa. LBP is a global problem and yet is under-represented in research from countries such as Kenya.

This is a generally well-written paper, with appropriate methods and analysis and presentation of results. So the overall opinion is that this is a useful, well-performed and reasonably well-reported study.

There are some weaknesses however, and they are discussed below in the hope that they will help interpretation of results and be constructive for future research by the authors.

1. Study rationale:
The authors carefully chose a narrow focus for their paper. This study is about LBP in University teaching staff, and the limit of the generalisations made at the end of the paper is that results can be extended to teaching staff in other Higher Education institutions in Kenya. The authors' main

conclusions relate to a proposal that the risk factors for low back pain identified in the study should and could be reduced in these workplaces.
This is admirable as a stimulus to local preventive action, but the interest for an international readership would be (a) to consider to what extent the prevalence estimate in this workplace population represents the occurrence of LBP in older Kenyans and Africans more widely, and (b) to know how the findings on the risk factors for LBP compare with and contribute to the extensive global literature on these factors. Such wider objectives would draw out the study's importance beyond the local occupational setting, but require a more detailed discussion section (see below).

2. Study context:
It is rather alarming to read that this observational study of LBP in a random sample of teachers in a University health faculty could take as its case definition *low back pain of minimum 24 hours plus visit to health care plus spinal imaging*. Given that international guidelines recommend strongly against X-ray for uncomplicated back pain, does this mean that in Kenya most people experiencing back pain will expect to have an X-ray (which would be important contextual information for the paper) OR does it mean that this is a highly selected sample of all those in this population who had LBP (i.e. were there many people reporting back pain who had not had an X-ray and were therefore excluded from the study? – this would be important for study interpretation).

3. Study style:
The authors have appropriately and importantly included workplace stress and supervisor support and demographic/lifestyle factors among the potential risk factors for LBP. This is excellent, but much of the introduction and discussion defaults to "physical" explanations of, and mechanisms for, LBP. Chronic LBP is a complex biopsychosocial phenomenon, in which mental health and cultural perceptions play as big a role as mechanical factors, and this could be recognised more explicitly in the introduction and discussion sections.

4. The definition of low back pain:
The definition of the area of the back to be included is admirably clear, as is the minimum duration of 24 hours. However it is unfortunate (especially for the estimate of prevalence) that there were no further details on the pain itself and its impact, in order to sub-group the prevalence estimate according to severity. Back pain is so common that, to provide prevalence estimates that are more widely useful for planning, prevention and care, it should be standard practice in prevalence surveys to add a measure of severity and impact, such as that in Von Korff et al, Pain, 2020.[1] (The authors might argue that this was not so necessary for the risk factor component of their study but that is one reason for clearly separating the discussion of prevalence and risk factor components of the study – see comments below).

5. Study design:
The authors say at the end of their paper that more research with stronger designs (including case-control) is needed to confirm the results found in their cross-sectional study. I think the authors are underplaying their own design. There is an argument for saying that their study has two components – first, a cross-sectional population survey to estimate prevalence, and second, a population-based case-control study to study associations with LBP.
The arguments for suggesting that the risk factor study is a case-control study are:

1. Exposures were compared between those without LBP in the survey who represent a population sample of "controls", and "cases" with LBP (after exclusion of cases with other

causes (injury/infection)).

2. The sample size has been estimated on the basis of exposure data, as for a case-control study, rather than for the prevalence study.

3. The authors have attempted to ensure that, when gathering exposure data, participants were asked to recall exposures in periods prior to the onset of their LBP – a classic piece of case-control design.

If these two components of their study were separated, then the authors could usefully critically reflect on the following design points:

a. It was good to see a flow diagram of response and exclusion, and a high response rate, for the prevalence study. But what was the size of the total eligible population that provided the basis for stratified sampling for the study population (before exclusions, invitations, and nonresponse)? A small point to note is that the word “aggressive” in relation to following up non-responders is best avoided. It is better to give the details of exactly what was done, including a clear account of how and when people’s non-response is taken as final.

b. What was the origin of the questions used in the semi-structured interviews, and had there been any investigation of questionnaire validity prior to the main study? For example, alternative external records on the “lumbar support” seating data might have been sought from departmental purchasing data; repeatability of physical activity recall might have been tested by repeat interviews in a sub-sample of participants; were the interviewers aware of the participants’ back pain status when they asked about the risk exposures? Even if these “safeguards” were not carried out, the authors could consider adding a critical discussion about what they might have added to the credibility and validity of the study.

6, Study analysis:

1. Independent data entry is excellent practice – but some details of how any disagreements were handled would be useful, together with a summary of such disagreements.

2. Medians are fine but it might be better to make a statement about distributions of the relevant continuous variables because looking at them it is unclear why means and standard deviations were not chosen. The authors seem a little uncertain themselves because mean age is quoted in the discussion and median age in methods and results.

3. The analysis of results was nicely structured and followed a clear and appropriate pathway from descriptive to univariable to backwards multivariable models. However there was often a slightly ‘formulaic’ style to the writing of this, which could be avoided and softened by inclusion of some actual descriptive data in the text.

4. Mention should be made that the high prevalence of some exposures means that the odds ratios are likely to be overestimates of actual risk.

7. Discussion:

This was the weakest part of the paper and could have been a lot stronger.

1. The section on bias again seemed rather ‘textbook’ in style and content, and does not convey the sense of a rigorous critical discussion of the specific issues raised by this study.

More detail from the study itself and more detailed discussion of the individual points would help.

2. The authors raise as a limitation that the outcomes (presumably meaning back pain present or absent) are based on self-report – but it is difficult to see how the presence of back pain could be based on anything else but self-report. So this should rather have been a discussion of what the effects of misclassification of cases and controls might have been.

3. The sentence that states *"it is anticipated that the current study's prevalence underestimates the true burden of LBP in this study population"* is decidedly odd, given the initial high response rate. This is where it would help to link the discussion back to the rationale for the study (what population is the prevalence trying to represent? How much bias could an initial 20% response possibly introduce?).

4. The final sentence of the discussion is not convincing.I don't think it is right to say this is a "hypothesis generating" study – it does not fit with their main conclusion which urges all educational institutions in Kenya to look at how to modify risk factors in the workplace. This is an important conclusion but needs to be reached from (a) careful critical assessment of whether there study has established 'cause' or just association, and (b) rigorous comparison of their results with the wide international literature on these risk factors to see if their study is consistent with that literature and therefore strong enough to drive recommendations.

5. Finally there should be a separate conclusion about the prevalence study, with suggestions of how the authors' methodology might be used as the basis for more research to establish prevalence in other sectors of Kenyan society and why this might be useful to know. The authors are helpfully comprehensive about how their study fits with other prevalence studies in Africa – this is so important - but they could perhaps acknowledge that severity and impact must be added to future prevalence studies in their country.

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Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Epidemiology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 24 February 2020

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This manuscript deals with the prevalence of low back pain in teachers at the University of Nairobi and analyzes the relationship between the incidence of low back pain and some variables taken as risk factors.

In general, the manuscript was well written, and the study was well conducted, with a consistent statistical analysis and a good discussion.

I only have a few minor comments and suggestions.

Page 4 - Sample size:

- Unfortunately, the calculated sample size could not be guaranteed. Given the possibility of sample loss in most studies, why did the authors not start the study with a larger sample than that calculated here?

Page 4 - Study variables:

- I think it would be interesting if the authors could justify the choice of the study variables/factors analyzed here. I think some other factors are, in some extension, more important than that cited here.

- For example: office chair design is important, but I think the number of hours of sitting work is more or as important as office chair design. Some comments about this would be welcome. Something like "teachers spend most of their time working in a sitting position, thus we considered the chair design as a risk factor for LBP", for example.

- However, a question can be raised: why not evaluate the number of hours of sitting work?

Conceptual framework in Figure 2:

- I recommend emphasizing that those relationships presented in Figure 2 are a conception of the authors that motivate the choice of the "risk factors" presented here.

- Those relationships may be different in other conditions, or for other populations, or even other authors may interpret those relationships in a different way.

Page 5 - Figure 2 captions:

- I recommend not using this term here: "causal diagram". We cannot say that those factors are causal factors of LBP: the cause-effect relationship between them and LBP cannot be guaranteed. Furthermore, the relationships presented here are a personal interpretation of the authors. Other authors may establish a different relationship between the factors presented here. For example: for the authors, the level of stress is a risk factor for LBP, but, perhaps, LBP increases the level of stress, especially for a teacher who works seated most of the time.

Page 6 - 4.2 Risk factors for LBP:

- I suggest changing this subsection to something such as "Variables studied as risk factors for LBP".

- There are other variables that may be related to LBP, and some variables studied here may not be considered risk factors for LBP by other authors.

Page 7 - Last paragraph:

- The interpretation here is somewhat speculative. However, the level of physical activity for each age group can be verified. The authors have this information.

- This information would be welcome and would support the interpretation raised in that paragraph.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Biomechanics, gait and posture, pattern recognition, feature extraction, feature selection, feature classification.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.