Scientific Research Publishing

Open Journal of Applied Sciences, 2025, 15(6), 1529-1553
https://www.scirp.org/journal/ojapps
ISSN Online: 2165-3925
ISSN Print: 2165-3917

Socio-Anthropometric Profile of Women with Chronic Low Back Pain in a Peri-Urban Environment in the City of Kisangani

Lehumadja Raphaël Talona[1*], Eba Ntsambi[2], Longembe Eugène Basandja[3], Likwela Joris Losimba[3], Kitoko Roger Amisi[1], Kabangu Jean Marie Vianney Tshimbila[1], W'Ifongo Freddy Wami[1]

[1]Department of Surgery, Faculty of Medicine and Pharmacy, University of Kisangani, Kisangani, Democratic Republic of the Congo
[2]Department of Neurosurgery, Faculty of Medicine, University of Kinshasa, Kisangani, Democratic Republic of the Congo
[3]Department of Public Health, Faculty of Medicine and Pharmacy, University of Kisangani, Kisangani, Democratic Republic of the Congo
Email: *drtalona@gmail.com

How to cite this paper: Talona, L.R., Ntsambi, E., Basandja, L.E., Losimba, L.J., Amisi, K.R., Tshimbila, K.J.M.V. and Wami, W.F. (2025) Socio-Anthropometric Profile of Women with Chronic Low Back Pain in a Peri-Urban Environment in the City of Kisangani. *Open Journal of Applied Sciences*, **15**, 1529-1553.
https://doi.org/10.4236/ojapps.2025.156106

Received: March 31, 2025
Accepted: June 9, 2025
Published: June 12, 2025

Abstract

Introduction: Low back pain constitutes a real public health problem and one of the causes of years lived with disability. This study aimed to determine the socio-anthropometric profile of women with chronic low back pain (cLBP) from Lubuya Bera in Kisangani and the characteristics of the loads they carried. **Method:** This was a Case-Control study of women aged 15 to 49, including 76 Cases. Data collection was prospective. Statistical inferences were made using Pearson's chi-square, t-student and Mann Whitney Wilcoxon (MWW) tests. The OR was calculated with dichotomous variables adjusted to the 5% significance level. Variables with bivariate association were aligned in a multivariate model using a step-by-step ascending approach. **Results:** The Cases were of middle age (42.1 ± 6 years, t-student 0.001) and of low educational level (93%, t-student 0.001). Large multiparous (58%), multi-pregnancy (64%), polygamous (49%, X^2 0.001), high average weight (58 ± 14 kg, t-student 0.002) and practicing agriculture (79%, X^2 0.001) were more at risk. Early median age (9 - 10 years, MWW 0.001), high weekly frequency (5 - 6 times, MWW 0.021), weight carried (68.3 ± 21.5 kg, t-student 0.001) and duration of carrying (60 - 120 min, MWW 0.023) were significant. Carrying weight greater than 50 kg (OR 2.4; CI95 1.04 - 5.57; PValue 0.025), age at start of carrying less than 10 years (OR 8.5; CI95 3.8 - 19, 4; PValue 0.001) and frequency of weekly carrying more than 3 times (OR 5.4; 95% CI 2.1 - 15.8; PValue 0.004) were associated with cLBP. **Conclusion:** The woman with cLBP from Lubuya Bera in Kisangani was middle-aged, poorly educated, polygamous, highly multiparous, living from agriculture and carrying heavy loads almost daily.

Keywords

Chronic Low Back Pain, Socio-Anthropometric Profile, Kisangani

1. Introduction

According to the 2021 Global Burden of Disease Study [1], low back pain is among the top ten causes of years lived with disability across multiple age groups, placing it in fourth place in the 25 - 49 age group, with standardized discomfort rates increasing for adolescents. Disability often manifests itself from young age to old age, which places a significant burden on social health coverage [2]. Low back pain constitutes a real public health problem due to its cosmopolitan nature, its high frequency and the permanent discomfort it induces [3] [4]. Chronic low back pain is defined as pain that occurs in the lumbosacral region, at the level of the iliac crests or even lower. It can be axial or lateralized, radiating towards the thigh without going beyond the knee, but with a lumbosacral predominance. It is a pain that has already persisted for at least three months, felt almost every day and without any tendency to sedation [5]-[9]. It is more frequently encountered in women and several risk factors have been identified [10] [11]. Sex differences, and the timing of its onset, may be related to the earlier age of onset of puberty in females and the growth spurt, as well as the different distribution of adipose tissue and body composition [12].

This symptom can be considered a complex condition in itself. Structural or organic causes of pain are difficult to diagnose and characterize. And even if pathological lesions can be identified, they cannot alone explain persistent pain and disability [13]. It is one of the most common causes of long-term disability in most countries around the world [14]-[16].

The majority of low back pain is said to be non-specific or common low back pain since no specific or formal anatomopathological lesion can be confirmed [17] [18]. It is defined as pain of unknown origin extending from the upper lumbar vertebrae to the gluteal folds. This pain would be linked to a supposed musculoligamentous lesion [19] and spasms of the paraspinal muscles [14]. In a minority of cases, low back pain is specific or secondary to a cause identified as radiculopathy or a severe pathology affecting the lumbar spine [14].

The causes of low back pain can be classified into two main types, including pain of spinal or spinal origin and non-spinal or soft tissue pain [20].

Although chronic low back pain can develop unexpectedly or progressively after a definite injury, often no triggering circumstances can be found in many patients [21] [22].

In high and middle-income countries, with the development of technology, household appliances, road infrastructure, means of transport adapted to all ages and all physical conditions, mechanization and industrialization of agriculture, heavy loads are no longer directly carried by men [23] [24].

In the United States, an author pointed out that the American economy was post-industrial and increasingly automated and robotized. Medicine had improved diagnostic imaging of the spine and developed new forms of surgical and non-surgical treatments. But incapacity for work, caused by chronic low back pain, had steadily increased [25].

In Germany, professional lifting carried a real risk of low back pain based on objective measures of exposure to cumulative lifting loads and the daily and long-term course of low back pain [26] [27]. Physically demanding work (including professional lifting) was associated with higher levels of body fatigue [28], which in turn represented a risk factor for developing lower back pain [29]. In turn, musculoskeletal pain (including low back pain) and body fatigue were significant predictors of future sickness absenteeism. High physical and/or psychosocial demands could increase the perception of tension, which was a known predictor of musculoskeletal pain [26].

In Nepal, load-carrying practices linked to certain traditions have been described [30] [31]. Asian porters use special equipment for head loading that includes a namlo (circular linen band) connecting the forehead to a doko (craft basket), which rests against the wearer's back and can sometimes be supported by a tokma (T-shaped stick), which is also used as a walking aid [32] [33], so they can carry various heavy products. This practice disrupted the comfort of life of women carriers due to the occurrence of musculoskeletal disorders, including chronic lower back pain.

Studies on the association between water transport and women's health were carried out. They showed moderate quantitative and strong qualitative evidence that water transport was associated with musculoskeletal pain, fatigue, perinatal health problems and violence against vulnerable people in Africa. Lower back pain due to carrying water was most likely to be reported [34].

Some published research on weight bearing in low- and middle-income countries has suggested that this practice negatively influences spinal pain at various levels as well as musculoskeletal function, especially for women and girls [10] [35]. Many of the existing studies on this topic have been conducted in developed (high-income) countries or have focused largely on the experience of pain among adult male workers [36] [37]. It is not possible to generalize this evidence to women and girls who have different physical capacities and physiology and sometimes greater sensitivity to injuries linked to carrying loads than men [38].

In sub-Saharan Africa, carrying heavy loads on the head is a common practice in rural and peri-urban areas. The cephalic position imposes considerable stress on the axial skeleton [39] [40]. The most popular method of external load carrying in Africa was a derivative of the Asian head loading technique. Women of the Luo and Kikuyu tribes of East Africa were particularly famous for carrying large loads balanced on their heads or using forehead support straps, similar to Nepalese porters. And these women regularly presented with chronic low back pain [41] [42].

In the Democratic Republic of Congo (DRC), the practice of carrying heavy

loads on the head and back remains current even in large cities. A study carried out in Kinshasa evaluating the effect of axial load on the cervical spine in Congolese women carrying firewood on the head observed a high rate of back pain predominating in the cos and lower back in relation to the age of the woman, the load carried and the duration of carrying [40].

In Kisangani in general, and in its immediate periphery including the community-sector of Lubuya Bera in particular, a common practice was observed, which consists of carrying heavy loads on the back suspended on the head by a rope, practiced since ancient times by rural women. For this technique, women also use a homemade basket, similar to that of the Asians [32] [33], called "Liyamba" of which there are several models, which they load with various products then tie with a rope. Either, they use ropes directly attached to the load and which they pass over the front. These ropes are made from natural wild lianas or strong and resistant tree bark, or sometimes from linen or loincloth, which they tie, for example, to the water container and wear on the forehead. They can cover significant distances on foot for several minutes, sometimes hours, with these loads carried, as shown in **Figure 1**.

Figure 1. (a) Lady wearing a liyamba of cassava leaves; (b) Carrying a bag of embers with excess; (c) Carrying a 25-liter container and a 15-liter bucket of water; (d) Carrying a large basket of fresh cassava.

This practice is mainly carried out on the route from subsistence crop fields or game trapping and hunting areas to villages, due to the absence of roads and also for domestic needs such as the search for food and firewood or even water at springs or rivers. In most cases, there are only small paths winding through forests, littered with roots, trunks of dead trees fallen across said paths and wild grass, inaccessible to rolling vehicles. In addition, in many villages in the Lubuya Bera community-sector, existing agricultural service roads are poorly maintained and impassable, public transport vehicles called "Fula-Fula" are rare or in poor condition. This forces women to carry heavy loads on their backs over long distances to major roads to get on a bicycle, a motorcycle or in a vehicle.

It is a risky practice whose medical consequences can be harmful in our socio-

cultural environment where healthy lifestyle seems precarious. Indeed, despite the predominance of load transport activities among the regular tasks of rural women of childbearing age in these disadvantaged environments, no clinical study has been carried out on the potentially harmful effects on the spine of this practice of carrying heavy loads on the back, suspended from the head by a rope in the peri-urban environment of the city of Kisangani.

This research is essential not only for the health of women with low back pain, but also for the vital and cultural character (aptitude for marriage) of this activity in these villages. The transport of subsistence products on the back, suspended by a rope from the head, is still practiced in many regions surrounding the city of Kisangani as well as in several provinces of the country. This empirical mode of transport contributes significantly to the supply of foodstuffs and the survival of the entire city of Kisangani in particular, or even of the country as a whole, difficult to do without it. However, there is a complete lack of information on the health problems these women face.

The aim of the present study was to determine the socio-anthropometric profile of women with chronic low back pain in a peri-urban environment in the city of Kisangani and the characteristics of the loads they regularly carried.

2. Materials and Methods

2.1. Search Field

This study was carried out on the outskirts of the city of Kisangani, precisely in the community-sector of Lubuya Bera, within a radius of approximately 40 kilometers from the city center, following the main roads including Buta, Ituri and Isangi roads. For security reasons, the Opala and Ubundu axes were not selected.

Peripheral of the city of Kisangani, the community-sector of Lubuya-Bera has the shape of a starfish. It is a delimitation in relation to the six urban communes of Kisangani which it surrounds on the one hand, namely Makiso, Mangobo, Tshopo, Kabondo, Kisangani and Lubunga; and on the other hand with the rural territories which surround it including Banalia in the North, Bafwasende in the North-East and East, Isangi in the West, Ubundu in the South and Opala in the South-West.

The total population was estimated at 325,114 inhabitants, spread across 206 villages with 28 notables. The total area of the community-sector was estimated at 18,800 km^2 with a density of 18 inhabitants per km^2 [43].

This region was chosen for its agricultural vocation and its occupation by a peasant population living from agriculture and gathering, and among whom, the practice of carrying heavy loads on their backs was the rule.

2.2. Study Population

It was made up of all women of childbearing age (15 to 49 years) living in a peri-urban area of the city of Kisangani, precisely in the community-sector of Lubuya Bera.

2.3. Type, Period and Sampling

We conducted a case-control study among women aged 15 to 49 years old over a period of 6 months, from March 16 to September 15, 2024.

For an expected probability of exposure of uninjured people estimated at 0.25 (P2*), with OR of 2, the confidence level of 95% and a relative precision of 50%, the minimum sample size was 76 subjects [44]. Thus, we included in this study 76 patients suffering from chronic low back pain and 76 women without it, recruited in the same environment and having the same characteristics.

For the selection of our respondents, we identified the health structures in three main roads which served as a consultation framework. These were chosen to obtain good representation thanks to their satisfactory rate of attendance and use of services as well as the great social influence they exercised in their communities.

For the Buta road, the Mbilinga Reference Health Center at PK 15 was chosen; Ituri road, the Ngene Ngene Reference Health Center at PK 16 and Isangi road, Banduku Reference health center at PK 9.

The Community Activities Cell (CAC) committees with their Community Relays (RECO) of these different structures were trained to raise awareness, identify and recruit eligible women suffering from lower back pain in general (low back pain) in their respective environments. In turn and in their respective structures, the Registered Nurses were trained in the use of the data collection sheet and various work materials. All the women recruited were registered and listed by the presidents of these CACs then the lists were transmitted to each Registered Nurse for centralization. By mutual agreement with the Registered Nurse, a program for the interview was determined, and a medical appointment was fixed for the respondents, by road, for a medical consultation, depending on the case. Schedule adaptations were required depending on the context, sometimes in the afternoon and on weekends.

Hundreds of women were consulted and treated according to their complaints. At the end of these medical consultations, through non-probabilistic convenience sampling, we retained 26 Cases at the Mbilinga reference health center, 25 at the Banduku center and 25 at the Ngene Ngene center.

The Witnesses (Controls) were recruited from family members who accompanied their sick relatives and also from women treated for any other health problem in these structures and who had consented to freely participate in this study.

2.4. Inclusion and Non-Inclusion Criteria

As a case

Inclusion criteria: having been treated several times or having had regular, daily lower back pain for 3 months or more; woman of childbearing age = woman aged 15 to 49 years, having regular periods or who is in pregnancy or lactation amenorrhea [45]; woman residing or having her activities in the community sector of Lubuya Bera and who freely consented to participate in this study.

Non-inclusion criteria: any woman with pain of traumatic origin; any woman

with a history of a known spinal injury, congenital or acquired, treated or not (traumatic, metabolic, infectious, dystrophic, etc.)

***As a witness* (*Controls*)**

Female subject, aged 15 to 49 years, residing in the Lubuya Bera Sector community, not meeting the definition of Case, treated for any other condition or accompanying person free from low back pain during her treatment, having freely consented to participate in this study.

2.5. Variables of Interest

1) Dependent variable: chronic low back pain, present or absent.

2) Independent variables

- The respondent's self-declared sociodemographic data included age, level of education, marital status, type of marriage, main socio-professional activity.
- The medico-anthropometric data of the respondent whose menstruation and obstetric formula were self-declared. Height (in m) and Body Mass (Kg) were measured and Body Mass Index (BMI) was calculated.
- Finally, the data related to the burden carried by the respondent was self-declared. These were the minimum age for starting to carry a load (in years), duration of carrying loads, products carried the last time, the number of times having carried loads in the last week, estimated weight of the load carried the last time before the day of the interview (in kg), average distance traveled with the load the last time before the day of the interview (in km), average duration of carrying the load the last time before the day of the interview (in minutes).

BMI was calculated according to World Health Organization definitions [46] [47] as body mass in kilograms divided by height in meters squared (kg/m^2), then coded as underweight (<18.5), normal weight (18.5 - 24.9), overweight (25 - 29.9), and obese (≥30).

2.6. Registration Procedure

The diagnosis of chronic low back pain was made by each trained Registered Nurse and by the Principal Investigator, in accordance with the guidelines for the management of low back pain [48] [49]. Also, a simplified definition (lower back pain felt almost every day, which has already lasted for more than three months) was given to the committees of community activities units and community relays to facilitate the identification and recruitment of respondents in their communities.

2.7. Preliminary Study

A preliminary study was carried out, from May to December 2023, a period of eight months, in several village communities with the collaboration of the committees of Community Animation Units (CAC) and their Community Relays (RECO) as well as village chiefs in order to identify and weigh, in advance, hundreds of burdens usually carried by women in the community-sector of Lubuya Bera, as illustrated by some examples of **Figure 2**.

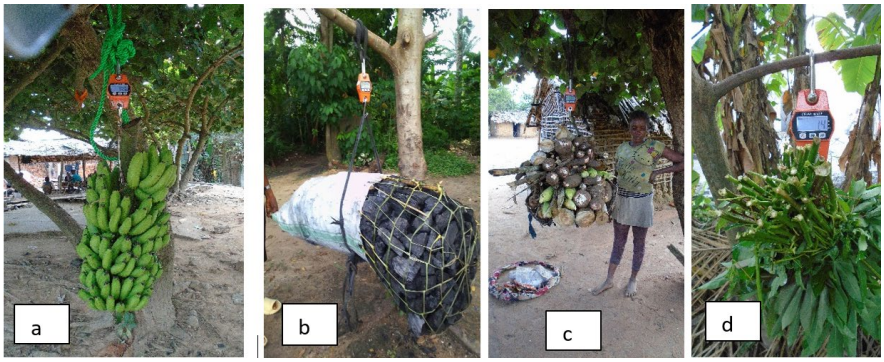

Figure 2. Weighing of: (a) sweet banana bunch; (b) bag of embers with excess; (c) various country products; (d) bunch of cassava leaves (pondu).

A benchmark of loads with their weights was determined for the different communities considered (as presented in Table 1). After consent and authorization from the women concerned, photos of these loads carried and weighed were taken and printed and their approximate weights were attached to the images on the same leaflet. Most of the villagers' fields were located in specific forest axes. Field descents on these main roads were carried out, and using Garmin GPS˚64 GPS, the distances and approximate times for the majority of busy main rural roads were measured, during the walks at an average speed of 4 to 5 km/h. Small adjustments to time and distance were then possible, using this reference data.

Table 1. Reference weight of burdens carried by the women of Lubuya Bera.

Products transported	Weight (kg)	Average weight
25-liter container filled with water up to the cap (Oki container)	28 - 30	28.8
25-liter container filled with Palm oil up to the cap	25 - 28	26.5
5-liter container filled with water up to the cap	5.5 - 6	5.7
5-liter container filled with Palm oil up to the cap	5 - 6	5.5
10-liter container filled with water up to the cap	11 - 12	11.6
10-liter container filled with Palm oil up to the cap	10 - 12	11
Bag of embers with excess (hat)	64 - 67	65
Bag of embers without excess (hat)	54 - 58	56
1 bunch of cassava leaves	1.4 - 2.2	1.7
1 slice of plantain	2 - 5	4
1 bunch of plantains	5 - 20	13
1 slice of sweet yellow banana	1 - 3	1.8
1 bunch of yellow sweet bananas	5 - 8	6
1 slice of sweet green banana	2 - 4	3.5
1 bunch of sweet green banana	4 - 18	13
Basket of cassava chips or fufu with excess (hat)	44 - 51	46.5
Basket of cassava chips or fufu without excess (hat)	35 - 40	37

Continued

Small basket of fresh cassava (Bofala)	48 - 55	50.5
Large basket of fresh cassava (Bofala)	98 - 105	103
Small basket of soaked cassava (Kivunde de chikwangue)	52 - 60	57
Large basket of soaked cassava (chikwangue kivunde)	103 - 110	107
Large chikwangue prepared Tokuma	1.8 - 3	2.5
Medium Chikwangue Wanierukula	0.4 - 0.7	0.6
Medium basket of fresh corn cobs	34 - 38	37
Medium basket of dried corn cobs with excess (hat)	44 - 50	46.5
Medium basket of dried corn cobs without excess (hat)	35 - 40	37
Bulky bag of unhulled rice	94 - 102	98
Medium bag of unhulled rice	55 - 60	56
Medium bundle of firewood	24 - 38	33
Large bundle of firewood	44 - 52	48
Average basket of various field products	27 - 35	34
Large basket of various field products	48 - 56	53.5

These data (burdens, distances and durations contained in the prospectus) were used during interviews or medical consultations with respondents to minimize the bias in remembering and estimating weight, distances and time.

To carry out this study, the following equipment was required, a Yamaha AG 100 motorcycle to reach the study sites, a Sony Lens 5x Optical Zoom digital camera of 20.1 Mega Pixels, GPS device brand GARMIN GPS˚ 64, Pen, Duplicating papers, Notepad and Record books.

2.8. Data Collection Technique

Data collection was prospective. The interview of the women was oriented according to a pre-established collection form including all the independent variables.

For the measurements of the respondents, a digital scale, type SECA, number SH-8002 with a maximum weight limited to 150 kg and an accuracy of within 0.1 kg and a wall measuring rod and a metric tape graduated in centimeters with an accuracy to 0.5 cm were used. Body mass was measured in barefoot, fully unloaded and lightly dressed women. The height measurement was carried out according to the recommendations of Winter [50], between the soles of the feet and the top of the head, the women being in a standing position, hair parted to the vertex and bare feet.

For weighing loads or burdens, a Crane Scale digital object scale, with a maximum of 300 kg with an accuracy to within 0.1 kg and a 15 mm section nylon rope capable of supporting up to 15 tonnes were necessary. The nylon rope was hung on a tree branch of good section and resistance, then attached to the balance; and the burden to be weighed hung on the hook of the scale. The result was read directly on the scale screen as shown in **Figure 2**.

On arrival in the community-sector of Lubuya Bera, pleasantries were presented to the Head of Community and the research certificate was endorsed by his designated services, and the objectives of the study were presented. The substantive work then began.

2.9. Data Analysis Techniques

The data collected was organized in a data base in Excel format, they were then exported to STATA 15 for statistical analyses.

The description of categorical data was made using proportions and that of quantitative data in the form of mean ± SD and median with p25 - p75 depending on whether the distribution was symmetrical or not. Statistical inferences were made using Pearson's chi-square tests for categorical variables, t-student and Mann Whitney Wilcoxon tests for quantitative variables depending on whether the distribution was symmetrical or not. The OR was calculated with dichotomous variables to look for factors associated with chronic low back pain in the context of this study.

Finally, the variables having presented a bivariate association were aligned in a multivariate model using an ascending step-by-step approach, the adjusted OR (AOR) was calculated at the 5% significance level.

2.10. Ethical Considerations

All women interviewed were fully informed of the research process. They had the possibility of withdrawing at any time. In the presence of adult witnesses, copies of the consent form in French, translated into Swahili and Lingala, two national languages commonly spoken in these settings, were provided and read to illiterate or semi-literate participants before consent by signature or fingerprint was obtained and before the interviews were carried out. All questions asked by participants were answered. The flat rate transportation cost was reimbursed to each participant. A circumstantial motivation bonus was paid to people who participated and contributed to the completion of the present study.

3. Results

Table 2 shows that the average age of the respondents and the low level of education (none and primary) were significantly high among the Cases compared to the Controls. Women living in Polygamy and those practicing Agriculture were more at risk of chronic low back pain.

Table 2. Description of the sample.

Variables	Cases N = 76 n (%)	Controls N = 76 n (%)	Total N = 152 N (%)	p-value
Age (mean ± SD)	42.1 ± 6	29 ± 4	35.5 ± 10	**0.001***
Educational level				**0.001***
None	26 (32)	1 (1)	27 (18)	

Continued

Primary	46 (61)	43 (57)	89 (59)	
Secondary	4 (5)	32 (42)	36 (24)	
Type of marriage				**0.001****
Polygamous	37 (49)	12 (16)	49 (32)	
Monogamous	39 (51)	51 (67)	90 (59)	
Lives alone	0	13 (17)	13 (9)	
Main activity				**0.001****
Agriculture	70 (79)	50 (66)	120 (79)	
Trade	2 (3)	0 (0)	2 (1)	
Official	2 (3)	11 (14)	13 (9)	
Restaurant	0 (0)	3 (4)	3 (2)	
All works	2 (3)	1 (1)	3 (2)	
Study	0 (0)	11 (14)	11 (7)	

*T-student, **Pearson's chi-square.

Reading Table 3 indicates that high average weight, high multiparity and high multi-pregnancy were associated with chronic low back pain in women.

Table 3. Anthropometric data.

Variables	Cases N = 76 n (%)	Controls N = 76 n (%)	Total N = 152 N (%)	p-value
Weight (mean ± SD)	58 ± 14	52 ± 10	55 ± 12	**0.002***
Size (mean ± SD)	1.56 ± 0.8	1.55 ± 0.6	1.56 ± 0.6	0.99*
BMI (mean ± SD)	23 ± 4	22 ± 4	22.5 ± 4	0.498*
Parity				
Nulliparous	2 (3)	2 (3)	4 (3)	**0.001****
1 to 3	7 (9)	45 (59)	52 (34)	
4 to 6	23 (30)	23 (30)	46 (30)	
>6	44 (58)	6 (8)	50 (33)	
Gesture				
Nulligest	0 (0)	2 (3)	2 (1)	**0.001****
1 to 3	6 (8)	34 (45)	40 (26)	
4 to 6	6 (8)	28 (37)	34 (22)	
> 6	64 (64)	12 (16)	76 (50)	

*T-student, ** Pearson's chi-square.

Table 4 demonstrates that early median age, weekly frequency of high load carrying, weight carried and duration of load carrying were associated with chronic low back pain ($p < 0.05$).

Table 4. Characteristic of the burdens carried by women.

Variables	Cases N = 76 n (%)	Controls N = 76 n (%)	Total N = 152 N (%)	p-value
Age of start of wearing (years) (median p75 - p25)	10 (10 - 9)	11 (12 -10)	10 (11 - 10)	**0.001***
Weekly wearing frequency (median p75 - p25)	6 (6 - 5)	5 (6 - 3)	6 (6 - 4)	**0.021***
Weight transported (Kg) (mean ± SD)	68.3 ± 21.5	58.8 ± 16.1	63.5 ± 19.5	**0.001****
Distance traveled (Km) (median p75 - p25)	5 (10 - 5)	5 (7 - 3.5)	5 (10 - 5)	0.147*
Wear time (minutes) (median p75 - p25)	60 (120 - 60)	60 (90 - 45)	60 (120 - 60)	**0.023***
Load/weight ratio (%) (mean ± SD)	121 ± 41	116 ± 38	119 ± 39	0.229**

*Mann Whitney Wilcoxon, **T-student.

From the analysis of the factors associated with chronic low back pain, as presented in Table 5, it emerges that carrying a weight greater than 50 kg increased the risk by 2 times, the age of starting to carry less than 10 years increased the risk by approximately 8.5 times and the frequency of carrying more than 3 times per week increased the risk by approximately 5 times.

Table 5. Bivaried analysis of factors associated with chronic low back pain.

Factors	Low back pain		OR	IC95	p-value
	Present n (%)	Absent n (%)			
Carrying weight					
Less than or equal to 50 Kg	13 (17)	25 (33)	**2.4**	1.04 - 5.57	**0.025**
Greater than 50 kg	63 (83)	51 (67)			
Charging wearing time					
Less than 60 minutes	43	55	2	0.97 - 4.2	0.042
More than 60 minutes	33	21			
Age of start of wearing					
Less than 10 years	14	50	**8.5**	3.8 - 19.4	**0.001**
Greater than 10 years	62	26			
Baggage carrying frequency					
≤3 times	7	27	**5.4**	2.1 - 15.8	**0.001**
>3 times	69	49			
Distance traveled					
Less than or equal to 5 km	43	53	1.8	0.86 - 3.6	0.09
Greater than 5 km	33	23			
Nutritional status					
Normal	56	62	1.58	0.58 - 3.7	0.243
Bad (lean. overweight and obese)	20	14			

4. Discussion

This study aimed to determine the socio-anthropometric profile of women with chronic low back pain in a peri-urban environment in the city of Kisangani and the characteristics of the loads they regularly carried.

The results of the present study showed that the low level of education (none and primary) was significantly high among chronic low back pain (93%) compared to Controls (58%, t-student 0.001). They were similar to those of Dionne [51] who showed that a lower level of education was associated with an increased risk of low back pain and associated disability. Kahere M [52], in 2021, in KwaZulu-Natal in South Africa, observed that people without formal education were approximately 6 times more likely to develop chronic low back pain. This link between low education and chronic low back pain could reflect differences in behavioral and environmental risk factors as well as differences in living conditions and work opportunities. We believe with these authors that women with a higher level of education would have an easier time exercising less restrictive liberal professions or occupying management positions or other qualified professions in public administration or private business, which may generally be less physically demanding and where there is more possibility of avoiding work situations that could cause chronic pain, particularly lower back pain [53]-[55].

The results of this study showed that women living in polygamy (49%, X^2 0.001) were at greater risk of chronic low back pain. These results were corroborated by the Trocaire report [56] published in 2017 according to which polygamy represented more than 25% of all marriages in the Democratic Republic of Congo, 47% in Sierra Leone and 53% in The Gambia. For Alhassan AR [57], polygamy was chosen for socio-economic reasons. He noted that, in traditional African societies, polygamy increased the number of children in households. These represented available and free labor for domestic, agricultural and pastoral work (livestock breeding) in agricultural communities. For Harel-Shalev A [58], the rapid growth of poverty in rural societies of sub-Saharan Africa exposed girls to early marriages with older polygamous men, because they had very few other income possibilities other than within the framework of such a marriage. For Kassaw C [59], it was up to husbands to take care of all their wives and children in terms of social, economic, psychological and physical needs, maintaining economic dependence on the husband, who sometimes does not have sufficient financial resources. In the socio-economic conditions of our environments, we think that this would push each wife in polygamy to devote themselves hard to manual and rural work and increase the agricultural workload to provide for the care of their loved ones. These polygamous women felt obliged to exploit large areas of land compared to their rivals and to transport large loads of rural products at once in the hope of obtaining a little more money, thus increasing the physical stress on the lumbar spine and the emotional stress, which is the basis of interminable low back pain [60]. However, according to Hannibal [61], stress causes the secretion of cortisol into the bloodstream. Cortisol is a powerful anti-inflammatory hormone, and re-

peated high levels of cortisol are thought to promote defects in its metabolism. As a result, oxidative stress, free radical release and cell damage would occur, leading to chronic pain. Barros Dos Santos [62], in 2021 in Brazil, had confirmed that higher cortisol levels were associated with a significant decrease in lumbar muscle strength, leading to persistent low back pain [62] [63].

This study showed that high multiparity and high multi-pregnancy were associated with chronic low back pain in women in the peri-urban area of Kisangani. Aleku M [64], in 2021, in Uganda, established that the difference in the occurrence of chronic low back pain in women could be linked to anatomical, physiological and structural differences between men and women. In the latter, hormonal changes were often observed during pregnancy, notably the production of relaxin and the drop in estrogen levels in the blood. These hormonal changes caused the ligaments of the spine to relax, reducing the strength of the lower back muscles and therefore increasing the risk of low back pain. Also, women have a lower pain threshold than men, so they are more likely to complain of the symptoms of low back pain than men [64]. For Omoke NI [65], the causes of pregnancy-related low back pain, although not yet clearly demonstrated, were generally attributed to changes in body burden (through excessive weight gain in a short time) and mechanics that occur during carrying a fetus in utero and to the effect of hormonal changes. He estimated that low back pain during pregnancy, as in low back pain of mechanical origin in the general population, could recur or develop into chronicity. Sencan S [66] had noted that the risk of low back pain in a subsequent pregnancy was very high once there was a history of low back pain in a previous pregnancy, reported to be a common predisposing factor for low back pain in pregnancy. Thus, in this study, the occurrence of successive multiple pregnancies, sometimes at close birth intervals, in disadvantaged environments with a precarious lifestyle, could justify chronic low back pain in these multiparous-multigestural women.

This study showed that high average weight (58 ± 14 kg) was associated with chronic low back pain in women in the peri-urban area of Kisangani. Makkiyah FA *et al.* [67], in 2023, in Indonesia, found the similar result that high body mass was associated with low back pain. They reasoned that as body weight increased, a greater load was placed on the joint carrying that weight, and compression of the intervertebral disc could be induced due to axial mechanical loading on the lumbar spine. This compression could lead to injury and continued pain in the lower back. Lee CA *et al.* [68] found that adipose tissues, in subjects with high body mass, produced pro-inflammatory cytokines including tumor necrosis factor-α and interleukin-6 which triggered the release of C-reactive protein (CRP) and which contributed to the development of pain through the alteration of the neurophysiological properties of peripheral nociceptors and central neurons. Alnaami I, 2019 [69], highlighted the fact that women with normal waist circumference and high CRP tended to report chronic low back pain than women with low CRP. For De Souza, supported by Ando, weight gain can cause a misalignment of

the spine, in particular leading to lumbar hyper lordosis, leading to low back pain [70] [71].

This study showed that women practicing agriculture (79%, X^2 0.001) were at greater risk of chronic low back pain. Kossi O *et al.* [72] in 2022, in Benin, made the same observation. They showed that agriculture was the main socio-economic activity in most village communities. Shivakumar M *et al.* [73], in India, in 2024 had carried out research that focused on populations working in subsistence and small-scale agriculture. They found that in sub-Saharan Africa, a single person performed a multitude of high-risk tasks and activities on the lumbar spine at the same time (e.g. clearing bush, sowing, weeding, harvesting and transporting) rather than a particular type of agricultural task (e.g. operating a machine, threshing, sowing, storing). In our environment, agriculture is still considered the main professional activity. The majority of village women practiced agriculture manually, using equipment such as machete, axe, hoe and rake, due to their difficulty in accessing mechanization due to lack of adequate financial resources. Eatough EM [74] noted that this precariousness of means forced women farmers to sometimes adopt various positions during the execution of their tasks including trunk flexion, extension, rotation and lateral flexion. He established that physical and psychosocial stressors linked to mechanical work were associated with musculoskeletal symptoms including chronic low back pain.

This study showed that women with chronic low back pain in the peri-urban area of Kisangani carried loads weighing 68.3 ± 21.5 kg (t-student 0.001). These results were higher than those of Motaung TG [75], in 2022 in South Africa, who noted that girls and women carried loaded masses on their heads ranging from 2 kg to 35 kg and those found by Kadota in 2020 [35], where Tanzanian women carried loads weighing on average 18.8 kg over the course of several trips. For ISO, supported by Iwakiri [76] [77], the weight limit for manual carrying would be 25 kg for men and 20 kg for women. The recommended mass limit was calculated based on the work content such as horizontal and vertical location, moving distance, twist angle, lifting frequency and duration, and grip type based on the weight limits. Kurten *et al.* [78] had shown that the load brought to the head produced an anterior inclination of the pelvis, which accentuated the hyperextension of the lumbar vertebrae, producing an exaggeration of lumbar lordosis. Knapik J *et al.* [79] observed that, when an individual walked with a load carried on the back, the forward inclination of the trunk increased and generated with each step repeated microtrauma to the vertebrae, intervertebral discs, muscles and other structures of the spinal column. Furthermore, Orr R *et al.* [80] proved that heavy loads did not move at the same rate as the trunk. The rigidity and anteflexion of the trunk increased proportionally to the weight of the loads carried due to the active co-contraction of the abdominal and paraspinal muscles as well as the paraspinal reflexes. The combined stresses on the vertebrae, discs, muscles and other structures of the spine are likely to be associated with lower back pain and injuries in susceptible individuals.

In our study, the weight-to-body mass ratio was around 121% ± 41% (t-student 0.229) in Cases. Our result was superior to that of Bastien GJ [32] who, in 2005, found that African women balanced loads on their heads of up to 70% of their body mass. Falola *et al.* [81] suggested that the maximum mass or load on the head that a subject could support without increasing painful constraints would be 20% of their body mass. Kinoshita H, in 1985 [82], and Holt KG, in 1990 [83], had proven that the load carried by a woman was normal when it was less than 20% of her body mass. Any burden whose mass was greater than 20% of the body mass of the woman carrying it was considered an overload. This is how Singh D [84] observed that limiting weight to 40% body mass for male workers and less than 24% for female workers had preventive effects on low back pain in obese people. However, from a biomechanical point of view, Ghezelbash F *et al.* [85] showed that it was not good to limit loads as a percentage of body weight. They observed that when people of the same height and different weights carried the same load, the compressive and shear forces on the lumbar disc were greater in the heavier person. For these authors, with the weight limit set as a percentage of body weight, a heavier person could lift even heavier loads, further increasing the compressive and shear forces on the lower lumbar discs. On the other hand, they showed that limiting the weight below 10 kg suppressed the development of low back pain caused by handling loads. They concluded that relative weight limits set as a percentage of body weight were inappropriate and ineffective in preventing low back pain.

This excess weight carried by these women with low back pain, in our series, could be explained by socio-economic and subsistence reasons. Indeed, women being essential providers of their homes, would be forced to carry a lot of items to sell and hope to earn a little more money. In addition, these women were sometimes forced to carry all the products necessary for the daily survival of the family, combining food (rice, cassava, banana and others), energy sources (firewood or embers), packaging (various foliage and bark), drinks and/or medicinal plants in the same basket and at the same time.

In our study, women started regularly carrying heavy loads at the age of 10 (10 - 9) years. These results were corroborated by those of Maloiy *et al.* [42]. These authors, in 1986, in East Africa, estimated that there were training factors and/or anatomical modifications carried out since childhood, which allowed these young ladies to carry heavy loads at lower energy cost. And that the lesser mechanical work observed in these load-bearing women would come from a greater conservation of mechanical energy, resulting from an improvement in the transfer of pendulum energy and kinetic energy from the center of mass at each step. For Kawamori [86], the female body in rural areas has been adapted to the cephalic position practiced since early childhood. He considered that this practice was comparable to the repeated use of different additional loads during sports training sessions, with the aim of developing muscle mass. So, the sooner a young woman starts carrying heavy loads, the sooner she will get used to it and no longer notice

it. This theory was supported in 2023 by Makkiyah FA [67] who considered handling as an essential mobilizing physical activity. He noted that low back pain was common in people who rarely or never exercised and was caused by shortened and weakened back muscles, leading to misalignment of the spine. He believed that exercise reduced the occurrence of low back pain by lengthening the back muscles, which would support and keep the spine in proper alignment. Additionally, regular movement increased blood supply to the muscles, joints, and intravertebral discs of the spine, reducing injury and promoting repair [87]. Finally, Prieto-González P *et al.* [88] showed that strengthening the spinal muscles through exercises such as stretching or aerobic training reduced low back pain by 30% in terms of intensity and disability. Bastien GJ [32], in Nepal in 2005, thought that the energy expenditure of walking while carrying a load would depend first of all on the walking speed, the body mass and the mass carried, all in association with the characteristics of the terrain crossed, the clothing worn and the level of thermal stress. For our part, we believe that despite the possibility of a certain human adaptation to this type of regular physical constraints, the risks for the integrity of the spine would be significant and the health of these women in the peri-urban area of Kisangani would be threatened.

It resulted from our study that three predictive variables, linked to the transport of heavy loads on the back suspended by a rope from the head, were significantly associated with chronic low back pain.

The load port having a weight greater than 50 kg had an Odd Ratio (OR) of 2.4, which was higher than the OR 2 that we had set. This meant that regularly carrying a load weighing more than 50 kg increased the risk of chronic low back pain by more than two times. It clearly appears from this study that the woman in the peri-urban area of the city of Kisangani carried loads beyond all standards and recommendations related to handling (less than 25 kg and/or less than 40% of body weight).

The very young (or early) age of starting to carry heavy loads was a risk factor in the progression to chronic low back pain. Thus, for this study, the age of less than 10 years, from which young girls in the peri-urban area of Kisangani began to regularly carry heavy loads, increased the risk of chronic low back pain by approximately 8.5 times than those who had started carrying at a slightly older age. There is a need to raise awareness among village communities not to expose young girls at a very early age to intense mechanical stress on their fragile, growing bodies which have not yet reached maturity.

The high weekly frequency of carrying loads also appeared to be a determinant of chronic low back pain in the women surveyed. Thus, the probability that a woman who carried a heavy load more than 3 times per week increased the risk of chronic low back pain by approximately 5 times than one who carried only less than three times. This result raises the problem of creating grain stores or warehouses where villagers could preserve or store fresh food products that can be consumed a little longer instead of women being forced to go to the fields or forest

several times a week to harvest subsistence products which are, for the most part, quickly perishable. The diversification of energy sources other than wood would also be indicated to help relieve these women.

However, transport time and distance traveled were not statistically significant probably because all women frequented the same fields, forests, streams and other common areas in the same durations of time. And also, the nutritional status was inconclusive because these women, living in the same environments, probably had the same eating habits.

5. Conclusion

This study showed that the socio-anthropometric profile of the woman suffering from chronic low back pain in the peri-urban area of Kisangani was that of a middle-aged woman, poorly educated, cohabiting in polygamy, highly multiparous and highly multigestural, living mainly from agriculture. At an early age before 10 years old, this woman had started carrying heavy loads of more than 50 kg, more than three times a week.

Limitations of the Study

The present study showed its limitations. First of all, the sample size seemed small, for economic reasons. The study did not benefit from any third-party funding. Second, the self-reported nature of some data collection could have been affected by recall or desirability bias, which would bias the results. Thus, some respondents could have over-declared the loads carried, the weekly number of transports and the age at which they started carrying in order to prove their strength and bravery as well as their capacity for productivity in the villages. Others, on the other hand, could under-report the same data for reasons of self-esteem and social considerations, having other much more liberal socio-professional activities. Finally, this study did not allow us to investigate the prevalence of chronic low back pain in the peri-urban area of the city of Kisangani, which is a case-control study.

State of Knowledge on the Subject

- It has been shown that carrying loads on the back and head of women induces musculoskeletal disorders including chronic low back pain.
- To avoid this, women should not carry loads of more than 20 kg or more than 20% of their body mass.

Contribution of Our Study to Knowledge

- This study revealed that the woman with chronic low back pain from Lubuya Bera had started carrying loads through Liyamba at a very early age.
- This woman regularly carried heavy loads of more than 50 kg, sometimes corresponding to double her body mass, at an almost daily rate.

In view of the results of the present study, the following hypothesis was formulated. This artisanal practice, which does not meet any standards, can modify the

biomechanics of the lumbar spine and influence the early occurrence of degenerative spinal lesions. In the socio-economic conditions of low-income countries, the clinic associated with standard radiography is essential in establishing the diagnosis and monitoring of degenerative spinal lesions.

To verify this hypothesis, we propose to conduct a second study with the aim of evaluating the clinical and radiological state of the lumbar spine of these women carrying loads in the peri-urban area of the city of Kisangani.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Ferreira, M.L., de Luca, K., Haile, L.M., Steinmetz, J.D., Culbreth, G.T., Cross, M., *et al.* (2023) Global, Regional, and National Burden of Low Back Pain, 1990–2020, Its Attributable Risk Factors, and Projections to 2050: A Systematic Analysis of the Global Burden of Disease Study 2021. *The Lancet Rheumatology*, **5**, e316-e329.

[2] Vos, T., Lim, S.S., Abbafati, C., Abbas, K.M., Abbasi, M., Abbasifard, M., *et al.* (2020) Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990-2019: A Systematic Analysis for the Global Burden of Disease Study 2019. *The Lancet*, **396**, 1204-1222.

[3] Jahn, A., Andersen, J.H., Christiansen, D.H., Seidler, A. and Dalbøge, A. (2023) Occupational Mechanical Exposures as Risk Factor for Chronic Low-Back Pain: A Systematic Review and Meta-Analysis. *Scandinavian Journal of Work, Environment & Health*, **49**, 453-465. https://doi.org/10.5271/sjweh.4114

[4] Ricci, J.A., Stewart, W.F., Chee, E., Leotta, C., Foley, K. and Hochberg, M.C. (2006) Back Pain Exacerbations and Lost Productive Time Costs in United States Workers. *Spine*, **31**, 3052-3060. https://doi.org/10.1097/01.brs.0000249521.61813.aa

[5] Agence Nationale d'Accréditation et d'Evaluation en Santé (ANAES) (2000) Diagnostic, prise en charge et suivi des malades atteints de lombalgie chronique. ANAES.

[6] Duquesnoy, B. (2001) Classification des lombalgies communes. *Revue du Rhumatisme*, **68**, 145-149. https://doi.org/10.1016/s1169-8330(00)00096-x

[7] Bourigua, I., Simoneau, E., Leteneur, S., Gillet, C. and Barbier, F. (2010) Revue de la littérature La lombalgie chronique: Définitions, Evaluation et Traitement. *Sciences et Technologies pour le Handicap*, **4**, 9-38.

[8] Guevara-Lopez, U., Covarrubias-Gomez, A., Elias-Dib, J., Reyes-Sanchez, A., Rodriguez-Reyna, T.S. and Consensus Group of Practice Parameters to Manage Low Back Pain (2011) Practice Guidelines for the Management of Low Back Pain. *Cir Cir*, **79**, 264-279. https://pubmed.ncbi.nlm.nih.gov/22381000/

[9] Chenot, J., Greitemann, B., Kladny, B., Petzke, F., Pfingsten, M. and Schorr, S.G. (2017) Non-Specific Low Back Pain. *Deutsches Ärzteblatt international*, **114**, 883-890. https://doi.org/10.3238/arztebl.2017.0883

[10] Meierhofer, R., Tomberge, V.M.J., Inauen, J. and Shrestha, A. (2022) Water Carrying in Hills of Nepal-Associations with Women's Musculoskeletal Disorders, Uterine Prolapse, and Spontaneous Abortions. *PLOS ONE*, **17**, e0269926. https://doi.org/10.1371/journal.pone.0269926

[11] Vlaeyen, J.W.S., Maher, C.G., Wiech, K., Van Zundert, J., Meloto, C.B., Diatchenko,

L., *et al.* (2018) Low Back Pain. *Nature Reviews Disease Primers*, **4**, Article No. 52. https://doi.org/10.1038/s41572-018-0052-1

[12] Ben Ayed, H., Yaich, S., Trigui, M., *et al.* (2019) Prevalence, Risk Factors and Outcomes of Neck, Shoulders and Low-Back Pain in Secondary-School Children. *Journal of Research in Health Science*, **19**, e00440.

[13] Hartvigsen, J., Hancock, M.J., Kongsted, A., Louw, Q., Ferreira, M.L., Genevay, S., *et al.* (2018) What Low Back Pain Is and Why We Need to Pay Attention. *The Lancet*, **391**, 2356-2367. https://doi.org/10.1016/s0140-6736(18)30480-x

[14] Shokri, P., Zahmatyar, M., Falah Tafti, M., Fathy, M., Rezaei Tolzali, M., Ghaffari Jolfayi, A., *et al.* (2023) Non-Spinal Low Back Pain: Global Epidemiology, Trends, and Risk Factors. *Health Science Reports*, **6**, e1533. https://doi.org/10.1002/hsr2.1533

[15] Knezevic, N.N., Candido, K.D., Vlaeyen, J.W.S., Van Zundert, J. and Cohen, S.P. (2021) Low Back Pain. *The Lancet*, **398**, 78-92. https://doi.org/10.1016/s0140-6736(21)00733-9

[16] Abbafati, C., Machado, D., Cislaghi, B., *et al.* (2020) Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990-2019: A Systematic Analysis for the Global Burden of Disease Study 2019. *The Lancet*. **396**, 1204-1222.

[17] Bardin, L.D., King, P. and Maher, C.G. (2017) Diagnostic Triage for Low Back Pain: A Practical Approach for Primary Care. *Medical Journal of Australia*, **206**, 268-273. https://doi.org/10.5694/mja16.00828

[18] Russo, M., Deckers, K., Eldabe, S., Kiesel, K., Gilligan, C., Vieceli, J., *et al.* (2018) Muscle Control and Non-Specific Chronic Low Back Pain. *Neuromodulation: Technology at the Neural Interface*, **21**, 1-9. https://doi.org/10.1111/ner.12738

[19] Taguchi, T. (2003) Low Back Pain in Young and Middle-Aged People. *Japan Medical Association*, **46**, 417-423.

[20] Goel, S. (2019) Non-Spinal Causes of Back Pain: An 'Undiagnosed' Diagnosis. *Journal of Medical Research and Innovation*, **3**, e000172. https://doi.org/10.32892/jmri.172

[21] Riihimaki, H. (1991) Low-Back Pain, Its Origin and Risk Indicators. *Scandinavian Journal of Work, Environment & Health*, **17**, 81-90. https://doi.org/10.5271/sjweh.1728

[22] Wang, L., Ye, H., Li, Z., Lu, C., Ye, J., Liao, M., *et al.* (2022) Epidemiological Trends of Low Back Pain at the Global, Regional, and National Levels. *European Spine Journal*, **31**, 953-962. https://doi.org/10.1007/s00586-022-07133-x

[23] UNDESA (2012) World Urbanization Prospects: The 2011 Revision, United Nations Department of Economic and Social Affairs. UNDESA, Population Division.

[24] Osinuga, A., Janssen, B., Fethke, N.B., Story, W.T., Imaledo, J.A. and Baker, K.K. (2021) Understanding Rural Women's Domestic Work Experiences (DWE) in Ibadan, Nigeria: Development of a Measurement Tool Using Confirmatory Factor Analysis. *International Journal of Environmental Research and Public Health*, **18**, Article 11043. https://doi.org/10.3390/ijerph182111043

[25] Deyo, R.A., Mirza, S.K., Turner, J.A. and Martin, B.I. (2009) Overtreating Chronic Back Pain: Time to Back Off? *The Journal of the American Board of Family Medicine*, **22**, 62-68. https://doi.org/10.3122/jabfm.2009.01.080102

[26] Liew, B.X.W., De Nunzio, A.M., Srivastava, S. and Falla, D. (2020) Influence of Low Back Pain and Its Remission on Motor Abundance in a Low-Load Lifting Task. *Scientific Reports*, **10**, Article No. 17831. https://doi.org/10.1038/s41598-020-74707-4

[27] Arjmand, N., Plamondon, A., Shirazi-Adl, A., Larivière, C. and Parnianpour, M.

(2011) Predictive Equations to Estimate Spinal Loads in Symmetric Lifting Tasks. *Journal of Biomechanics*, **44**, 84-91. https://doi.org/10.1016/j.jbiomech.2010.08.028

[28] Latash, M.L., Gorniak, S. and Zatsiorsky, V.M. (2008) Hierarchies of Synergies in Human Movements. *Kinesiology* (*Zagreb*, *Croatia*), **40**, 29-38.

[29] Latash, M., Levin, M., Scholz, J. and Schöner, G. (2010) Motor Control Theories and Their Applications. *Medicina*, **46**, Article 382. https://doi.org/10.3390/medicina46060054

[30] Subba, S. (1999) Women, Woodfuel, and Health in Adamtar Village, Nepal. *Gender, Technology and Development*, **3**, 361-377. https://doi.org/10.1080/09718524.1999.11909939

[31] Earth, B. and Sthapit, S. (2002) Uterine Prolapse in Rural Nepal: Gender and Human Rights Implications. A Mandate for Development. *Culture, Health & Sexuality*, **4**, 281-296. https://doi.org/10.1080/13691050110090248

[32] Bastien, G.J., Schepens, B., Willems, P.A. and Heglund, N.C. (2005) Energetics of Load Carrying in Nepalese Porters. *Science*, **308**, 1755-1755. https://doi.org/10.1126/science.1111513

[33] Minetti, A.E., Formenti, F. and Ardigò, L.P. (2006) Himalayan Porter's Specialization: Metabolic Power, Economy, Efficiency and Skill. *Proceedings of the Royal Society B: Biological Sciences*, **273**, 2791-2797. https://doi.org/10.1098/rspb.2006.3653

[34] Geere, J.L., Cortobius, M., Geere, J.H., Hammer, C.C. and Hunter, P.R. (2018) Is Water Carriage Associated with the Water Carrier's Health? A Systematic Review of Quantitative and Qualitative Evidence. *BMJ Global Health*, **3**, e000764. https://doi.org/10.1136/bmjgh-2018-000764

[35] Kadota, J.L., McCoy, S.I., Bates, M.N., Mnyippembe, A., Njau, P.F., Prata, N., *et al.* (2020) The Impact of Heavy Load Carrying on Musculoskeletal Pain and Disability among Women in Shinyanga Region, Tanzania. *Annals of Global Health*, **86**, Article 17. https://doi.org/10.5334/aogh.2470

[36] Murray, K.J., Le Grande, M.R., Ortega de Mues, A. and Azari, M.F. (2017) Characterisation of the Correlation between Standing Lordosis and Degenerative Joint Disease in the Lower Lumbar Spine in Women and Men: A Radiographic Study. *BMC Musculoskeletal Disorders*, **18**, Article No. 330. https://doi.org/10.1186/s12891-017-1696-9

[37] Watanabe, S., Takahashi, T., Takeba, J. and Miura, H. (2018) Factors Associated with the Prevalence of Back Pain and Work Absence in Shipyard Workers. *BMC Musculoskeletal Disorders*, **19**, Article No. 12. https://doi.org/10.1186/s12891-018-1931-z

[38] Middleton, K., Vickery-Howe, D., Dascombe, B., Clarke, A., Wheat, J., McClelland, J., *et al.* (2022) Mechanical Differences between Men and Women during Overground Load Carriage at Self-Selected Walking Speeds. *International Journal of Environmental Research and Public Health*, **19**, Article 3927. https://doi.org/10.3390/ijerph19073927

[39] Joosab, M., Torode, M. and Prasada Rao, P. (1994) Preliminary Findings on the Effect of Load-Carrying to the Structural Integrity of the Cervical Spine. *Surgical and Radiologic Anatomy*, **16**, 393-398. https://doi.org/10.1007/bf01627659

[40] Echarri, J.J. and Forriol, F. (2002) Effect of Axial Load on the Cervical Spine: A Study of Congolese Woodbearers. *International Orthopaedics*, **26**, 141-144. https://doi.org/10.1007/s00264-002-0336-6

[41] Porter, G., Hampshire, K., Dunn, C., Hall, R., Levesley, M., Burton, K., *et al.* (2013) Health Impacts of Pedestrian Head-Loading: A Review of the Evidence with Particu-

lar Reference to Women and Children in Sub-Saharan Africa. *Social Science & Medicine*, **88**, 90-97. https://doi.org/10.1016/j.socscimed.2013.04.010

[42] Maloiy, G.M.O., Heglund, N.C., Prager, L.M., Cavagna, G.A. and Taylor, C.R. (1986) Energetic Cost of Carrying Loads: Have African Women Discovered an Economic Way? *Nature*, **319**, 668-669. https://doi.org/10.1038/319668a0

[43] Bera, L. (2020) Rapport d'activités globales de. Exercice 2020.

[44] Lwanga, S.K., Lemeshow, S. and World Health Organization (1991) Détermination de la taille d'un échantillon dans les études sanométriques: Manuel pratique. Organisation mondiale de la Santé.

[45] Broekmans, F.J., Kwee, J., Hendriks, D.J., Mol, B.W. and Lambalk, C.B. (2006) A Systematic Review of Tests Predicting Ovarian Reserve and IVF Outcome. *Human Reproduction Update*, **12**, 685-718. https://doi.org/10.1093/humupd/dml034

[46] WHO (2000) Obesity; Preventing and Managing the Global Epidemic: Report of a WHO Consultation. World Health Organization.

[47] WHO (1995) Physical Status: The Use and Interpretation of Anthropometry. Report of a WHO Expert Consultation. World Health Organization.

[48] Koes, B.W., van Tulder, M.W. and Thomas, S. (2006) Diagnosis and Treatment of Low Back Pain. *BMJ*, **332**, 1430-1434. https://doi.org/10.1136/bmj.332.7555.1430

[49] Chou, R., Qaseem, A., Snow, V., Casey, D., Cross, J.T., Shekelle, P., *et al.* (2007) Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice Guideline from the American College of Physicians and the American Pain Society. *Annals of Internal Medicine*, **147**, 478-491. https://doi.org/10.7326/0003-4819-147-7-200710020-00006

[50] Winter, D.A. (1979) Biomechanics of Human Movement. A Wiley-Interscience Publication.

[51] Dionne, C.E. (2001) Formal Education and Back Pain: A Review. *Journal of Epidemiology & Community Health*, **55**, 455-468. https://doi.org/10.1136/jech.55.7.455

[52] Kahere, M. and Ginindza, T. (2021) The Prevalence and Risk Factors of Chronic Low Back Pain among Adults in Kwazulu-Natal, South Africa: An Observational Cross-Sectional Hospital-Based Study. *BMC Musculoskeletal Disorders*, **22**, Article No. 955. https://doi.org/10.1186/s12891-021-04790-9

[53] Nduwimana, I., Nindorera, F., Sinzakaraye, A., Bleyenheuft, Y., Thonnard, J. and Kossi, O. (2022) Biopsychosocial Factors Associated with Chronic Low Back Pain-Related Activity Limitations in Burundi. *South African Journal of Physiotherapy*, **78**, a1783. https://doi.org/10.4102/sajp.v78i1.1783

[54] Meucci, R.D., Fassa, A.G. and Faria, N.M.X. (2015) Prevalence of Chronic Low Back Pain: Systematic Review. *Revista de Saúde Pública*, **49**, Article 73. https://doi.org/10.1590/s0034-8910.2015049005874

[55] Reisbord, L.S. and Greenland, S. (1985) Factors Associated with Self-Reported Back-Pain Prevalence: A Populationdashbased Study. *Journal of Chronic Diseases*, **38**, 691-702. https://doi.org/10.1016/0021-9681(85)90023-2

[56] Trocaire (2017) Understanding Women's Lives in Polygamous Marriages: Exploring Community Perspectives in DRC and Sierra Leone.

[57] Alhassan, A.R. (2023) Polygynous Marriage Union among Ghanaian Christian Women: Socio-Demographic Predictors. *PLOS ONE*, **18**, e0275764. https://doi.org/10.1371/journal.pone.0275764

[58] Harel-Shalev, A. and Kook, R. (2021) Ontological Security, Trauma and Violence,

and the Protection of Women: Polygamy among Minority Communities. *Frontiers in Psychology*, **12**, Article 743478. https://doi.org/10.3389/fpsyg.2021.743478

[59] Kassaw, C. and Shumye, S. (2021) The Prevalence of Suicidal Behavior and Its Associated Factors among Wives with Polygamy Marriage Living in Gedeo Zone, Southern Ethiopia, 2020. *PLOS ONE*, **16**, e0259029. https://doi.org/10.1371/journal.pone.0259029

[60] Sinai, M. and Peleg, O. (2020) Marital Interactions and Experiences of Women Living in Polygamy: An Exploratory Study. *International Journal of Psychology*, **56**, 361-377. https://doi.org/10.1002/ijop.12726

[61] Hannibal, K.E. and Bishop, M.D. (2014) Chronic Stress, Cortisol Dysfunction, and Pain: A Psychoneuroendocrine Rationale for Stress Management in Pain Rehabilitation. *Physical Therapy*, **94**, 1816-1825. https://doi.org/10.2522/ptj.20130597

[62] Barros dos Santos, A.O., Pinto de Castro, J.B., Lima, V.P., da Silva, E.B. and de Souza Vale, R.G. (2020) Effects of Physical Exercise on Low Back Pain and Cortisol Levels: A Systematic Review with Meta-Analysis of Randomized Controlled Trials. *Pain Management*, **11**, 49-57. https://doi.org/10.2217/pmt-2020-0020

[63] Sugano, A. and Nomura, T. (2000) Influence of Water Exercise and Land Stretching on Salivary Cortisol Concentrations and Anxiety in Chronic Low Back Pain Patients. *Journal of Physiological Anthropology and Applied Human Science*, **19**, 175-180. https://doi.org/10.2114/jpa.19.175

[64] Aleku, M., Nelson, K., Abio, A., Lowery Wilson, M. and Lule, H. (2021) Lower Back Pain as an Occupational Hazard among Ugandan Health Workers. *Frontiers in Public Health*, **9**, Article 761765. https://doi.org/10.3389/fpubh.2021.761765

[65] Omoke, N.I., Amaraegbulam, P.I., Joannes Umeora, O.U. and Okafor, L.C. (2021) Prevalence and Risk Factors for Low Back Pain during Pregnancy among Women in Abakaliki Nigerian. *Pan African Medical Journal*, **39**, Article 70. https://doi.org/10.11604/pamj.2021.39.70.24367

[66] Sencan, S., Ozcan-Eksi, E.E., Cuce, I., Guzel, S. and Erdem, B. (2018) Pregnancy-Related Low Back Pain in Women in Turkey: Prevalence and Risk Factors. *Annals of Physical and Rehabilitation Medicine*, **61**, 33-37. https://doi.org/10.1016/j.rehab.2017.09.005

[67] Makkiyah, F.A., Sinaga, T.A. and Khairunnisa, N. (2023) A Study from a Highly Populated Country: Risk Factors Associated with Lower Back Pain in Middle-Aged Adults. *Journal of Korean Neurosurgical Society*, **66**, 190-198. https://doi.org/10.3340/jkns.2021.0278

[68] Lee, C.A., Jang, H., Moon, J.E. and Han, S. (2021) The Relationship between Change of Weight and Chronic Low Back Pain in Population over 50 Years of Age: A Nationwide Cross-Sectional Study. *International Journal of Environmental Research and Public Health*, **18**, Article 3969. https://doi.org/10.3390/ijerph18083969

[69] Alnaami, I., Awadalla, N.J., Alkhairy, M., Alburidy, S., Alqarni, A., Algarni, A., *et al.* (2019) Prevalence and Factors Associated with Low Back Pain among Health Care Workers in Southwestern Saudi Arabia. *BMC Musculoskeletal Disorders*, **20**, Article No. 56. https://doi.org/10.1186/s12891-019-2431-5

[70] Fabris de Souza, S.A., Faintuch, J., Valezi, A.C., Sant'Anna, A.F., Gama-Rodrigues, J.J., de Batista Fonseca, I.C., *et al.* (2005) Postural Changes in Morbidly Obese Patients. *Obesity Surgery*, **15**, 1013-1016. https://doi.org/10.1381/0960892054621224

[71] Ando, K., Kobayashi, K., Nakashima, H., Machino, M., Ito, S., Kanbara, S., *et al.* (2020) Poor Spinal Alignment in Females with Obesity: The Yakumo Study. *Journal*

of Orthopaedics, **21**, 512-516. https://doi.org/10.1016/j.jor.2020.09.006

[72] Kossi, O., Yamadjako, D., Timmermans, A., Michiels, S., Adoukonou, T. and Janssens, L. (2022) Prevalence and Biopsychosocial Factors Associated with Chronic Low Back Pain in Urban and Rural Communities in Western Africa: A Population-Based Door-to-Door Survey in Benin. *European Spine Journal*, **31**, 2897-2906. https://doi.org/10.1007/s00586-022-07345-1

[73] Shivakumar, M., Welsh, V., Bajpai, R., Helliwell, T., Mallen, C., Robinson, M., *et al.* (2023) Musculoskeletal Disorders and Pain in Agricultural Workers in Low- And Middle-Income Countries: A Systematic Review and Meta-analysis. *Rheumatology International*, **44**, 235-247. https://doi.org/10.1007/s00296-023-05500-5

[74] Eatough, E.M., Way, J.D. and Chang, C. (2012) Understanding the Link between Psychosocial Work Stressors and Work-Related Musculoskeletal Complaints. *Applied Ergonomics*, **43**, 554-563. https://doi.org/10.1016/j.apergo.2011.08.009

[75] Motaung, T.G., Ellapen, T.J. and Paul, Y. (2022) The Consequence of Head-Loading on the Neuro-Musculoskeletal Health of the Ilembe District Youth of Kwazulu-Natal. *African Journal of Disability*, **11**, a1039. https://doi.org/10.4102/ajod.v11i0.1039

[76] ISO 11228-1: (2021) Ergonomics-Manual handling-Part 1: Lifting, Lowering and Carrying.

[77] Iwakiri, K., Sasaki, T., Sotoyama, M., Du, T., Miki, K. and Oyama, F. (2023) Effect of Relative Weight Limit Set as a Body Weight Percentage on Work-Related Low Back Pain among Workers. *PLOS ONE*, **18**, e0284465. https://doi.org/10.1371/journal.pone.0284465

[78] Kurten, M., Motaung, G.T., Ellapen, T.J., Paul, Y., Hammill, H.V. and Muluvhu, T.C. (2021) The Effects of Cranial Loading among Bucolic Female African Children Neuromusculoskeletal Health and Well-Being: A Literature Overview (2000-2018). In: Balint, G., Antala, B., Carty, C., Mabieme, J.-M.A., Amar, I.B. and Kaplanova, A., Eds., *Physical Education and Sport for Children and Youth with Special Needs: Researches-Best Practices-Situation*, Fédération Internationale d'Education Physique, 224-233.

[79] Knapik, J.J. and Reynolds, K. (2015) Load Carriage-Related Injury Mechanisms, Risk Factors, and Prevention. In: Gefen, A. and Epstein, Y., Eds., *Studies in Mechanobiology, Tissue Engineering and Biomaterials*, Springer International Publishing, 107-137. https://doi.org/10.1007/8415_2014_182

[80] Orr, R., Pope, R., Lopes, T.J.A., Leyk, D., Blacker, S., Bustillo-Aguirre, B.S., *et al.* (2021) Soldier Load Carriage, Injuries, Rehabilitation and Physical Conditioning: An International Approach. *International Journal of Environmental Research and Public Health*, **18**, Article 4010. https://doi.org/10.3390/ijerph18084010

[81] Falola, J., Gouthon, P., Aremou, M., Tonon, B., Falola, S. and Azifan, Y. (2010) Les déterminants non socio-économiques de la surcharge lors du port céphalique chez des femmes marchandes au Bénin. *Journal de la Recherche Scientifique de l'Universite de Lome*, **11**, 15-23. https://doi.org/10.4314/jrsul.v11i1.56773

[82] Kinoshita, H. (1985) Effects of Different Loads and Carrying Systems on Selected Biomechanical Parameters Describing Walking Gait. *Ergonomics*, **28**, 1347-1362. https://doi.org/10.1080/00140138508963251

[83] Holt, K.G., Hamill, J. and Andres, R.O. (1990) The Force-Driven Harmonic Oscillator as a Model for Human Locomotion. *Human Movement Science*, **9**, 55-68. https://doi.org/10.1016/0167-9457(90)90035-c

[84] Singh, D., Park, W., Hwang, D. and Levy, M. (2015) Severe Obesity Effect on Low

Back Biomechanical Stress of Manual Load Lifting. *Work*, **51**, 337-348. https://doi.org/10.3233/wor-141945

[85] Ghezelbash, F., Shirazi-Adl, A., Arjmand, N., El-Ouaaid, Z., Plamondon, A. and Meakin, J.R. (2016) Effects of Sex, Age, Body Height and Body Weight on Spinal Loads: Sensitivity Analyses in a Subject-Specific Trunk Musculoskeletal Model. *Journal of Biomechanics*, **49**, 3492-3501. https://doi.org/10.1016/j.jbiomech.2016.09.026

[86] Kawamori, N. and Haff, G.G. (2004) The Optimal Training Load for the Development of Muscular Power. *The Journal of Strength and Conditioning Research*, **18**, Article 675. https://doi.org/10.1519/1533-4287(2004)18<675:totlft>2.0.co;2

[87] Diallo, S.Y.K., Mweu, M.M., Mbuya, S.O. and Mwanthi, M.A. (2019) Prevalence and Risk Factors for Low Back Pain among University Teaching Staff in Nairobi, Kenya: A Cross-Sectional Study. *F1000Research*, **8**, Article 808. https://doi.org/10.12688/f1000research.19384.1

[88] Prieto-González, P., Šutvajová, M., Lesňáková, A., Bartík, P., Buľáková, K. and Friediger, T. (2021) Back Pain Prevalence, Intensity, and Associated Risk Factors among Female Teachers in Slovakia during the COVID-19 Pandemic: A Cross-Sectional Study. *Healthcare*, **9**, Article 860. https://doi.org/10.3390/healthcare9070860