Risk factor of Low Back Pain and the Relationship with the sagittal lumbar alignment in Tanzania
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I. Summary

Low Back Pain (LBP) is a common and serious problem affecting vast populations of the world [1]. It is widely recognized as the leading cause of disability in the high-income (HIC) countries [2]. In the low-income countries (LIC), particularly sub-Sahara Africa (SSA), very little is known about LBP. A few reports chiefly from Nigeria and South Africa show that LBP problem is huge [3]. Owing to the fact that socio-demographic characteristics in SSA are rather similar, it is viable to regard LBP as a significant problem which needs increased attention. Previous studies [3] have shown 32% of adults in SSA suffer from LBP. The rate of LBP in SSA, where the prevalence rate was assumed to be relatively lower than in advanced countries, is caused primarily by lack of literature on its epidemiology. It is imperative, therefore, that more studies should be done on this continent.

Also, many people have LBP in Tanzania where I worked as a physiotherapist during 2013 - 2015, but there are few studies about that. LBP interferes with not only work but also a number of other daily activities such as exercise and sleeping. Therefore, the strategy to prevent LBP should involve a kind of holistic health promotion activity. For that purpose, it is important first to understand the state of LBP and how it affects people’s lifestyle to clarify the direction of implementation to reduce the incidences of LBP among adults who complain from LBP caused by unknown reasons taking a case study of Tanzania. In the country, I assume that LBP is related to the pelvic angle.

Based on such a situation and my assumption, I would like to investigate the cause whether LBP is related to pelvic angle and lifestyles. In my prediction, a group with a higher pelvic angle may have LBP. If a person with a higher pelvic angle tends to have LBP, enhancing the stretching techniques of medical staff and patients’ self-exercise skills can be effective preventive measures against the high-risk group. For the above reasons, I carried out field research to obtain the actual prevalence of LBP, factors of LBP and the relationship between pelvic angle and the disabilities affected by LBP among adults in Moshi city, Tanzania.

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1 Kyoto University Graduate School/ Department of Physical Therapy/Human Health Sciences/ First-year master's degree
Country: Republic of Tanzania
Host University: Kilimanjaro Christian Medical Centre College of Physiotherapy
The period of field research conducted: 92days - 20th/Sep/2017~23th/Dec/2017
題：タンザニアにおける腰痛のリスク因子と骨盤角度との関係

概要

腰痛（Low Back Pain、LBP）は、世界で多くの人々が共通して抱える深刻な問題である[1]。そして、高所得国（HIC）[2]における障害の主要な原因として広く認識されている。反対に、低所得国（LIC）、特にサブサハラアフリカ（SSA）では、LBPについての調査報告がまだ充実とは言えないうち。限定的な報告としては、ナイジェリアと南アフリカを中心とした報告があり、その報告によりアフリカ全土における LBP の有病率は少なくない可能性が示唆されている[3]。なぜなら、SSA は社会的 - 人口統計学的特徴が酷似している傾向にあることから、LBP はアフリカ地域全域において、注目していく必要がある重大な問題といえるだろう。先行研究[3]によると、SSA の成人的 32％が LBP に罹患していることを示している。有病率が先進国に比べて相対的に低いと推定された SSA における LBP の疫学に関する文献は、調査報告が蓄積されていないことに起因する。したがって、アフリカ大陸において、より多くの研究が行われることが不可欠である。

そして、SSA のひとつの国であるタンザニアもまた、LBP を持つ人が非常に多い。しかし、タンザニアでもまだ LBP に関する研究はほとんど報告されていない。LBP は仕事だけでなく、運動や睡眠などの様々な活動の妨げになるとされている。したがって、LBP を予防する戦略は、一種の総合的な健康促進活動であるといえる。そのためには、タンザニアにおいても LBP の発生状況を把握し、タンザニアの人々の生活習慣にどのような影響を及ぼしているのかを調査する必要があり、この調査は LBP の発生を軽減するための施策の方向性を明確にする重要な取り組みだといえる。タンザニアでも、多くの人々が LBP を抱えているが、原因が明確でないことが多い。

さらに、HIC では LBP と骨盤角が相互に関連しているとの報告があり、アフリカ系人種においても調査するべきであると考えた。また、より高い骨盤角度を有するグループが LBP を有する可能性があると仮定すると、高リスク群に対して、ストレッチングや筋力増強訓練などの予防措置を講じることが可能となる。このような状況を踏まえ、LBP が骨盤の角度やライフスタイルに関係するかを調査をタンザニアの Moshi 市にて、LBP の実際の罹患率、LBP の要因、および成人の LBP の影響を受けた骨盤角と障害の関係を把握するために、フィールド調査を実施した。
II. Research Activity

1. Introduction

Low back pain (LBP) is the most prevalent musculoskeletal condition and the most common cause of disability in developed countries [4]. According to the previous study [3], 32% of adults in Africa had LBP. This result is the prevalence rate of LBP which is rising in African countries where the prevalence rate of LBP was assumed to be relatively lower than in advanced countries. It also reports that further research on strategies for the prevention and management of LBP in Africa is needed. Although studies focusing on African countries have started to develop recently, however, most of the research is accounted for by the Republic of South Africa and Nigeria.

The literature on the epidemiology of LBP has been accumulated, but for the most part, studies are limited to high-income countries and little is known about the factors related to LBP focused on adults in Africa including Tanzania [5]. In spite of high prevalence (73.6%) of LBP among nurses in the country for essence [6], there are not enough studies which investigated the occurrence of LBP within the country.

Furthermore, there are reports in Japan that LBP and pelvic angle are interrelated [7], and African residents are generally said to have a high pelvic angle [8].

LBP interferes with not only work but also some activities such as exercise and sleeping. Therefore, the strategy to prevent LBP should be a kind of holistic health promotion activity. For that purpose, it is important to grasp the state of LBP and how it affects people’s lifestyle in Tanzania as a case study to be able to clarify the direction of implementation of physiotherapy treatment to reduce the incidences of LBP among the adults.

2. Study Area

This study has taken place in the school and the department of physiotherapy at Kilimanjaro Christian Medical Centre (KCMC) in Moshi, Tanzania between October and December 2017. The country supervisor works at the school of physiotherapy, thus, it is viable for me to conduct the study in KCMC because of availability of guidance.

![Figure 1: Position of Moshi as a survey site](image)
3. Methodology

Several agreements on the classification of LBP have been documented. It is viable, to describe these classifications collectively under three major domains namely “physical”, “psychological” and “pathological”. A multitude of studies has reported physical stress [9–11], psychological stress [12, 13], personal characteristics [14–17] and physical characteristics [18, 19] as predictors of LBP. These factors surround primarily ergonomic conditions in which body mechanics and extrinsic factors including work conditions play important role in developing the pain. Much has as well been reported on pathological LBP, which involves primarily the degeneration of anatomical structures including intra-articular structures: ligaments, adjoining articular surfaces and facets, and para-articular structures. The latter may be difficult to prevent from happening as it involves degenerative processes of the structures [20, 21].

In this study, I conducted a survey focusing on individual characteristics and physical characteristics as predictors of LBP.

Main Objective:
The overall objective of this study is to investigate the anthropometric relationship between pelvic angle and the disabilities affected by LBP among people in Moshi city, Tanzania.

Specific objectives
• To investigate into characteristic life history of persons in relation with the LBP.
• To relate characteristic presentation of the LBP with anthropometric measurements among symptomatic persons.
• To compare the anthropometric measurements between symptomatic and asymptomatic persons.

Subjects
I selected subjects from KCMC staff and students through gatherings. There was a total of 68 subjects who participated. I divided the participants into two groups, depending on the questionnaire: 1) asymptomatic group (n=52, age = 20 - 55) and 2) symptomatic group (n=16, age = 20 - 55), and the measurements were carried out in the KCMC. Written informed consent was received from all participants before proceeding with data collection.

Data collection procedure
I arranged a series of venues for introduction and sharing the purpose of the study to KCMC students, staff and patients with the assistance of the country supervisor. After that, they were requested to participate in the study voluntarily. Informed consent from those who agreed to participate in the study was obtained before data collection.

Following signing consent forms, participants were given questionnaires on their status quo about the LBP. Responding to this questionnaire took approximately 10 minutes.

Anthropometric measurements followed, and participants’ height, weight, curvature of the spine and pelvic angle were measured. Height was measured by Height Meter HM 200P (AS One Corporation, Japan); weights by Omron weighing scale model HBF-214-EBW (Omron Healthcare Co. Ltd, Kyoto, 617-0002 Japan); spine curvature and pelvic angle by palpation meter (PALM) (Performance Attainment Associates, St. Paul, MN) and Spinal Mouse ® (Idiag, Fehraltdorf, Switzerland). PALM is a pelvic-
leveling device that combines the features of a measurement caliper and an inclinometer, and Spinal Mouse is used to measure sagittal thoracic and lumbar curvatures (spinal alignment). Spinal Mouse is a non-invasive device that combines with a computer program to assess the curvatures of the vertebral column.

The Range of Motion (ROM) was measured by a goniometer (healthcare -V2U, Mid-view City 573969 Singapore). The ROM of four (4) joints of the lower quadrant were measured. These are trunk: - flexion, extension, rotation and lateral bending; hip joint: - flexion, extension, adduction, abduction, internal rotation and external rotation; knee joint: - flexion and extension; and ankle joint: - dorsiflexion and plantar flexion.

The flexibility of the hip was measured by Thomas test for iliopsoas muscle; Erie test for Quadriceps femoris muscle; Straight Leg Raising (SLR) test for hamstrings; and finger-to-floor distance test for posterior trunk muscles.

Trunk function is evaluated by Kraus weber test. Anthropometric measurements took approximately 30 minutes per participant.

**Measurements:**
* Anthropometry (height, weight, the curvature of the spine and pelvic angle)
* ROM (Trunk-flexion, extension, rotation, lateral bending. Hip joint-flexion, extension, adduction, abduction, internal rotation, external rotation. Knee joint-flexion, extension. Ankle joint-dorsiflexion, plantar)
* Flexibility (Iliopsoas Muscle-Thomas test. Quadriceps Femoris Muscle-Erie test. Hamstrings -SLR test. Posterior Trunk Muscle-Finger Floor Distance.)
* Trunk function (Kraus weber test)
* Interview and questionnaire.
(About whether the subject has LBP pain or not, a degree of pain, and weekly schedule.)

**Statistical analysis**
The analyses were carried out primarily to describe three features: 1) the comparison of groups of high and low pelvic angle in relation with history of the LBP, 2) the correlation between LBP and pelvic angle, and 3) the comparison of differences in pelvic angle, thoracic vertebra / lumbar spine angle, and trunk muscle strength between the asymptomatic and symptomatic groups in relation to the LBP. Differences in continuous variables in each item were assessed using independent t-test or Mann-Whitney U test.

All the statistical analyses were carried out using SPSS version 20.0 (IBM Corp., Armonk, NY, USA) and a p-value of <0.05 was considered as significant.

**Ethical consideration**
Ethical clearance was sought from Research Ethical Committee of the National Institute for Medical Research (NIMR), Dar es Salaam, Tanzania. Permission before conducting this study was requested from KCMC. All data are coded in order to ensure confidentiality and anonymity. The researcher requested a
Data Transfer Agreement (DTA) from the NIMR to be processed before taking the data to Kyoto University.

4. Research Findings

Results

The physical characteristics of the participants of each group are shown in Table 1.

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<th>Table 1. Physical characteristics of participants</th>
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<tr>
<td>Asymptomatic group (n=52)</td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Height (cm)</td>
</tr>
<tr>
<td>Weight (kg)</td>
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<tr>
<td>Body mass index (kg/m²)</td>
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<td>mean ± SD</td>
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The descriptive statistics of asymptomatic and symptomatic groups are shown in Table 2.

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<th>Table 2. Parameters of sagittal pelvic alignment and abdominal muscle strength in asymptomatic group and symptomatic group</th>
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<tr>
<td>Asymptomatic group(n=52)</td>
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<tr>
<td>Lumbar lordosis(°)</td>
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<tr>
<td>Abdominal muscle strength</td>
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<tr>
<td>Mean ± SD</td>
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</table>

Table 1 presents the mean values, the standard deviations, and the ranges for each shape and orientation variable of the physical characteristics such as age, height, weight, and BMI of the participants in each group. Table 2 presents the relationship between lumbar lordosis angle and abdominal muscle strength in the asymptomatic and symptomatic group in LBP. As a result of Mann-Whitney U test, there was a significant difference in BMI between the asymptomatic group and the symptomatic group. On the other hand, there was no significant difference between the lumbar lordosis angle and the abdominal muscle strength between the asymptomatic group and the symptomatic group (Table 2).

The correlation analysis combining pelvic angle and the asymptomatic or symptomatic of low back pain predicted the symptomatic history. Meanwhile, the correlation analysis of lumbar lordosis angle with symptomatic or asymptomatic in low back pain did not concern the symptoms.

5. Discussion

On theoretical bases, it can be assumed that abnormality of posture may play a role in the occurrence of LBP by creating concentrations of stress. Nevertheless, this assumption remains speculative because of the absence of criteria for normal posture. Several studies have investigated sagittal spinal alignment and pelvic angle in lumbar disorders [22–25]. In a study evaluating the sagittal lumbar alignment of LBP, no differences were found in the parameters of the lumbar or pelvic alignment compared with normal
individuals [26, 27]. On the opposite, it was also reported that showing the relationship between lumbar lordosis and LBP [28].

In consequence, the influence of sagittal spinal and pelvic alignment on LBP is still poorly understood. Additionally, there has been literature on the epidemiology of LBP, but little is known about the factors related to LBP in adults in Tanzania [5].

In the present study, the results show a better understand of the relationship between sagittal alignment and LBP in Tanzania, as there are not enough studies which investigated the occurrence of LBP in that country. Accordingly, the investigation could potentially promote in identifying subjects prone to develop the LBP in Tanzania in the future based on their sagittal spinal and pelvic alignment.

In this study, no significant differences were found in the parameters of lumbar lordosis segments in subjects with asymptomatic and symptomatic of LBP in Tanzania. In other words, the large lumbar lordosis in Tanzania is not directly linked to the cause of low back pain (Table 2).

A previous study [29] supports the concept that the pelvis and spine of asymptomatic adults can be considered in the sagittal plane as an open linear chain linking the head to the pelvis. And this concept implies that a change in shape or orientation at any level will affect a change in adjacent segments and will modify their shape. Therefore, there are many reports that recommend muscle strengthening training of core muscles, including abdominal muscles aiming to improve hyperlordosis of a lumbar segment as a prevention of LBP [30, 31, 32].

Considering the results of this study, it can be said that the approach to improving LBP is not enough by only improving trunk muscles strength.

Likewise, the results suggest that obesity seems to be one of the main reasons why the hyperostosis of the lumbar vertebrae did not show a significant difference from LBP in this survey. From the BMI results in Table 1, the group with LBP has a significantly higher obesity rate. Obesity causes tissue thickening. Due to the thick soft tissue, it can be considered that the spinal mouse measured along the body surface could not catch the original lumbar vertebrae curves.

In conclusion, this study has demonstrated that to understand the cause of LBP in Tanzania, not only to evaluate lumbar hyperlordosis but also to promote measurement of obesity is needed. Further studies are needed, therefore, to improve measures against obesity of Tanzania residents with LBP. Though much remains to be unclear, I believe this research made a few contributions to this subject.

6. Conclusion
I investigated whether trunk strength and a curvature of the lumbar vertebra are not related to low back pain among the Tanzania residents. The results indicated that the person with LBP symptoms in Tanzania has a large BMI.
Accordingly, the investigation could potentially identify subjects prone to develop LBP in Tanzania in the future, based on their BMI. This study is to give a better understanding of the relationship between obesity and LBP in Tanzania.

The Sustainable Development Goals (SDGs) are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity [36]. This research can contribute to "Goal 3. Ensure healthy lives and promote well-being for all at all ages" in SDGs. In particular, it corresponds to the following three targets. "3.4 by 2030 reduce by one-third premature mortality from non-communicable diseases (NCDs) through prevention and treatment, and promote mental health and wellbeing. ", "3.c reduction substantially health financing and the recruitment, development and training and retention of the health workforce in developing countries, especially in LDCs and SIDS. "," 3.d Strength of all countries, developing countries, for early warning, risk reduction, and management of national and global health risks. "

A majority of the current international community consists of developing countries with a lower standard of health service than that of developed countries. As this research focuses on LBP that is one of the areas where the analysis and practices have not been enough progressed in Africa, the result will highly contribute to reducing the risk of many local populations’ musculoskeletal problems and will promote the concept of prevention. Improving the quality of health service to provide, this research can bring a good and big impact on larger populations which is in align with SDGs.

• Acknowledgement

I am grateful to all the participants in this study for the contribution of their time and dedication. Also, I would like to thank Dr. Egfrid Mkoba of the local supervisor and my laboratory colleagues for their valuable advice.

Moreover, I have had the support and encouragement of GLTP 2017.

Without their guidance and persistent help, this field research would not have been possible. I would also like to express my gratitude to United Nations University for their financial support.
References


Appendix

✓ Acquisition of NIMR Tanzania (Ethics Committee) approval – Appendix i
✓ Acquisition of COSTECH (Survey permission) – Appendix ii
✓ Preparation for registration to Immigration (Residence permit / immigration office) : Switching from tourist visa to residence visa
✓ Physical measurements for staff and students at local academic universities (Kilimanjaro Christian Medical Center / KCMC) and university hospitals
✓ Dual task exercise seminar held at KCMC to recruit subjects
✓ Recruitment of measurement assistants among the students and technical guidance to the students assisting in taking a measurement.
III. Reflection to the GLTP in Africa

This part should include all contents below with photos which show your life in the field.

- Your motivation to participate in the GLTP:
  I have worked as a volunteer physiotherapist in Tanzania for two years (2013 – 2015). During the period, I met many patients who had Low Back Pain (LBP). Although I did my best to treat them, there was not enough time to identify the factors causing their low back pain. Even after coming back to Japan, I still had interests in health promotion to prevent LBP, and this is the reason why I enrolled Kyoto University to conduct field research in Tanzania to investigate the causes and factors of LBP. My target was to identify the factors of LBP to develop the method of LBP prevention. That is why I applied for GLTP.

- Field experiences:
  I used my network to visit a local physiotherapist’s school in 2016 before entering the graduate school of Kyoto University. At that time, I informed my local supervisor about my intention to cooperate with him in the future on field research for health promotion in Tanzania and he kindly agreed. After this visit in 2016, I kept in contact with him by e-mail from Japan. Through this continuous communication, my local supervisor has fully understood the objectives and contents of my research. When I arrived at the research site in 2017 under the GLTP, the supervisor gave me an opportunity to interact with other local teachers and hospital staffs. However, local college students were not always in the school for practical training in the hospital on account of classes in other buildings or personal reasons. Due to this, I had to go to the school every day to request their presence then made a physical measurement to persons who could recognize me. As a result, they also well understood about me and the purpose of my research through these daily interactions and measurement exercise. Whenever I met them, I chatted and talked about the progress of my research, and also asked their assist to recruit more subjects for this research. I realized the importance of getting help from the local people and always requested them for their cooperation whenever faced troubles.

- Challenges:
  My local supervisor is the principal of the school. As he had many meetings and document work on a daily basis, I tried to be very careful not to disturb his work and schedule. Whenever I needed to make a schedule with him, I had to understand all his plans in advance. Particularly in order to progress any required procedures with documents for administration, application and registration, we allocated all tasks clearly such as while I was preparing official documents, he communicated with the Ethics Committee staff via email. Through this joint planning and task allocation, we could effectively monitor the progress and results of respectively allocated tasks each other not to miss any requirements saving our time.

- How to make use of this experience to your future career development:
  After obtaining the master’s degree, I am planning to apply for JICA Junior Expert Development Project or to find a job in a Japanese consulting company. However, if I successfully develop an algorithm to identify the cause of Low Back Pain in Tanzania, I will consider establishing a local company. Whatever the position I will be in, I’d like to work for development projects in developing countries, especially in Africa.

- Encouragement to other students:
  Think globally, act locally.
Photos

1) Measurement Room

- Bed
- Table
- Chair
- Weight meter
- Height meter
- Measuring equipments
- PC

2) Measuring equipment

- Left) Spinal Mouse
- Right) Palpation Meter

3) Measurement

and Questionnaire
4) Recruitment of measurement assistants among the students and technical guidance to the students assisting in taking measurement.

5) Dual task exercise seminar held at KCMC to recruit subjects