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SHORT REPORTS

Leg Length Discrepancy in College Students and Its Association with Low Back Pain: a Preliminary Study

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Abstract

Leg length discrepancy (LLD) is a condition in which lower extremities have a different length. The discrepancy can cause functional dysfunction and health problem. Low back pain (LBP) is one of a health problem associated with LLD. The prevalence of LBP in young people increases over time. This study aimed to evaluate the association between LLD and LBP in college students. This cross-sectional study involved 75 (40 female) students of Faculty of Medicine, Atma Jaya. Height, weight, and BMI were measured and calculated. True leg length was measured three times using tape measurement in the supine position. The LLD was defined as the difference of 10 mm or more. Numeric data between LLD vs no LLD were compared using independent samples of the t-test. The association between LLD, LBP, and other variables were evaluated using chi-square. A p-value <0.05 was set as statistically significant. Statistics analysis was computed using SPSS (ver. 17). Leg length discrepancy and LBP were found in 31 (22 female) and 36 (22 female), respectively. Among those with LBP, 16 were LLD (44.4%). No association was found between LBP and LLD (p=0.548), BMI (p=0.518), and gender (p=0.164). Gender was associated with LLD (OR 3.53, 95%CI 1.32 - 9.42, p=0.010). Only 5 (13.9%) of affected LBP experienced dysfunctional state. There is no relationship between LLD, gender, BMI and LBP in students of the Faculty of Medicine. Female have a higher risk of LLD.

Key words: *Leg Length Discrepancy, Low Back Pain, Students' College, Gender Different, Body Mass Index*

Introduction

Leg length discrepancy (LLD) is an inequality of the lower limb length. The LLD is commonly found in population and the prevalence is varied widely depending on the magnitude of the discrepancy. It is estimated that 23% of the general population having inequality of 1 cm or more (Gross, 1978). A study by Raczkowski, Daniszewska, & Zolynski (2010) measuring and classifying discrepancy reported that differences of 1 cm were more prevalent in children aged 5 to 17 years.

The cutoff for LLD is usually determined based on the effect of different leg length that results in significant clinical symptoms. Previous studies used different cutoff for leg length discrepancy (Liu, Fabry, Molenaers, Lammens, & Moens, 1998; Shailam, Jaramillo, & Kan, 2013). In one study (Shailam et al., 2013), LLD was assumed as 10 mm whereas another study (Liu et al., 1998) determined 20 mm of LLD that can cause clinical symptoms. The inequality of the leg length will affect posture and induce gait abnormality. Scoliosis, pelvic obliquity, and gait asymmetry are the most common consequences of LLD (Gross, 1978; Liu et al., 1998; Shailam et al., 2013).

The prevalence of LBP is high worldwide. Low back pain is defined as pain on the posterior area between the lower margin of the lowest rib and gluteal folds. Low back pain affects all age group but mostly in young adult (Lunde, Koch, Hanvold, Waersted, & Veiersted, 2015). Many causes of LBP have been documented. Even with no mortality reported, LBP causes functional disturbance leading to disability, decreases pro-

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ductivity, and being a health and economic burden (Delitto, George, van Dillen, Whitman, Sowa, Shekelle, Denninger, & Godges, 2012; Katz 2006). The association of LBP and LLD has not been established yet. Our study was aimed to examine LLD and its relationship with LBP in college students.

Methods

This is a pilot study with a cross-sectional design. Subjects were 35 male and 40 female students of Faculty of Medicine, Universitas Katolik Indonesia Atma Jaya aged 18-20 years. They were invited to participate voluntarily. Exclusion criteria were set as follow: musculoskeletal trauma affecting gait and leg length and rheumatoid arthritis. Subjects were informed of the study purposes prior to signing informed consent. The study was approved by the local ethics committee of Faculty of Medicine, Universitas Katolik Indonesia Atma Jaya.

Height and weight were measured using standard equipment and methods in standing position. Body mass index (BMI) was calculated according to the established formula, expressed in kg/m2. True leg length was measured three times using a direct tape for each lower extremity in a supine position, from the anterior superior iliac spine (ASIS) to the medial malleolus. The difference of 10 mm between left and right leg was considered as LLD.

Low back pain was obtained from self-reported. The numerical rating scale was used to assess pain intensity. The LBP was classified into acute if less than 12 weeks, and chronic if 12 weeks or more (Koes et al., 2010). Functional disability was assessed using the Rolland Morris Disability Questionnaire (RMQ). Results of RMQ was determined as a functional state if score ≤4, and dysfunctional state if score >4 (Xia et al., 2017).

Descriptive statistics are presented as mean±SD and frequency (percentage). The comparison of the numerical data between normal and LLD was analyzed using an independent sample of the t-test. The association between LLD and gender, BMI, and LBP was evaluated using Chi-square or Fisher's exact test. Significance was determined at $p < 0.05$. The statistic analysis was computed using SPSS ver 17.

Results

Comparison between normal and LLD are presented in Table 1. Independent samples of t-test was applied to compare numeric data whereas Chi-square was for categoric data. Forty participants (53.3%) were female and thirty-one (41.3%) were LLD. Subjects had a significant taller height than LLD (p=0.01). The LLD in female was significantly higher than in male (22 vs 9, p=0.01). Female gender had a risk of 3.53 times higher to have LLD (p=0.010, 95%CI, 1.32-9.42).

Table 1. Characteristics of Subjects

	Normal (n=44)	LLD (n=31)	p
Gender			
Male	26	9	0.010
Female	18	22	
Age (years)	19.52±0.93	19.64±1.05	0.596
Weight (kg)	64.75±15.78	60.34±10.74	0.182
Height (cm)	164.81±9.54	159.39±7.50	0.010
BMI (kg/m2)	23.60±4.17	23.68±3.66	0.922
BMI			
Normal	31	22	0.962
Overweight	13	9	
TLL right cm)	85.95±4.31	84.51±4.54	0.167
TLL left (cm)	85.95±4.31	83.96±4.60	0.058

Note: LLD: leg length discrepancy; BMI: body mass index; TLL: true leg length; p: probability is significant at <0.05

Table 2 demonstrates the association between LBP with gender, BMI, and LLD. Thirty-six (48%) subjects reported having LBP. Gender, BMI, and LLD had no association with LBP (p=0.164 for gender, p=0.518 for BMI, and p=0.548 for LLD).

Table 2. The Association between LBP with Gender, BMI, and LLD

	Low Back Pain		Total	p
	Yes	No		
Gender				
Male	14	21	35	0.164
Female	22	18	40	
Body mass index				
Normal	25	28	53	0.518
Overweight	11	11	22	
Leg legth equality				
Similar	20	24	44	0.548
LLD	16	15	31	

Note: LBP: low back pain; LLD: leg length discrepancy; BMI: body mass index; p: probability is significant at <0.05

Characteristics of LBP is described in Table 3. Most subjects experienced pain in acute (28/77.8%), mild intensity (26/77.2%) with low frequency (seldom and some time) of pain attack (33/91.7%). Only 5 subjects (91.7%) reported having a dysfunctional state.

Table 3. Characteristics of the Low Back Pain

Characteristics		Number (%)
Duration of LBP	Acute	28 (77.8%)
	Subacute-chronic	8 (22.2%)
Frequenty of LBP	Seldom	20 (55.6%)
	Sometime	13 (36.1%)
	Often-very often	3 (8.3%)
Intensity of LBP	Mild	26 (72.2%)
	Moderate	10 (27.8%)
Rolland Morris Disability	Functional State	31 (86/1%)
Questionnaire Scope	Dysfunctional State	5 (13.9%)

Note: LBP: low back pain.

Discussion

Low back pain is a very common musculoskeletal problem and affects large people. Many factors are attributed to low back pain. Leg length discrepancy is known to be strongly associated with LBP. This study evaluated the association between LLD and LBP in college students. Low back pain was found in thirty-six subjects (48%) whereas LLD in 41.3%. Among those with LBP, 16 subjects (44.4%) had LLD. However, the association between LBP with LLD, gender, and BMI were not proven. Female are 3.5 times more likely to have LLD. Among those with LBP, only 5 (13.9%) were indicated to experience dysfunctional state.

There is still disagreement among different studies' findings regarding the association of LBP and LLD. No association between LLD and LBP in our study is in accordance with prior studies. Noormohammadpour et al. (2016) evaluated a small sample of 28 adolescent football players and reported that LBP had no link with LLD. A study by Goss, Moore, Slivka, & Hatler (2006) involved 1100 military cadets and match controls after 1-year participation in military training and athletic participation. The results showed no association between injury and LLD. The association between LBP and LLD was confirmed by Rannisto et al. (2015) involving meat cutters and service workers on their study. The results showed LBP was obviously correlated with LLD. The different cut off of LLD may influence conflicting results in which higher cut off value will usually give more significant results. Another possible mechanism is related to the position during working. Stand while working performed by subjects was supposed to enhance the burden on low back in LLD leading to LBP. It has been proposed that long-standing in LLD could induce a degenerative change in the spine, gait disturbance, and low back pain (Sheha et al., 2018)

Women are more at risk of developing LBP. The recent study found LBP frequency in female is much higher than in male students (55% vs 40%). A previous study supposed that higher incidence of low back pain in women might be related to weaker muscle strength, incorrect posture, low physical fitness (Vujcic et al., 2018). Nevertheless, the association between gender and LBP was not statistically significant. Similarly, a prior study evaluating medical college students reported that no association between gender and musculoskeletal pain (Haroon, Mehmood, Imtiaz, Ali, & Sarfraz, 2018). In addition, a study in India evaluating large sample Indian young also reported that gender was not included as a risk factor for LBP (Ganesan, Acharya, Chauhan, & Acharya, 2017). Epidemiological data seem not to be in line with statistic analysis yet.

Body mass index has been known to be a risk factor of LBP (Leboeuf-Yde, 2004). The logical assumption behind is that increased BMI will increase the mechanical load on the spine and trunk muscles during weight-bearing activity (Boćkowski et al., 2007). In fact, our study did not find any association between BMI and LBP. The result was also supported by Yue, Liu, & Li (2012) evaluating LBP in teachers. They reported that BMI did not relate to LBP. As mentioned above, the working position may play more a role in LBP than BMI per se.

Pain characteristics were also explored in this study. The pain felt by subjects did not appear to be severe and disturbing. Most of them experienced acute pain with mild intensity in a low frequency of pain attack. Rolland Morris Disability Questionnaire indicated that most of the subjects still function normally.

Limitations of this study were noted. As a pilot study, the small sample size is an important limiting factor, especially with a very small amount of subjects with ≥ 20 cm LLD. Small sample size affects the validity of the study and the significance of the statistic results. The limitation also arises due to measurement methods. Radiologic examination of the spine was not planned to do in the study. Some possible LBP etiologies such as spondylolysis, mild scoliosis, HNP, etc, can be identified through x-ray examination.

In conclusion, this study reported there was not an association between low back pain and leg length discrepancy, LBP, and LLD in student college-aged 18-20 years. Female had more risk of having LLD. There were only small amount of students with LBP have a dysfunctional state. However, the conclusion should be taken under cautious consideration due to study limitation especially the small number of subjects.

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Conflict of Interest
The authors declare that there are no conflicts of interest.

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References

Gross, R.H. (1978). Leg length discrepancy: how much is too much? *Orthopedics, 1*(4), 307-310.

Raczkowski, J.W., Daniszewska, B., & Zolynski, K. (2010). Functional scoliosis caused by leg length discrepancy. *Archives of Medical Science, 6*(3), 393-398.

Shailam, R., Jaramillo, D., & Kan, J.H. (2013). Growth arrest and leg-length discrepancy. *Pediatric Radiology, 43*(S1), 155-165.

Liu, X.C., Fabry, G., Molenaers, G., Lammens, J., & Moens, P. (1998). Kinematic and kinetic asymmetry in patients with leg-length discrepancy. *Journal of Pediatric Orthopaedics, 18*(2), 187-189.

Lunde, L.K., Koch, M., Hanvold, T.N., Waersted, M., & Veiersted, K.B. (2015). Low back pain and physical activity. A 6.5 year follow-up among young adults in their transition from school to working life. *BMC Public Health, 15*, 1115. doi: 10.1186/s12889-015-2446-2.

Delitto, A., George, S.Z., van Dillen, L.R., Whitman, J.M., Sowa, G.A., & Shekelle, P., Denninger, T.R., Godges, J.J. (2012). Low back pain. Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability, and Health from the Orthopaedic Section of the American Physical Therapy Association. *Journal of Orthopaedic & Sports Physical Therapy, 42*(4), A1-7.

Katz, J.N. (2006). Lumbar disc disorders and low back pain: socioeconomic factors and consequences. *Journal of Bone and Joint Surgery America, 88*(S2), 21-24.

Koes, B.W., van Tulder, M., Lin, C.W., Macedo, L.G., McAuley, J., & Maher, C. (2010). An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. *European Spine Journal, 19*(12), 2075-2094.

Xia, T., Long, C.R., Vining, R.D., Gudavalli, M.R., DeVocht, J.W., Kawchuk, G.N., Wilder, D.G., & Goertz, C.M. (2017). Association of lumbar spine stiffness and flexion-relaxation phenomenon with patient-reported outcomes in adults with chronic low back pain - a single-arm clinical trial investigating the effects of thrust spinal manipulation. *BMC Complementary & Alternative Medicine, 17*(1), 303. doi: 10.1186/s12906-017-1821-1.

Noormohammadpour, P., Khezri, A. H., Linek, P., Mansournia, M. A., Hassannejad, A., Younesian, A., Farahbakhsh, F., & Kordi R. (2016). Comparison of lateral abdominal muscle thickness and cross sectional area of multifidus in adolescent soccer players with and without low back pain: A case control study. *Asian Journal of Sports Medicine, 7*(4), e38318. doi: 10.5812/asjsm.38318.

Goss, D.L., Moore, J.H., Slivka, E.M., & Hatler, B.S. (2006). Comparison of injury rates between cadets with limb length inequalities and matched control subjects over 1 year of military training and athletic participation. *Military Medicine, 171*(6), 522–525.

Rannisto, S., Okuloff, A., Uitti, J., Paananen, M., Rannisto, P.H., Malmivaara, A., & Karppinen, J. (2015). Leg-length discrepancy is associated with low back pain among those who must stand while working. *BMC Musculoskeletal Disorder, 16*(1) 110. doi: 10.1186/s12891-015-0571-9.

Sheha, E.D., Steinhaus, M.E., Kim, H.J., Cunningham, M.E., Fragomen, A.T., & Rozbruch, S.R. (2018). Leg-length discrepancy, functional scoliosis, and low back pain. *Journal of Bone & Joint Surgery Review, 6*(8), e6. doi: 10.2106/JBJS.RVW.17.00148.

Vujcic, I., Stojilovic, N., Dubljanin, E., Ladjevic, N., Ladjevic, I., & Sipetic-Grujicic, S. (2018). Low back pain among medical students in Belgrade (Serbia): A cross-sectional study. *Pain Research and Management, 2018,* 1-6 pages. doi: 10.1155/2018/8317906.

Haroon, H., Mehmood, S., Imtiaz, F., Ali, S.A., & Sarfraz, M. (2018). Musculoskeletal pain and its associated risk factors among medical students of a public sector University in Karachi, Pakistan. *Journal of Pakistan Medical Association, 68*(4), 682–688.

Ganesan, S., Acharya, A.S., Chauhan, R., & Acharya, S. (2017). Prevalence and risk factors for low back pain in 1,355 young adults: a cross-sectional study. *Asian Spine Journal, 11*(4), 610–617.

Leboeuf-Yde C. (2004). Back pain - individual and genetic factors. *Journal of Electromyography Kinesiology, 14*(1), 129-133.

Boćkowski, L., Sobaniec, W., Kułak, W., Smigielska-Kuzia, J., Sendrowski, K., & Roszkowska, M. (2007). Low back pain in school-age children: risk factors, clinical features and diagnostic management. *Advance in Medical Science, 52*(S1), 221-223.

Yue, P., Liu, F., Li, L. (2012). Neck/shoulder pain and low back pain among school teachers in China, prevalence and risk factors. *BMC Public Health, 12*, 789. doi.org/10.1186/1471-2458-12-789.