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Relationship between body mass indexand lumbar lordosis curve

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ABSTRACT

Background: Body mass index (BMI) is an indicator of health that is often used with the ratio between body weight and height. Health problems related to BMI vary widely, including bone problems such as lordosis. Lordosis is a disorder that causes an abnormally enlarged curvature of the vertebrae or spine. This study aimedto review the correlation between BMI and lumbar lordosis curve.

Methods: This study used a literature review design.The articles that discusses the correlation of BMI and increase in the lumbar lordosis curve based on secondary data from published literature on Google Scholar and PubMed using the keywords body mass index, lumbar curve, and lordotic lumbar.

Results: From 5 studies discussing the relationship between BMI and lumbar lordosis, it was found that all journals showed that there was a relationship between Body Mass Index and lumbar lordosis.

Conclusion: Based on some of the literature that has been discussed, it could be concluded that the BMI correlated with the lumbar lordosis curve.

Keywords : Body Mass Index, Lumbar Curve, Lumbar Lordosis, Spine

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Introduction

Ideal body weight and height are important factors in maintaining physical health, especially the bone structure, which plays a crucial role in the body; this also affects the Body Mass Index (BMI).[1] BMI is a measurement commonly used to evaluate whether a person's weight is healthy for their height. According to the World Health Organization (WHO), this classification includes underweight, normal weight, overweight, and obesity, closely associated with an increased risk of chronic diseases based on BMI.[2]

BMI is a measure used to determine body weight by calculating the ratio of body weight to the square of height.[3] The way to determine BMI is by separately measuring body weight in kilograms (kg) and height in meters (m), and then dividing the results to obtain the BMI value in units of kg/m^2. The WHO Asia-Pacific region classifies BMI into six categories, namely, underweight (<18,5 kg/m^2), ideal (18,5 ≤ IMT< 22,9 kg/m^2), overweight (≥ 23,0 kg/m^2), obesity (23,0 ≤ IMT≤ 24,9 kg/m^2), obesity I (25 ≤ IMT≤ 29,9 kg/m^2) dan obesity II (≥ 30 kg/m^2).[2] In Indonesia, BMI is classified into 3 levels: underweight, normal, and overweight.[4] The increasing prevalence of obesity in society is not only experienced among adolescents but also across almost all age groups. In 2016, data from the WHO indicated that more than 1.9 billion people aged 18 and above were affected by obesity. In Indonesia, based on the results of the Riskesdas (Riset Kesehatan Dasar) from 2007 to 2018, there has been a year-on-year increase, amounting to 10,5% (2007), 14,8% (2013), and 21,8% (2018).[4] BMI can be influenced by several factors such as age, gender, and physical activity. Physical activity has a significant impact on BMI changes, low physical activity can result in an undesirable BMI and affect lifestyle.[5] If someone cannot maintain an ideal BMI, it will have various health risks, such as non-communicable diseases like respiratory disorders, psychosocial issues due to discrimination, and including various bone problems, one of which is lordosis.

Lordosis is a condition characterized by an excessive curvature of the spine in the anterior direction.[6] However, lordosis also refers to the normal inward curvature in the lumbar and cervical vertebrae. The human spine or vertebrae has five curvatures, namely cervical, thoracic, lumbar, sacrum, and coccyx. Abnormal curvatures are classified into three types: scoliosis, kyphosis, and lordosis.[7] Lordosis most commonly occurs in the lower back, known as lumbar lordosis. Lumbar lordosis is a condition where the curvature of the spine from L1 to L5 increases in the anterior direction.[8] All age groups have the potential to experience lumbar lordosis, but the risk is higher in individuals with a high body mass index. The condition of excessive curvature in the lumbar lordosis curve has adverse effects on the body. This condition can lead to tension in the lower back muscles,

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resulting in pain and discomfort that may limit daily activities.[9]

Based on research, the lordotic angle is considered normal within the range of 20-40 degrees, and it is termed lumbar hyperlordosis if the formed angle exceeds 40 degrees.[10] A study also states that an imbalance in the strength of trunk muscles can affect the curvature of lumbar lordosis and be one of the contributing factors to lower back pain.[11] In obesity with a protruding abdomen, there is a shift in the center of gravity, leading to the spine adapting by increasing the angle of the lumbar lordosis curve to maintain body balance. This process is also assisted by the contraction of paravertebral and iliopsoas muscles. Continuous muscle contractions can result in muscle shortening and an increased tilt of the pelvis anteriorly, contributing to the elevation of lumbar lordosis.[12] Additionally, the increased curvature of lumbar lordosis can exert excessive pressure on the joints and cause imbalance in the spine, resulting in difficulties in performing daily activities. Ignoring these changes may lead to reduced productivity for many individuals due to alterations in bone structure caused by lumbar lordosis. Based on the description above, the author is interested in conducting a literature review with the title the relationship between body mass index and lumbar lordosis curve.

Methods

The research method employed a literature review in the form of a literature survey compiled based on secondary data from several research journals related to the relationship between BMI and the increase in lumbar lordosis curve. This literature review included the search for journals from databases such as Google Scholar and PubMed using keywords such as body mass index, lumbar curve, and lordotic lumbar. The inclusion criteria used include: journals describing the relationship between BMI and the increase in lumbar lordosis, journals published between 2015-2023. The exclusion criteria used include: excluding other articles if there are duplicates, excluding abstracts, theses, and dissertations.

The author established inclusion and exclusion criteria independently. The author reviews and reads comprehensively from all literature that meets the inclusion and exclusion criteria. The full text of each keyword search for research journal articles found a total of 28 journals. After reviewing based on inclusion criteria, which include the journal topic and the publication year, 19 journals were eliminated. Out of the remaining 9 journals, 4 were excluded because they were abstracts and theses, resulting in 5 main journals. The data was extracted by summarizing information grouped in a table containing the journal author, journal title, research method, and research results.

Results

The results of the journal search five journals used within the last 8 years, indicating that all the journals show a positive correlation between BMI and the increase in lumbar lordosis curve. The details can be seen in table 1.

Based on Rahmawati et al., (2021) showed that obesity and circumference waist circumference excessive related with increased lumbar curve in college students. In the obesity BMI category, 20 (83.3%) out of 24 respondents experienced an increase in lumbar lordosis curve. Based on the Chi-square analysis, a significance value of p <0.05 was obtained, namely 0.000. This indicates a significant relationship.

Based on Malepe et al., (2015) showed that the relationship between postural deviations and body mass index among university students. The measurement tools that used was assessment postural (lateral, anterior, and posterior). There is a significant relationship between BMI and lumbar lordosis (X = 19.193, p=0.001).

Based on Onyemaechi, et al., (2016) showed that impact of overweight and obesity on the musculoskeletal system using lumbosacral angles. The measurement tools that used was square X-ray and goniometer. Significant correlation was found between BMI and lumbar lordosis angle (LLA) (p=0.001).

Based on Wendra et al., (2021) showed that Correlation Between Obesity and the Depth of Lumbar Lordosis in Obesity-Typed Women in Internal Medicine Clinic Dustira Military Hospital Cimahi. The measurement tools that used was caliper calibration range. The research results showed an average lumbar lordosis depth of 60.1 mm overall. The correlation value (r) between obesity BMI and lumbar lordosis is 0.843. This indicates a strong positive correlation with a very strong correlation strength.

Based on Taweetanalarp et al., (2015) showed that Comparison of Lumbar Spinal Angle Between Normal Body Mass Index and Overweight Young Adults. The measurement tools that used was flexible ruler. In the lower lumbar angle in the overweight group, a significance value of p <0.05 was obtained, and the correlation coefficient was 0.28, indicating a significant relationship with a weak correlation.

Discussion

Based on the journals discussing the relationship between BMI and the increase in lumbar lordosis curve, the results show that five journals state a connection between BMI and the increase in lumbar lordosis curve. This is due to various variables discussed in each research.

According to a study conducted by Rahmawati, et al. in 2021 on the relationship between obesity and the increase in lumbar lordosis curve in 88 samples in Jakarta, the results showed that obesity is significantly related to the increase in lumbar lordosis.[13] The research instrument used is a flexible ruler, which is a tool for measuring the spine with good reliability, namely 0.97.[14] Someone is said to experience lumbar hyperlordosis if they have a lumbar lordosis angle exceeding 40 degrees.[10] Individuals experiencing overweight and obesity with an increase in lumbar lordosis curve are an effort to maintain body balance. When there is an increase in the lumbar lordosis

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curve, this imaginary vertical line will shift posteriorly from the body's central axis. Changes in the body's center of gravity will also cause excessive pressure on the joints due to overweight, accompanied by a shift in the lumbosacral axis. This condition will impact the body's balance due to the changes in the center of gravity. This is also supported by Malepe et al.'s study in 2015 regarding the relationship between postural deviation and Body Mass Index, involving 100 male and female students.[15] The results indicate that a significant number of individuals who are overweight and obese tend to experience lordosis because some have a protruding abdomen and large hips, where the spine tries to support the body. In this process, a curvature in the lumbar region develops to support the body and keep it upright.

Table 1. Characteristics of research journals describing the relationship between BMI and the increase in lumbar lordosis curve.

Authors	Title	Methods	Results
Rahmawati *et al.,* (2021)	Obesitas dan Lingkar Pinggang Berlebih Berhubungan Dengan Peningkatan Kurva Lumbar Pada Mahasiswa	Method: Cross-sectional with consecutive non-random sampling technique Sample (n): 88 Measurement tools: lumbar curve: flexible ruler.	In the obesity BMI category, 20 (83.3%) out of 24 respondents experienced an increase in lumbar lordosis curve. Based on the Chi-square analysis, a significance value of p <0.05 was obtained, namely 0.000. This indicates a significant relationship.
Malepe *et al.,* (2015)	The relationship Between Postural Deviations and Body Mass Index Among University Students	Method: cross sectional study Sample (n): 100 Measurement tools: Lumbar curve: assessment postural (lateral, anterior, and posterior)	There is a significant relationship between BMI and lumbar lordosis (X^2 = 19.193, p=0.001).
Onyemaechi , *et al.,* (2016)	Impact of Overweight and Obesity on the Musculoskeletal System Using Lumbosacral Angles	Method: prospective research in a cross-sectional design Sample (n) : 300 Measurement tools: lumbar curve: square X-ray and goniometer	Significant correlation was found between BMI and LLA(p=0.001).
Wendra *et al.,* (2021)	Correlation Between Obesity and the Depth of Lumbar Lordosis in Obesity-Typed Women in Internal Medicine Clinic Dustira Military Hospital Cimahi	Method: Cross-sectional with consecutive sampling technique. Sample (n) : 40 Measurement tools: lumbar curve: Caliper calibration range.	The research results showed an average lumbar lordosis depth of 60.1 mm overall. The correlation value (r) between obesity BMI and lumbar lordosis is 0.843. This indicates a strong positive correlation with a very strong correlation strength.
Taweetanalarp *et al.,* (2015)	Comparison of Lumbar Spinal Angle Between Normal Body Mass Index and Overweight Young Adults	Method: cross sectional study Sample (n): 60 (age 18-25 years) Measurement tools: lumbar curve: *flexible ruler*	In the lower lumbar angle in the overweight group, a significance value of p <0.05 was obtained, and the correlation coefficient was 0.28, indicating a significant relationship with a weak correlation.

LLA, lumbar lordosis angle; BMI, body mass index

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In line with the study by Onyemaechi et al. in 2016 on the impact of overweight and obesity on the musculoskeletal system using the lumbosacral angle.[16] The results show that the lumbar lordosis angle is higher in samples that are overweight and obese, and there is a positive correlation between lumbar lordosis angle and BMI. This is due to the increased mechanical load on the lumbar spine caused by excessive lumbar lordosis angle. This is similar to the postural changes observed in pregnant women.[17] The resulting biomechanical changes can generate higher compressive forces on the lumbar spine structure and may lead to an increased incidence of mechanical lower back pain in individuals.

Another study conducted by Wendra et al. in 2021 involving 40 respondents who met the criteria.[18] The research was conducted to determine the correlation between obesity and increased lumbar lordosis, and the results showed a significant relationship between BMI and the increase in lumbar lordosis with a strong correlation. This is because obesity can cause a shift in the axis of gravity, resulting in axial load falling on the vertebral column. Obesity also leads to the weakness of the gluteal muscles, causing the pelvis to move ventrally, which results in lumbar lordosis. In obesity, there is also shortening of the paravertebral muscles due to continuous contraction to maintain an upright posture, causing the curvature to be pulled forward and increasing lordosis. Additionally, contracted iliopsoas muscles cause an increase in the lumbosacral angle, forcing the lumbar spine into more lordosis. With the shortening of these muscles, there will be a decrease in the range of motion in hip flexion and trunk flexors, resulting in a higher lumbar lordosis.

Another supporting study is the research by Taweetanalarp et al. in 2015. This study compares the upper and lower lumbar angles between respondents with normal BMI and overweight BMI.[19] The research results indicate an increase in both upper and lower lumbar angles in the overweight group compared to the normal BMI group, especially in the lower lumbar angle. This result supports the assumption that excess weight contributes to the increase in lumbar lordosis curvature. This is because obesity induces an increase in anterior pelvic tilt to compensate for the anterior shift of the center of mass, resulting in an increase in lumbar lordosis.

Based on the 5 studies discussing BMI's impact on the increase in lumbar lordosis curve, it is found that these studies have a positive correlation, as elaborated above. This is due to excessive BMI classified as overweight and obesity, inducing an increase in anterior pelvic tilt to compensate for the anterior shift of the center of mass, causing a change in the axis of gravity so that the axial load falls on the vertebral column.[20,21] Additionally, some individuals with obesity have a protruding abdomen and large hips, where the spine tries to support the body. An increase in lumbar lordosis curve can trigger various conditions such as lower back pain.[22] Therefore, a tendency towards a higher BMI will increase the risk of increased lumbar lordosis and have a negative impact on body composition, including bone density.

The limitations of this study were not explained regarding the intervention to treat the problem, so there is a possibility of bias, and it cannot be generalized to all patients with lumbar lordosis. Future studies can explain the specifics of the intervention to treat the problem in patients with lumbar lordosis and their relationship between body mass index and lumbar lordosis curve with quality of life.

Conclusion

Based on several discussed and elaborated literature, it can be concluded that BMI is related to the increase in lumbar lordosis curve. Excessive BMI is associated with an increased risk of lumbar lordosis.

Author Contribution

IAPW conceived the study design and data collection and drafted the manuscript; GPK and IPGSA collected the data and revised the manuscript.

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Conflict of interest

The author states there is no potential conflict of interest in connection with the research, authorship and or publication of this article.

Ethical consideration

This review study used published articles that are accessible. Thus, this study did not require any informed or ethical consideration.

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