REVIEW

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Correlation between body mass index with scoliosis: a narrative review

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ABSTRACT

Background: Body mass index (BMI) is a score that is assessed by a person's weight in kilograms divided by height in meters squared. If a person does not maintain a normal BMI and activity frequency, it will impact various disease risks, including bone problems, one of which is scoliosis. Scoliosis is a disorder that causes an indentation in the vertebrae or spine in the form of sideways or lateral deviation. This study aimed to determine the relationship between body mass index and scoliosis.
Methods: This study used a literature review study method or literature review from five English-language journals that were relevant to the relationship between BMI with scoliosis. The journal searched Google Scholar, PubMed, and Pedro with the keywords "Scoliosis," "Body Mass Index," "Spine," "Correlation," and "Relationship."
Results: From five studies discussing the relationship between BMI with scoliosis, it was found that all journals showed a relationship between BMI with scoliosis. This is associated with several factors, such as gender, diet, and others.
Conclusion: Based on the literature that has been collected along with the previous discussion, it can be concluded that there is a relationship between BMI and scoliosis.

Keywords: Body mass index, Scoliosis, Spine.
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INTRODUCTION

Every activity carried out by humans will certainly affect somebody's health. The magnitude of the frequency of activities carried out can be one indicator that affects the risk of pathology in the body. According to the Indonesian Ministry of Health, heavy Body weight and physical activity are associated with various chronic and even fatal diseases that lead to death.[1] The ideal weight and height are important for maintaining a healthy body, especially the bone structure that becomes the support of the human body; it will affect body mass index, a measurement instrument or screening method commonly used for body composition classification.[2,3] The classification that includes degrees of underweight and overweight are associated with an increased risk of non-communicable pathologies based on the body mass index presented by the World Health Organization (WHO).[4]

The body mass index is a score that is assessed by a person's weight in kilograms divided by height in meters squared.[5] In Indonesia, body mass index is classified into four levels, thin, normal, fat, and obesity.[6,7] High and low body mass index can affect disease, morbidity, and future death, so everyone needs to maintain their body mass index and activities to remain balanced.[8] Based on data from Riskesdas Ministry of Health RI in 2013 the prevalence rate of obesity in the adult group is 15.4%, while overweight is 13.5%.[9] If the prevalence of obesity and overweight combined, this would have a percentage of 28.9%.[10] If a person does not maintain body mass index and frequency of activity, it will have an impact on various risks of disease including problems one of the bones is scoliosis.[11]

Scoliosis is a disorder that causes a curvature of the vertebrae or spine in the form of deviation to the side or laterally.[12] All age levels have the potential to experience scoliosis, but a high risk occurs in people with grades body mass index and poor activity. Scoliosis causes several complications because of the impact, such as back pain, muscle weakness, lung compression, and spinal imbalance. Based on research, scoliosis sufferers have asymmetrical shoulders, the vertebrae tend to slant the direction of deviation is right or left, and the waistline and hips are not the same height.[13] According to data from the American Academy of Orthopedic Surgeons, about 2-3% of the 7 million residents of the United States experience scoliosis.[14,15] Meanwhile, according to data published by the National Scoliosis Foundation it is stated that there are 12 million people in the world experiencing scoliosis, of them as many as 3.26% of Korean children have scoliosis with an increase of about 3.7 times from 2000 to 2008, which was initially 1.66% to 6.17%, this shows the percentage of scoliosis continues to increase significantly.[16] Lowering the body mass index will increase the risk of vertebral rotational deformity.[17,18] This is because a low body mass index will supply fewer nutrients to the bones, thereby reducing bone mineral density, which results in weak bones when maintaining posture.[19,20] So that it can be at high risk of developing adolescent idiopathic scoliosis. This condition can occur because low body mass index is associated with low peak bone mass attainment and high bone mass loss.[21]

Currently, research on the relationship between body mass index and adolescent idiopathic scoliosis has been conducted abroad, but there are differences in the results of these studies. In addition, this study has also never been conducted in Bali, while in Indonesia itself, research on this topic already exists, but there are differences in variables.[22,23] Therefore, researchers want to know the general relationship between body mass index and vertebral rotation deformity in adolescents with adolescent idiopathic scoliosis. Based on the description of the phenomenon above, the authors are interested in conducting a literature review on the relationship between BMI and scoliosis.

METHODS

This study used a literature review study method from five English-language journals that were relevant to the relationship between BMI with scoliosis. The journal searched Google Scholar, PubMed, and Pedro with the keywords "Scoliosis," "Body Mass Index," "Spine," "Correlation," and "Relationship." The choice of literature was determined using inclusion and exclusion criteria. The inclusion criteria used in the literature review were: published literature from credible institutions, the literature reviewed is literature published from the last ten years, contains two or more variables such as scoliosis, BMI, and correlation, the references taken contain the correlation BMI with scoliosis, the samples used for primary scoliosis. The exclusion criteria in the literature review were: the sample has a history of fracture. The literature used in the literature review has met the criteria set by the author.

RESULTS

This study found five articles were suitable for the research topic (Table 1). Kyoung Kyu Jeon and Dong-il Kim (2021) researched low body mass index levels and idiopathic scoliosis in Korean children using a cross-sectional study involving elementary school students and first graders of junior high school in the Capital City area of Korea, with the last group consisting of 1375 participants underwent body composition measurements and screening for idiopathic scoliosis. The results of the study stated that the risk of scoliosis decreased significantly by 31% and 34% in the underweight group (UW) and normal weight (NW) after controlling for age and sex, OR as appropriate were 0.72 (95% CI: 0.52-0.98) and 0.70 (95% CI: 0.51-0.96). The risk decreased significantly by 28% and 30% in underweight and normal weight.[14]

Kyoungkyu Jeon and Dong-il Kim (2018) researched the Association between low body weight and scoliosis among Korean Elementary School students using a cross-sectional analysis study with 1,062 participants evaluated for scoliosis based on body composition, including weight and height with bone structure analysis equipment behind. This study found that the low-weight group had a 1,5 times higher risk of scoliosis compared to the healthy and overweight group (OR: 1.5, 95% CI: 1.2-1.8). Results research shows that the underweight and severely underweight groups have a significantly higher risk of developing scoliosis than the normal weight group.[15]

Kota Watanabe et al. (2018) researched physical activities and lifestyle factors related to adolescent idiopathic scoliosis using an analytical cross-sectional study with data collection through questionnaires completed by 2,747 students (99.6% response rate). This study involved 2,759 Japanese junior high school students who planned a follow-up examination after an initial moiré topography examination indicated a possibility of scoliosis students and their mothers or guardians were asked to fill out a questionnaire consisting of 38 questions about demographic factors, lifestyle factors, social factors, household environment, sports participation, health status, and factors related to pregnancy and mother's health. In this second examination, the student's height and weight were measured wearing leg stockings and light clothing. Body mass index is calculated in kg/m2. This research determines the relationship between activity and lifestyle factors in Adolescent Idiopathic Scoliosis by producing data that a low body mass index has a significant OR of 1.38 (95% CI, 1.17 to 1.63) for adolescent idiopathic scoliosis (AIS). Patients with adolescent idiopathic scoliosis evidence this matter have been reported to have a lower body mass index than the general population. This research explained that a low body mass index can affect bone mass loss and hormone imbalance. However, interpretation requires caution because the distribution of body mass index in the population (47% have BMI <18.5 kg/m2) differs from the Western population.[16]

Weijun Wang et al. conducted a study with the topic body composition in males with adolescent idiopathic scoliosis: a case-control study with dual-energy x-ray absorptiometry involving 47 males suffering from adolescent idiopathic scoliosis and 40 control healthy age and sex-matched recruits. This study uses the abjure equation and body mass index calculations by obtaining adolescent idiopathic scoliosis patients with subcarinal lean mass(LM), Lmi, and bone mineral content (BMC) significantly lower than the healthy control. Several factors of bone development and male puberty can cause this.[17]

Emma M Clark et al. researched the association between components of body composition and scoliosis: a prospective cohort study reporting identifiable differences before the onset of scoliosis.[18] This study conducted the first prospective population-based study of the relationship between fat and lean mass at ten years of age as assessed by DXA, and the presence of scoliosis at 15 years of age using the avon longitudinal study of parents and children. The study obtained 5,299 children aged 15 years, of whom 312 (5.9%) suffered from scoliosis. Results showed that there was a 20% reduction in the risk of scoliosis at the age of 15 years per junior high school and an increase in body mass index at the age of 10 years. Likewise, increased fat mass can reduce the risk of scoliosis by 14% at the age of 15 per junior high scholl of increase in fat mass at ten years of age.[23-25] The relationship between being overweight and the increased risk of scoliosis is not due to bias but is explained by the difference between fat and lean mass. But it's not scoliosis that causes weight loss; many factors cause one to worry about body image.[25]

Table 1. Five articles based on literature searched on the correlation between body mass index with scoliosis

Author	Title	Methods	Results
Kyoung-kyu Jeon and Dong-il Kim (2021)[14]	Low Body Mass Index Levels and Idiopathic Scoliosis in Korean Children: A Cross-Sectional Study	Study design: A cross-sectional analysis Sample: 1.375 partisipans Sample inclusion criteria: Using a elementary school students and junior high school first graders in the Korean capital area, underwent body composition measurement (BMI) and screening for idiopathic scoliosis	Underweight and Normal Weight group had a significantly OR: 0.72, 95% CI: 0.52-0.98.
Kyoungkyu Jeon and Dong-il Kim (2018)[15]	The Association between Low Body Weight and Scoliosis among Korean Elementary School Students	Study design: A cross-sectional analysis Sample: 1.062 participants Sample inclusion criteria: people that have scoliosis based on body composition, including weight and height with spinal structural analysis equipment, having a Cobb angle greater than 10◦.	Underweight and Severely Underweight groups had a significantly higher risk of developing scoliosis OR: 1.43, 95% CI: 1.07-1.90.
Kota Watanabe, Takehiro Michikawa, Ikuho Yonezawa, Masashi Takaso, Shohei Minami, Shigeru Soshi, Takashi Tsuji, Eijiro Okada, Katsumi Abe, Masamichi Takahashi, Keiko Asakura, Yuji Nishiwaki, and Morio Matsumoto (2018)[16]	Physical Activities and Lifestyle Factors Related to Adolescent Idiopathic Scoliosis	Study design: A cross-sectional analysis Sample: 2.759 participants Sample inclusion criteria: japanese junior high school girls and began with a baseline moiré topography examination, students and their mothers or guardians were asked to complete a questionnaire consisting of 38 questions on demographic factors, lifestyle factors, social factors, household environment, sports participation, health status, and factors related to pregnancy and maternal health.	Low BMI had a significant for Adolescent Idiopathic Scoliosis OR: 1.38, 95% CI, 1.17 - 1.63.
Weijun Wang, Zhiwei Wang, Zezhang Zhu, Feng Zhu and Yong Qiu (2016)[17]	Body composition in males with adolescent idiopathic scoliosis: a case–control study with dual-energy X-ray absorptiometry	Study design: A case-control analysis Sample: 47 partisipant Sample inclusion criteria: the males suffering from adolescent idiopathic scoliosis, 40 age and gender matched healthy controls were recruited.	Lower body weight and body mass index compared had a significantly higher risk of developing scoliosis OR 0.87, 95%CI 0.74-1.03,
Emma M Clark MB.BS PhD, Hilary J Taylor MSc, I Harding, J Hutchinson, I Nelson, JE Deanfield, Andy R Ness MD PhD, Jon H Tobias MD PhD (2014)[18]	Association Between Components of Body Composition and Scoliosis: A Prospective Cohort Study Reporting Differences Identifiable Before the Onset of Scoliosis	Study design: prospective analysis Sample: 5299 partisipant Sample inclusion criteria: age 10 assessed by DXA, and the presence of scoliosis at age 15 using the avon longitudinal study of parents and children (ALSPAC). people who had scoliosis	The association between lower body weight OR 0.80, 95%CI 0.65-0.97.

DISCUSSION

Based on journals that discuss the relationship between body mass index and scoliosis, it was found that five journals stated that there was a relationship between body mass index and scoliosis. This is caused by various variables that have been discussed in each of the studies.

Body mass index is closely related to the nutritional status of a person and will affect bone development and growth. It is related to vertebral rotation deformity with adolescent idiopathic scoliosis against body mass index, which is regulated by food intake. Nutritional intake is needed balancing so that the body can maintain a normal body mass index so there is no bone deformity such as adolescent idiopathic scoliosis.[20]

The research conducted by Kyoungkyu Jeon and Dong-il Kim in 2018 shows that the body mass index is underweight, leading to lower muscle mass and resulting in adverse effects on the stability of the musculoskeletal system, as seen in rotational deformities. The heavy low body causes a decrease in bone density, which results from changes in bone structure, thereby increasing the risk of adolescent idiopathic scoliosis. Whereas in people with a body mass index, overweight is not directly related to adolescent idiopathic scoliosis, but more often occurs as a result of the body trying to maintain body alignment to be stable. If the body mass index is high, then the body will try to maintain its stability so that it has the potential to cause changes in body posture, resulting in adolescent idiopathic scoliosis.

The same thing was also found in the research of Kota Watanabe et al. in 2018, who explained that patients with adolescent idiopathic scoliosis have been

reported to have an underweight body mass index than the general population. In this study, it was explained that the body mass index underweight can affect the decrease in bone mass and hormone imbalance. Therefore, body mass index can be responsible for the incidence of rotational deformity and adolescent idiopathic scoliosis of a person.

From this explanation, it can be seen that a body mass index is overweight and causes an increase in mechanical stress due to the force of gravity on the bones, resulting in more rapid fatigue and injury.[21] Whereas an underweight body mass index affects the body's metabolism so that it can not distribute hormones and nutrients like vitamins and protein as a source of building muscle mass and forming bone so that the muscles become weak and bone instability in maintaining posture caused by decreased production of estrogen by the tissues adipose tissue thereby increasing bone mass.[22] There is a mass index overweight and underweight bodies cause mechanical stress to the bones, and estrogen production is not stable, so it has an impact on the speed of disassembly of bone mass resulting in vertebral deformity.

Based on five studies that discuss body mass index on scoliosis, it was found that all of these journals had a correlation that had been described previously. This is due to a low Body Mass Index and lower muscle mass resulting in an adverse effect on the stability of the muscular system and vertebrae bones. Low body weight causes a decrease in bone density, which results in changes in bone structure, thereby increasing the risk of scoliosis. In people with a high body mass index, it is not related directly to scoliosis but occurs more because of the body trying to maintain body alignment to be stable. If the Body Mass Index is high, then the body will try to maintain its stability so that it has the potential to cause a change in posture that will cause scoliosis. In athletes, several sports can trigger scoliosis, but this does not have a high risk due to warming up or warming up before doing sports, which can reduce the burden and mechanical stress on the body to prevent scoliosis. Thus, an Index Body mass that tends to be low will increase the risk of scoliosis have negative effects on body composition, including bone density, and cause various complications.

Researchers have some limitations in this study. This study only seeks to find out the relationship between body mass index and vertebral rotation deformity in adolescents with adolescent idiopathic scoliosis, while other variables such as gender, physical activity level, and subject hormones have not been controlled by researchers. However, the researcher has attempted to use research subjects with patients with adolescent idiopathic scoliosis who are generally assessed from the results of medical diagnosis, interviews, and observations that the subject is able to follow instructions from the researcher well.

CONCLUSION

Based on some of the literature that has been collected along with the discussion previously, it can be concluded that there is a relationship between body mass index with scoliosis where a low Body Mass Index is associated with an increased risk of developing scoliosis.

CONFLICT OF INTEREST

No conflict of interest in this study.

FUNDING

No funding for this study.

ETHICAL CONSIDERATION

This literature review used publicly accessible documents as evidence and does not require institutional ethics approval.

AUTHOR CONTRIBUTIONS

IAJAP conceived the study design, wrote the manuscript, and NKYF searched the literature.

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