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NECK CIRCUMFERENCE AS AN ALTERNATIVE INDICATOR FOR OBESITY SCREENING IN ADOLESCENT: A SCOPING REVIEW

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Abstract

Obesity is a fat accumulation condition in the body that causes various health problems including hypertension, diabetes mellitus, coronary heart disease, and the risk of metabolic syndrome. Body mass index is commonly used to assess nutritional status, but it can not distinguish between fat and muscle mass. Neck circumference is an alternative indicator that can be used to determine adolescent obesity. Neck circumference can describe the accumulation of adipose tissue in the neck, can be used as an indicator of subcutaneous tissue in the upper body, and may be related to cardiovascular risk and new insights into the development of indicators in determining obesity in adolescent. This scoping review aimed to evaluate neck circumference as a screening indicatory for obesity in adolescents. The review followed the framework of Arksey and O'Malley and adhered to PRISMA Scr guideines. Three databases used in the article search were PubMed, Science Direct, and Scopus. Result: Five cross-sectional studies form Pakistan, India, Brazil, and Bahrain highlighted a strong positive correkation between neck circumference, BMI, and obesity in children and adolescents. Some studies also suggesting that neck circumference provided better sensitivity and specificity than BMI in identifying obesity. Neck circumference is a promosisng alternative screening tool for adolescent obesity. It correlates strongly with BMI and may offer greater accuracy when using gender specific cut-off points

Keywords: circumference; obesity; adolescent

Abstrak

Obesitas merupakan kondisi penumpukan lemak dalam tubuh yang dapat menimbulkan berbagai masalah kesehatan, termasuk hipertensi, diabetes melitus, penyakit jantung koroner, serta risiko sindrom metabolik. Indeks massa tubuh (IMT) umumnya digunakan untuk menilai status gizi, namun tidak dapat membedakan antara massa lemak dan massa otot. Lingkar leher merupakan indikator alternatif yang dapat digunakan untuk menentukan obesitas pada remaja. Lingkar leher dapat menggambarkan akumulasi jaringan adiposa di area leher, berfungsi sebagai indikator jaringan subkutan pada bagian tubuh atas, serta berpotensi berkaitan dengan risiko kardiovaskular dan memberikan wawasan baru dalam pengembangan indikator penentuan obesitas pada remaja. Scoping review ini bertujuan untuk mengevaluasi lingkar leher sebagai indikator skrining obesitas pada remaja. Tinjauan ini mengikuti kerangka kerja Arksey dan O'Malley serta mengacu pada pedoman PRISMA-ScR. Tiga basis data yang digunakan dalam penelusuran artikel adalah PubMed, ScienceDirect, dan Scopus. Lima studi potong lintang dari Pakistan, India, Brasil, dan Bahrain menunjukkan adanya korelasi positif yang kuat antara lingkar leher, IMT, dan obesitas pada anak dan remaja. Beberapa penelitian juga menunjukkan bahwa lingkar leher memiliki sensitivitas dan spesifisitas yang lebih baik dibandingkan IMT dalam mengidentifikasi obesitas. Lingkar leher merupakan alat skrining alternatif yang menjanjikan untuk obesitas pada remaja. Indikator ini memiliki korelasi yang kuat dengan IMT dan berpotensi memberikan akurasi yang lebih tinggi apabila menggunakan titik potong (cut-off) yang spesifik berdasarkan jenis kelamin.

***Kata kunci**: lingkar; obesitas; remaja*

Introduction

Obesity is defined as the accumulation of fat in the body that can lead to various health problems. Health problems that can arise due to obesity include hypertension, diabetes mellitus, insulin resistance, coronary heart disease, and the risk of metabolic syndrome. Obesity data according to the World Health Organization that by 2022 more than 390 million children and adolescents aged 5-19 years will be overweight and 160 million will be obese (WHO, 2024). The prevalence of obesity in adolescents in Indonesia based on SKI (Survei Kesehatan Indonesia) 2023 is 7.4% (Kemenkes, 2023). The incidence of obesity in adolescents is caused by several things, including low physical activity, sedentary lifestyles, and the wrong diet (Saraswati et al., 2021). Obesity that occurs in adolescence can risk causing obesity in adulthood and related (Ary et al., 2023). The indicator to determine obesity in adolescents is measuring weight and height and calculating the BMI formula according to the age of the adolescent. However, BMI has limitations, as it does not differentiate between fat mass, lean muscle mass, or fat distribution in the body (Jayadilaga et al., 2023). Consequently, there is a need for alternative anthropometric indicators that are practical, reliable, and capable of capturing fat distribution, especially in the upper body.

Neck circumference is one of the anthropometric indicators that aims to predict fat in the adolescent and pediatric population (Dewi & Ayuningtyas, 2023). Neck circumference is associated with risk factors for cardiovascular disease. Neck circumference can describe the accumulation of adipose tissue in the neck, this method can be used as an indicator of subcutaneous tissue in the upper body. Neck circumference measurement has an advantage as neck is located between the head and body and is often uncovered by clothing, allowing easy access to evaluate neck circumference (Ashok et al., 2021). The neck is one of the parts that play a role in the distribution of fat storage in the body. Fat in the body accumulates in three main parts, including the subcutaneous, prevertebral, and posterior parts (Pane & Ismail, 2023).

In obese individuals, excess fat will be stored in the subcutaneous layer, but chronically fat will accumulate in the visceral part, where it affects various metabolic diseases (Halim & Suzan, 2020). Neck fat is closely related to visceral fat tissue and the incidence of metabolic syndrome, this is because the upper body (neck) releases more free fatty acids into the plasma than other tissues and has similarities with fat in the visceral part of the body (Pamungkas et al., 2024). Although several studies have explored NC as an anthropometric measurement, there is no comprehensive synthesis of evidence on its potential role as a screening tool for adolescent obesity. Therefore, this scoping review aims to systematically map the existing literature regarding neck circumference as an alternative screening indicator of obesity in adolescents. By identifying current findings and research gaps, this review seeks to inform future studies and support the development of practical, context-appropriate obesity screening tools.

Method

The literature review in this study used the Arksey and O'Malley framework (Westphaln et al., 2021) and followed the PRISMA ScR (PRISMA extension for Scoping Review) (Peters et al., 2020). Inclusion criteria for articles included were articles published after 2019 (last 5 years), from all countries in the world, and articles that objectively discuss neck circumference as an alternative indicator or screening tool in adolescent obesity. Exclusion criteria for articles were articles with literature review methods, meta-analysis articles, articles with limited access, and articles that were not written in English. Databases used in the article search included Scopus, Science Direct, and PubMed. The article search combined terms with keywords "(Neck Circumference) AND (Screening OR Indicator OR Cut off) AND (Alternative OR New) AND (Adolescent Obesity OR Adolescent Adipocytes). This review uses a scoping review design to summarize, identify, and present research results relevant to the topic based on predetermined inclusion and exclusion criteria This review uses mendeley reference management software was used to manage the search results and organixe the bibliographic data. The software facilitated the removal of duplicate articles, supported the screening of titles and abstracts, and enabled efficient organization of included studies during the selection process.

Results

Researchers conducted a literature search with a tot of 24 articles found (Science Direct 9, Scopus 5, and PubMed 3). Of the 24 articles, 1 article was excluded due to duplication, leaving 23 articles. The remaining 23 articles were then eliminated based on title, and inclusion and exclusion criteria, resulting in 8 eligible articles. At the final stage, 3 articles were removed because the results of the article did not meet the objectives of the scoping review. This scoping review article finally included 5 articles that met the criteria of this scoping review. The PRISMA flowchart in Figure 1 illustrates the article search strategy used.

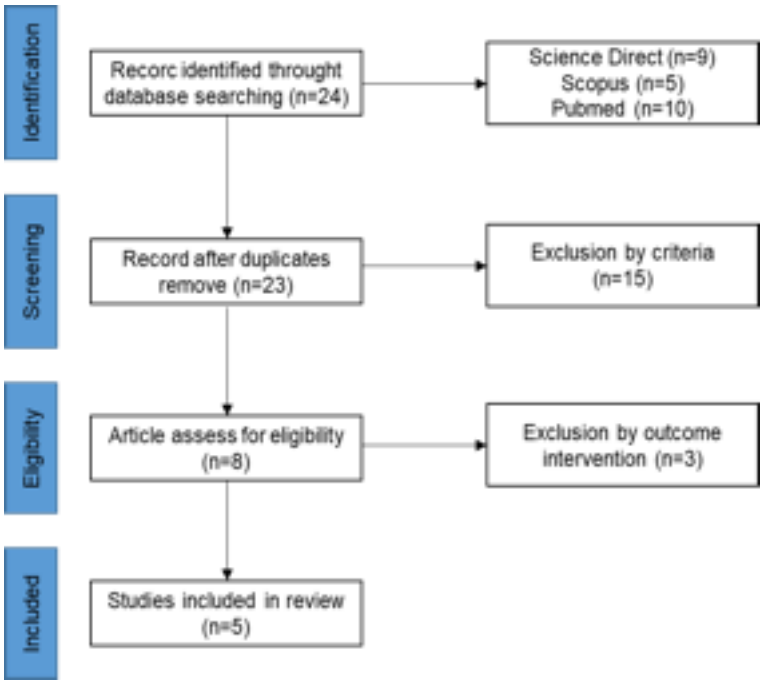


Figure 1. PRISMA flow chart, adapted from Tricco et al., 2018

Study and participant characteristics

Articles submitted for review are original research articles that have met the inclusion and exclusion criteria of this scoping review. The subjects studied were obese children and adolescents. These five articles include studies that have been conducted on obese child and adolescent populations from various countries, namely Pakistan, India, Brazil, and Bahrain. All five studies used a cross-sectional design and assessed neck circumference as an anthropometric indicator for obesity. The first and second studies in Pakistan found a strong positive correlation between neck circumference and BMI and a significant association with obesity, as well as differences in cut-off values by gender. The third study(Ashok et al., 2021) in India showed that neck circumference had better sensitivity and specificity than BMI as an obesity screening tool.

The fourth study in Brazil(de Santis Filgueiras et al., 2020) mentioned that neck circumference is a practical indicator that can be used to assess adiposity. Finally, the fifth study(Tantawy et al., 2020) in Bahrain confirmed a significant association between neck circumference, BMI, gender, and age, thus demonstrating the potential of neck circumference as an obesity screening indicator. This scoping review identified five cross-sectional studies from Pakistan, India, Brazil, and Bahrain that examined neck circumference (NC) as an alternative screening indicator for obesity in children and adolescents. All studies consistently reported a significant positive correlation between NC and body mass index (BMI). Two studies from Pakistan found NC to be strongly associated with obesity, with gender-specific cut-offs. The study in India demonstrated that NC had higher sensitivity and specificity than BMI in identifying obesity, particularly in adolescent boys (100%) and girls (86%).

The Brazilian study linked NC with android fat, highlighting its potential in reflecting upper-body adiposity. Meanwhile, the study from Bahrain confirmed associations between NC, BMI, age, and gender, supporting its use as a simple, accessible anthropometric marker. These findings suggest that NC may serve as a practical and effective tool for obesity screening in adolescents across diverse populations. After reviewing the articles, five articles met the criteria

Evidence finding

These five articles examined neck circumference used as an alternative indicator in screening for obesity. As shown in Table 1, all five studies consistently demonstrate a significant association between neck circumference and BMI, supporting its utility as an alternative screening tool for adolescent obesity.

Table 1. Evidence finding

Source	Country	Design	Result
Asif M *et al.,* 2020	Pakistan	Cross-sectional	Neck circumference increases with age followed by body weight, and BMI. Neck circumference had a strong positive correlation with BMI. NC cut-off for overweight was 25-30.35 cm in males and 24-31.62 cm in females.
Asif M *et al.,* 2021	Pakistan	Cross-sectional	Neck circumference is strongly correlated with BMI and can be an indicator for overweight
Ashok *et al.,* 2021	India	Cross-sectional	Neck circumference is an effective screening indicator to identify obesity in children by showing better sensitivity and specificity compared to BMI, which is 100% in adolescent boys and 86% in adolescent girls.
de Santis Filgueiras M *et al.,* 2020	Brazil	Cross-sectional	Neck circumference was significantly associated with android fat percentage. A 1 cm increase in neck circumference was associated with a 2.94% increase in android fat.
Tantawy SA *et al.,* 2020	Bahrain	Cross-sectional	Neck circumference has a significant relationship with BMI and age. Neck circumference can be used as an indicator to identify overweight or obesity.

Discussions

The results of the scoping review in this article indicated that neck circumference can be used as an effective alternative indicator for screening the incidence of obesity in ado lescents. The article written by Asif M et al., (2020; 2021) and the article written by Tantawy SA et al., (2020) explained that neck circumference had a significant correlation with body mass index (BMI), gender, and age, with NC cut off for overweight 25-30.35 cm in males and 24-31.62 cm in females(Asif et al., 2021) and neck circumference will increase with BMI and age (Tantawy et al., 2020). These results were in line with the research of Taheri et al. (2016) which states that neck circumference was significantly related to BMI, waist circumference, and upper arm circumference with a cut-off of 27.5-38.3 cm in men and 26.7-33.4 cm in women (Taheri et al., 2016). The article written by Ashok et al., (2021) stated that neck circumference was an effective screening indicator for identifying obesity in children and adolescents by showing better sensitivity and specificity compared to BMI, namely 100% in adolescent boys and 86% in adolescent girls, this was in line with previous studies which showed sensitivity and specificity for neck circumference used as an obesity screening tool of 98% and 96% in all subjects (male and female) (Lucas et al., 2016).

The article written by de Santis Filgueiras M et al., (2020) explained that neck circumference was significantly associated with the percentage of android fat. 1 cm increase in neck circumference was associated with an increase of 2.94% in android fat, fat in the android area consisted of visceral fat tissue where the fat tissue had higher lipolytic characteristics

compared to peripheral areas, causing the release of free fatty acids, LDL, triglycerides, and inhibiting insulin absorption which can cause insulin resistance (Septyaningrum & Martini, 2014). Neck circumference can describe the accumulation of fat in the neck which is used as an indicator of upper body subcutaneous fat tissue (Nyoman et al., 2017) and serves as a marker for various obesity-related diseases such as hypertension, diabetes, and cardiovascular disease (Martiningsih & Haris, 2019). The reviewed studies consistently show a strong correlation between neck circumference and obesity-related parameters such as BMI, age, and gender. This supports the potential of NC as a practical screening tool, especially given its simplicity and low cost. From a physiological perspective, neck fat—being part of upper-body adiposity—has higher lipolytic activity and contributes more to metabolic risks than peripheral fat, explaining its strong association with metabolic syndrome (Septyaningrum & Martini, 2014). These results are aligned with prior studies and emphasize the need for updated screening approaches tailored to adolescent physiology. Nevertheless, the variation in cut-off values suggests that universal application is limited without ethnic and regional validation. Therefore, NC could be incorporated into routine health assessments in adolescents, while future longitudinal studies should explore its predictive value across diverse populations.

Conclusion

This scoping review confirms that neck circumference is a practical and reliable anthropometric indicator for adolescent obesity screening, showing strong correlation with BMI and relevant health risks. This study contributes to the growing evidence that NC can serve as a simple alternative screening tool, especially in low-resource settings. Given the variations in NC cut-offs, future research should aim to establish standardized, population-specific thresholds and validate their use through longitudinal studies. In practice, NC measurement could be integrated into routine health assessments in schools and primary care to enhance early detection of obesity risk.

Strengths and limitations.

This scoping review provided a comprehensive overview of neck circumference as an alternative indicator for adolescent obesity screening that showed a significant correlations with BMI, age, and various health risks, and had high sensitivity and specificity compared to BMI. However, this scoping review included variations in cut-offs among studies therefore the variation can not be generated in the whole population and there was a limitation in clinical interpretation and ethnic coverage that may hinder the results applicability broadly. The limitations of this scoping review include several aspects that occur from the study selection stage to the bias assessment.

At the selection stage, limitations arise because only English-language articles are included, potentially ignoring relevant studies in other languages. In addition, restrictions on access to paid articles have excluded several potential studies that may meet the inclusion criteria. In terms of study diversity, most studies come from certain regions or ethnicities, limiting the generalizability of findings to the global population. In the bias assessment process, because the scoping review design does not systematically evaluate the risk of bias as in a systematic review or meta-analysis, the methodological quality assessment of each study is not carried out in depth. This has the potential to reduce the strength of interpretation of the internal validity of each study. Differences in design, sample size, and analysis approaches between studies also cause quite high data heterogeneity, which is an obstacle to drawing universal conclusions.

Conflicting Interest

All authors declare no conflict of interest.

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