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Visceral Adiposity Index - Predictive Index of Cardiovascular Diseases

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ABSTRACT

Background: Abdominal obesity is said to be the culprit which contributes to many non-communicable diseases. It leads to deterioration of cardiometabolic risk factors which cannot be measured by BMI. Visceral Adiposity Index (VAI), is a calculative index which can be used to assess the fat accumulation in the body.
Objective: The present review shows us that measuring central obesity is an important cardiometabolic risk factor at current scenario to overcome non communicable diseases by calculating VAI.
Methodology: The articles were extracted through thorough literature search using electronic databases by various combinations keywords. All the articles were screened well to be included in the study.
Conclusion: Thus, VAI is economical and novel indicator which is non-invasive method of evaluating fat accumulation in the body and can be used in large studies and clinical practices.

Key-words: Abdominal obesity, BMI, Cardiometabolic, Fat Accumulation, Visceral Adiposity Index.

Key Messages:
- Muscle mass and fat mass cannot be estimated through BMI.
- VAI can be a valuable indicator for adipose function and insulin sensitivity which has superiority over other anthropometric measurements that may reflect cardiometabolic risk which is cost effective.

INTRODUCTION

Abdominal obesity is increased accumulation of fat surrounding the intra-abdominal organs which is also termed as Visceral or Central Obesity or Adiposity.[1] Adipose tissue in the form of triglycerides is stored as the reservoir of fuel in adipocytes that controls glucose homeostasis and lipid metabolism.[2] In prolonged over accumulation of triglycerides in adipocytes, the lipid sizes are increased which results in fat expansion. Excessive lipid accumulation is linked directly with elevated levels of inflammation that may lead to insulin resistance and CVD by the secretion of adipokines. [3] The existence of low HDL levels and LDL and TG particles are the constituent of cardiometabolic syndrome.[4] (Figure: 1)

Body Mass Index (BMI) has common been established as the most anthropometric metrix to define and classify adults into obese, overweight, or normal weight in clinical practices. It is also used in interpreting the individual's fatness and risk factors for the development or the prevalence of many non-communicable diseases. [5] Abdominal obesity can be measured by waist circumference (WC) and waist to hip ratio (WHR), of which former

is an important measure of abdominal obesity compared to later.

WC is an indicator of intra-abdominal adipose tissue and higher levels leads to an increased risk of cardiometabolic disease. [6] WHR can be low in some obese people because of high hip circumference (HC) in the denominator. It is sometimes difficult to acquire a correct measurement in clinical setup of HC as compared to WC.[7]

The gold standard methods of measuring visceral fat masses were Magnetic Resonance Imaging (MRI) and Computed Tomography (CT), which are considered accurate for the quantitative detection of obesity. The two methods are unsuitable for larger scale studies due to inconvenient and expensive.[8] The VAI is an empirical index, which includes the anthropometric measurements and biochemical parameters which has shown to be related to adipose tissue function and express visceral fat distribution.[9] Due to the outcome of the rising epidemic of cardiovascular mortality, it is timely to understand the body fat distribution and its clinical implications is crucial.

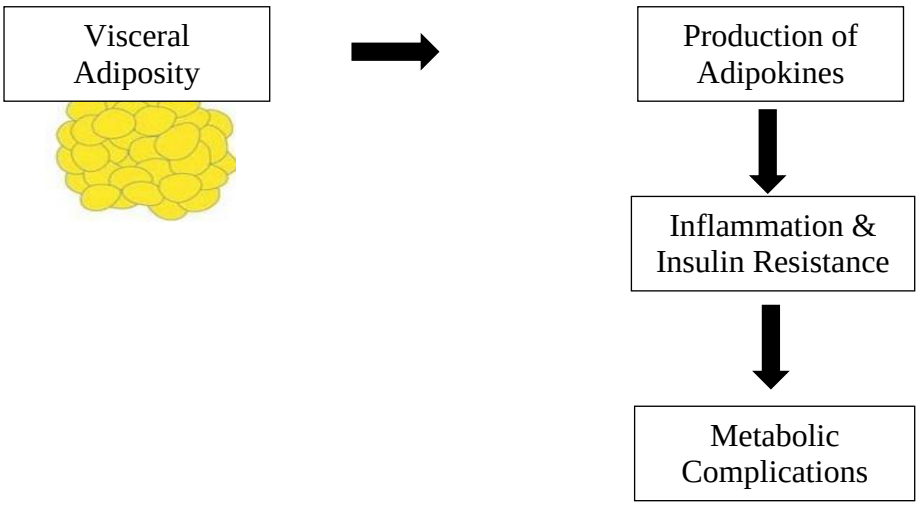

Figure 1: Mechanism of Visceral Adiposity leading to metabolic disturbances

MATERIALS AND METHODS

A thorough literature search was carried on in Pubmed, Google Scholar and Science Direct using relevant terms like visceral adiposity index, VAI indicator, cardiovascular indicators and combination words like VAI in cardiovascular diseases. Comprehensive search terms were used to accommodate the identification of all appropriate articles, with the last search performed on the 11th August 2020. Research articles pertaining to cardiovascular diseases were included whereas others were excluded. Apart from the collected studies, cross reference studies were also included. Review articles, original research articles, short communications and summaries related to the topic were included. The search was restricted to English language.

Visceral Adiposity Index (VAI): Predictive Indicator

The Visceral Adiposity Index is a gender specific and empirical mathematical formula based on anthropometric measurements like Body Mass Index (BMI) expressed in kg/m^2 and Waist Circumference (WC) expressed in cm and functional parameters like Triglycerides (TG) expressed and High Density Lipoprotein cholesterol (HDL) expressed in mmol/L. It is derived from the observations done in healthy normal/ overweight population by initially calculating model of adipose distribution (MOAD). To correct MOAD for fat function, TG (mmol/l) and

HDL (mmol/l) levels were introduced in the formula.[9] A strong positive correlation was seen between the VAI with peripheral glucose utilization during euglycemic hyperinsulinemic clamp and it is independently associated with cardio- and cerebrovascular events.[10]

$$\text{VAI for Males} = \frac{WC}{39.68 + (1.88 \times BMI)} \times \frac{TG}{1.03} \times \frac{1.31}{HDL}$$

$$\text{VAI for Females} = \frac{WC}{39.58 + (1.89 \times BMI)} \times \frac{TG}{0.81} \times \frac{1.52}{HDL}$$

VAI as Cardio Metabolic Risk Indicator

Adipose tissue distribution related to geographical distribution is an integral component explaining the relation between adiposity and cardiometabolic risk factors.[11] In a study which was carried among non-diabetic Asians aged above 20 years, showed that the visceral fat was associated with cardiometric risk factors, hence proving the link between visceral fat and development of insulin resistance leading to cardiovascular diseases.[12] In a long term prospective study carried on in Europe, found out that the visceral adiposity index is independently associated with ten years cardiovascular risk, particularly in men and suggests that the VAI can be used as an alternative indicator of long term cardio vascular diseases risk.[13]

A study proved that VAI could be used to evaluate adipose tissue dysfunction and associated with cardiometric risk in various patients and showed an existing association of VAI with HOMA-IR (homeostasis model assessment of insulin resistance).[14] In a large case-control study, the risk of CVD was elevated with a high VAI value among Chinese men and women.[15]

The higher VAI values were found with increased risk of developing cardiovascular disorder in future.[16] Randrianarisoa (2019), showcased an additional information as VAI can be used widely to estimate the visceral fat mass and predicting subclinical cardiometabolic risk.[17] The patients with ischemic heart failure revealed that visceral adiposity index may be a good predictor of mortality and confirmed that more relating studies.[18]

DISCUSSION

Higher body mass index is not certainly an expression of cardiometabolic risk considering the metabolically healthy obesity. The inflammatory release of the body at young age and increasing proneness to NCD's which is because of evidence *of fat deposition around visceral organs.*[19] Furthermore, it has also been noted as body mass index and waist circumference does not give a clear idea about central obesity.[20] Apart from its easy usage, body mass index can misclassify because that it fails to distinguish between individual amounts of fat-free mass and fat mass. Considering the limitation, BMI is incorrectly used and considered an acceptable predictor of the percentage of body fat.[21] Additionally, many factors affect the connection between BMI and body fat percentage such as gender, ethnicity, high muscle mass, and changes in hydration status.

Even though WC can give measure on the central obesity, the only limitation is inaccurate distinction between visceral and subcutaneous adipose tissue in the abdominal region. Although measuring body circumference is a valid method it requires an accurate execution to provide reproducible information.[22] Here arises the need for a gender and ethnic specific index to evaluate the body fat accumulation in specific to visceral fat in an efficient and economical way.

Pathak (2016) in his study suggested that VAI can replace imaging techniques by reducing economic burden and can be used among Indian population.[23] Many studies have found out the supremacy and utility of VAI on other anthropometric indicators. [24,25] Thus VAI has the ability to include physical as well as metabolic parameters than reflecting indirect change in the production of adipocytokines, plasma free fatty acids and increased lipolysis which cannot be found among waist circumference, body mass index, triglycerides and high-density lipoprotein separately. Therefore, it is evident that visceral adiposity index might be used as a valuable and surrogate index of both adipose tissue dysfunction and function. Even though many studies had proved the versatility and utility of visceral adiposity index, the application in varied age groups and ethnicity with a larger sample size would be beneficial to validate and to recommend strongly for use in clinical practices as a marker of abdominal adiposity.

CONCLUSION

VAI is a cost effective tool which can be performed easily and be utilised in many conditions by using waist circumference, body mass index; triglycerides and high density lipoprotein assessment. It is an effortlessly appropriate index for the assessment of visceral tissue dysfunction. The necessity for assessing the visceral obesity is utmost needed in reducing the cardiometabolic risk. It can also be used as a criterion to access the risk of NCD's among population studies and in clinical practices if the cut off values are validated.

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