International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Review on Association of Visceral Adiposity Index and Metabolic Disorders

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Abstract: ***Visceral Adiposity is the precursor of many non-communicable diseases. It leads to multiple metabolic deterioration in the body. VAI is an index which was formulated including gender, waist circumference, BMI, triglycerides and HDL and used to calculate the visceral fat disposition. The articles were screened well depending upon the inclusion and exclusion criteria. The concept of metabolically healthy and unhealthy normal and obese are essential for prevention of many non-communicable diseases. Therefore, VAI can be used as a assessment tool to evaluate the visceral fat accumulation.***

Keywords: Fat Accumulation, Metabolic Disorders, VAI, Visceral Adiposity

1. Introduction

Abdominal/ Central/ Visceral Obesity is considered as preeminent component for the onset of metabolic disturbances in the body. The visceral fat tissue is an active organ and the abdominal obesity present inside is a potent risk factor for the metabolic changes in our body. Although other indices have a major role in the clinical setup, differentiating the visceral fat from subcutaneous fat is crucial. Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) were used commonly in diagnosis of metabolic syndrome but are expensive and difficult to apply [1].

Asian Indians have an increased risk for metabolic syndrome, diabetes and coronary artery disease [2]. The metabolic disturbances caused due to presence of visceral fat is different for every obese individual depending upon the rate of fat distributed in the abdominal region. Adipose tissue dysfunction and dyslipidemia are conditions not necessarily associated with obesity, it can occur in a minor increase in body weight even among non-obese [3]. Hence simple tools that can be widely used in clinical practices to bring out the metabolic changes has to be validated.

A visceral indicator known as Visceral Adiposity Index (VAI) was developed. In 2010, the VAI was first modelled and originated from observations in a healthy normal/overweight population of a linear relationship between body mass index (BMI) and waist circumference (WC) [4]. The VAI is an empirical, gender specific index which includes both anthropometric measurements like Waist Circumference (WC) and Body Mass Index (BMI); biochemical parameters like Triglycerides (TG) and High-Density Lipoprotein (HDL) to calculate the visceral fat distribution in the body [5]. It can be used in determining the obesity phenotypes which will be beneficial in understanding metabolically healthy obese and metabolically unhealthy obese individuals.

VAI for Males
[WC/39.68+(1.88 × BMI)] × (TG/ 1.03) × (1.31/ HDL)

VAI for Females
[WC/39.58+(1.89 × BMI)] × (TG/ 0.81) × (1.52/ HDL)

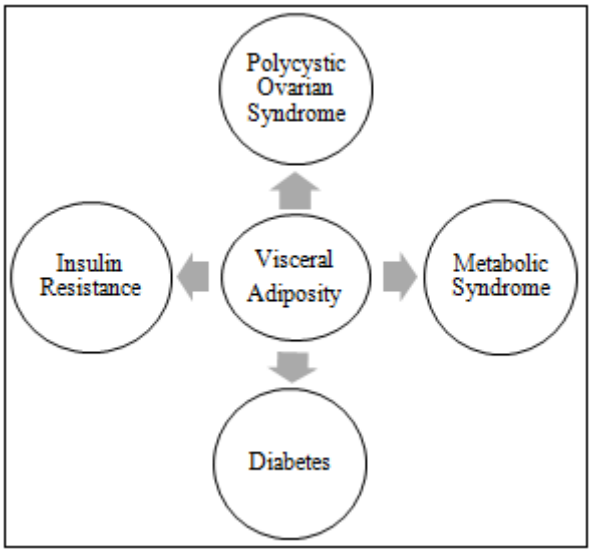

Figure 1: Bird's Eye view on relation of Visceral Adiposity with Metabolic Disorders

2. Methodology

The articles relating to the topic visceral adiposity index, VAI and metabolic syndrome, VAI and diabetics, VAI in PCOS, obesity indicators, adiposity indicators were collected and extracted by using search engines and electronic databases. The full-length articles were collected with the last search done on 1st September 2020. The retrieved articles were screened thoroughly depending upon the inclusion and exclusion criteria.

Review articles, original research papers, clinical trials, short communication and articles specific on the topic and related terms were included in the review. Apart from the collected studies, cross reference studies were also included. Articles related to cardiovascular diseases, hypertension, fatty liver, intervention studies, articles with other indicators and articles in other languages were excluded (Figure 2).

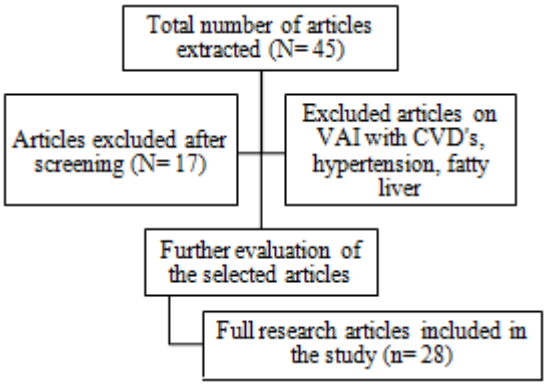

Figure 2: Flow design of the literature search

3. VAI and Metabolic Syndrome

Many findings related to insulin resistance, with an enlarged accumulation of abdominal fat and mass of upper body subcutaneous adipose tissue are consonant with the diagnosis of a metabolic syndrome [6].In a study conducted by Heloisa Goldani et al in 2015, resulted that the visceral adiposity index showed association with metabolic syndrome components in both older men and women at increased risk of abdominal obesity, hyperglycemia, hypertriglyceridemia, and low high-density lipoprotein cholesterol and thus proving to be a good predictor of metabolic syndrome components in the elderly [7].The discriminatory ability of Visceral Adiposity Index was studied in a population base study of 18 –74 years cohort study by Motamed N et al., in 2017. The finding of the study, was that Visceral Adiposity Index had an excellent ability in diagnosis of metabolic syndrome and was slightly better in women than men [8]. 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 [9].In a study carried out among normal and obese grade 1 obesity resulted that VAI is a useful indicator to rate the metabolic risk of both non-obese and obese individuals [10].

Increase in adipose tissue mass is the primary phenotypic characteristic of obesity. Visceral adipose tissue is like a smaller storage compartment for lipids that mechanically linked to many of the metabolic disturbances and adverse outcomes associated with obesity [11].In a study which evaluated the ability to identify metabolically obese normal-weight (MONW) phenotype resulted that VAI outperformed the anthropometric measurements [12]. To estimate the risk of metabolic disturbances associated with VAT accumulation, VAI might be used as a new surrogate marker [13]. The association of visceral adiposity estimated by VAI, with the metabolically healthy obesity (MHO) to metabolically unhealthy obesity (MUO) found that MHO phenotypes with high VAI values are associated with poor metabolic outcomes in future and VAI in determining the conversion has a good predictive value [14].

4. VAI, Insulin Resistance and Diabetes Mellitus

The outcome of abdominal obesity might be insulin resistance, which can lead to impaired glucose tolerance and thus leads to development of type II diabetes mellitus [15]. 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) [16]. The predictive ability of VAI was evaluated by Bozorgmanesh, Hadaegh & Azizi in the year 2011 concluded that visceral adiposity index could be a predicting tool for diabetes events. But the prediction ability can be improved by gathering information on its components like waist circumference, body mass index, triglycerides, and high-density lipoprotein cholesterol on WHtR. This study shows a different perspective of following a defined protocol for measuring the components of the VAI index [17]. The visceral adiposity index also showed association with insulin sensitivity and growth factor-I which proved to be a good index among the most common indexes of adiposity assessment [18]. Another important study conducted on VAI resulted that its useful in prognosticate visceral adiposity dysfunction and correlated with known adipocytokines and cardiometric risk among diabetes [19]. Pathak (2016), also suggested that VAI can replace imaging techniques by reducing economic burden and can be used among Indian population [20]. A study by Hameed &Qahar (2019) concluded that VAI is closely related with glycemic control in women and also suggested to diabetic care providers to consider VAI as management strategy [21]. In another study where VAI was tested at different levels of glucose intolerance concluded that increase in three lipid abnormalities with increase in glucose intolerance and the VAI values was increased in various phases of glucose intolerance [22]. In contrary, a study by Kavaric (2017) from Montenegro and Serbia concluded that VAI may not be a better parameter that enter in prediction of type 2 diabetes. This may be the reason of smaller sample sizes and ethnicity [23]. In a study carried out in China by Liu (2016) resulted that VAI values was associated with diabetes and pre-diabetes presence in Chinese adults [24]. A review study concluded that VAI can be used to estimate accumulation of abdominal fat and used as a practical predictor for type 2 diabetes mellitus among Asian population [25]. VAI appear to be clinically helpful tool to assess Insulin Resistance in adults with type 1 diabetes [26]. A study by Gu (2017), concluded that VAI was positively associated a convenient indicator of prediabetes [27].

5. VAI and PCOS

Obesity independently has an impact of synergistically on the PCOS manifestations and also negatively affect insulin sensitivity, cardiovascular profile and risk of diabetes [28]. Increased body weight might contribute to the complications

of PCOS in later life [29]. Lipid abnormalities including dyslipidemia are mostly found in women with both obesity and PCOS [30]. Visceral adiposity index can be used as a pre-screening in all PCOS women without risk of diabetes and effective tool in addition the higher values were found with higher risk of developing cardiovascular disorder in future [31]. Another study concluded that cardiovascular traditional risk factors cannot identify the risk of lean PCOS subjects and for accessing lean PCOS subjects in clinical practice assessment tools like VAI found to be essential [32]. Techatraisak concluded in his study as along with VAI he has found that anthropometric indices like BMI and WHtR (Weight Height Ratio) are the best predictors of Metabolic Syndrome [33]. The finding in a study of prevalence of visceral adiposity was found among lean PCOS girls [34].

Visceral fat is the precursor of many non-communicable diseases. The concept of healthy and unhealthy individuals among normal and obese is of utmost essential in understanding the underlying cause for the development and progression of metabolic changes leading to diseases. As far as metabolically healthy obese phenotype is concerned there is a compound interaction between genetic, environmental and behavioral factors [35]. Normal weight individuals are even at risk if the fat stored in the body is high. The conversion from normal/ obese healthy to unhealthy individuals is effortless if fat accumulated on the visceral region [36]. Therefore, simple tools like VAI are need of the hour for clinical evaluation and better identification of individuals at metabolic complications and risk.

6. Conclusion

VAI is a versatile, liable and lucrative tool in assessing the outcome of onset and prognosis of metabolic changes leading to varies diseases. This lay to the base for researching more on prevention of complications resulting due to visceral fat deposition.

7. Future Scope

Visceral Adiposity is a silent killer and major cause for many metabolic diseases. In future, determining the visceral adipose tissue among individuals helps us in preventing lifestyle diseases. VAI is an efficient and cost effective in assessing the visceral fat present in the body. Futher more studies are needed to evaluate the index among genders, ethinicity, age groups and diseases.

8. Acknowledgement

Nil

9. Conflicts of interest

There are no conflicts of interest

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