

# Identification of Increased Buccal Facial Fat as a Premature Predictor of Metabolic Syndrome: A Scoping Review

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**Abstract:** In recent decades, there has been a notable increase in the prevalence of obesity, particularly visceral obesity, which is associated with heightened morbidity and mortality worldwide. Recently, a series of studies have suggested that facial features, including buccal fat tissue, may serve as alternative indicators of insulin resistance, metabolic syndrome, and cardiovascular diseases, given that buccal and visceral adipose tissues share histological and metabolic similarities. This review followed the structure of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR) protocol to answer the research question: How does buccal facial fat act as an early predictor of metabolic syndrome? Buccal fat pad (BFP) was discovered by Xavier Bichat in 1801. Facial fat loss is related to a reduction in visceral fat. Facial parameters, such as the distance between earlobes and jaw width, were used to identify visceral obesity. The reviewed studies emphasize the relationship between facial adipose tissue, especially BFP, and visceral obesity, with valuable implications for clinical practice. Individuals with higher BFP tend to have more visceral fat, highlighting its potential in the early identification of metabolic risks.

**Keywords:** Metabolic syndrome; Obesity; Buccal facial fat.

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## 1. Introduction

In recent decades, there has been a significant increase in the prevalence of obesity, particularly visceral obesity, worldwide [1]. Statistically, approximately 60% of adults in Brazil are overweight, and one in four individuals is classified as obese, totaling more than 41 million people, according to data from the National Health Survey PNS/2020 [2]. Visceral obesity is closely associated with chronic diseases such as type 2 diabetes mellitus, dyslipidemia, and cardiovascular diseases, including hypertension, making it a serious public health problem in many countries [3].

Body adipose tissue is divided into two main categories: visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT), differing in their metabolic functions, such as the release of free fatty acids and cytokines. Free fatty acids are essential for insulin secretion, but the excess produced by VAT can result in hyperinsulinemia due to reduced hepatic clearance. This metabolic dysfunction is an important precursor to insulin resistance. In contrast, SAT is considered metabolically less active [4].

In light of the increasing morbidity and mortality rates associated with visceral obesity, identifying physical findings that help diagnose individuals at risk for these conditions is of utmost importance. In recent years, a series of studies have suggested that facial features, including buccal fat tissue (known as BFP, buccal fat pad), may be

alternative indicators of insulin resistance, metabolic syndrome, and cardiovascular diseases [5]. Although anatomically distinct, BFP and abdominal visceral adipose tissue share similarities in both histological and metabolic terms, sometimes being referred to as "visceral fat of the face" [6]. Xavier Bichat first described BFP in 1801, describing it as a mass of adipose tissue supported by the maxillary periosteum and the superior fibers of the buccinator muscle, with four distinct processes: pterygopalatine, temporal, pterygoid, and buccal [7].

Abraham et al. [6], in a case report of a South Asian patient, proposed explanations to justify the relationship between buccal fat deposition and visceral fat. Since the clinical assessment of visceral obesity usually involves measuring waist circumference (WC) and calculating the Body Mass Index (BMI), whose accuracy depends on the professional's skill and patient cooperation, visual inspection of the face's sideburn areas may offer a subtle perception of visceral adipose tissue size, considering the close relationship between these areas [5]. Therefore, this scoping review of the literature based on the most recent and updated research available was conducted to evaluate the increase of BFP as a potential early indicator of Metabolic Syndrome, focusing on its applicability in clinical practice and the importance of clarifying this relationship.

## 2. Material and Methods

This review followed the structure of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR) protocol. Two independent reviewers conducted a literature review following the study selection criteria. The development method involved searching for articles on the Biblioteca Virtual em Saúde (BVS), PubMed, Cochrane Library, and Scielo platforms to answer the research question: How does buccal facial fat act as an early predictor of metabolic syndrome? Using the PICO strategy (P: patients with early signs of metabolic syndrome; I: identification of increased buccal fat tissue; C: conventional screening; O: applicability of this parameter), the following search terms (MeSH) were used: Intra-Abdominal fat, and the free term: Facial fat, which, associated with Boolean operators (OR and AND), structured the search strategy.

### 2.1 Search Bases

For this review, the broad search platforms BVS and PubMed, Cochrane reviews, Scielo, and Up to date were searched on 03/09/2023. No date or language limits were imposed, and no search filters were used.

### 2.2 Search Strategy

#### 2.2.1 Strategy 1 – PubMed and Scielo

("Intra-Abdominal Fat"[Mesh] OR (Fats, Intra-Abdominal) OR (Intra Abdominal Fat) OR (Intra-Abdominal Fats) OR (Fat, Intra-Abdominal) OR (Fat, Intra Abdominal) OR (Intra-Abdominal Adipose Tissue) OR (Adipose Tissue, Intra-Abdominal) OR (Intra Abdominal Adipose Tissue) OR (Retroperitoneal Fat) OR (Fat, Retroperitoneal) OR (Fats, Retroperitoneal) OR (Retroperitoneal Fats) OR (Retroperitoneal Adipose Tissue) OR (Adipose Tissue, Retroperitoneal) OR (Visceral Fat) OR (Fat, Visceral) OR (Fats, Visceral) OR (Visceral Fats) OR (Abdominal Visceral Fat) OR (Abdominal Visceral Fats) OR (Fat, Abdominal Visceral) OR (Fats, Abdominal Visceral) OR (Visceral Adipose Tissue) OR (Adipose Tissue, Visceral)) AND (Facial Fat)

#### 2.2.2 Strategy 2 – BVS

FACIAL FAT AND VISCERAL FAT

### 2.2.3 Strategy 3 – Cochrane Reviews

#### FACIAL FAT AND VISCERAL FAT

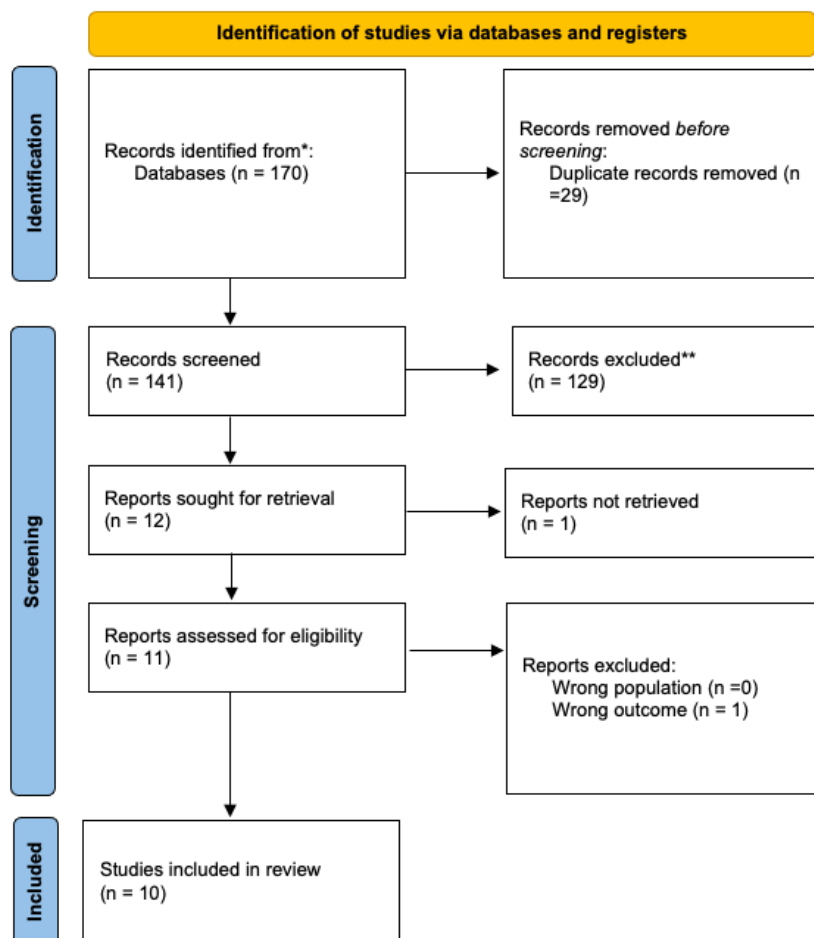
### 2.3 Selection

For selection, the Rayyan® Platform (<https://www.rayyan.ai/>) was used. Articles resulting from the search strategies were added, and two collaborators were invited for blind selection based on reading abstracts and titles. The inclusion criteria were relevance to the topic, appropriate clinical intervention, and outcomes compatible with the benefit of evaluating Bichat's fat pad. Conflict review was released for all collaborators. Once disagreements were resolved by consensus and following the inclusion criteria, the full texts of the included articles were read. The final inclusion of articles was then made.

### 2.4 Search Results

Initially, 170 articles were found through the aforementioned platforms, and after removing 29 duplicates, 141 references were retained. Of 141 studies, 32 were selected after reading the titles, and 129 articles were excluded after selection criteria were applied. One study had a relevant title for the search, but no full text was available. Eligible studies went through a full reading stage by two independent reviewers. These documents were evaluated according to the following eligibility criteria: the generalizability concerning the relevance and applicability of the results; the reproducibility leading to the consistency of the results; and finally, the statistical power. Ten articles were included in the final review (see Figure 1).

Figure 1. PRISMA-ScR® Flowchart.



\*\*Records excluded by humans

### 3. Compilation and Summary of Data

The compilation and summary of the data were carried out in a single step, following the methodological procedures recommended in the literature. A descriptive summary of each study was made, consisting of the following elements: author, year, study design, and main findings (see Table 1).

**Table 1.** Main results presented by the studies included in the review in chronological order of publication.

Study	Methodology	Main Findings
[8]	Cross-sectional observational	<ul style="list-style-type: none"> <li>- Both subcutaneous and visceral fat were associated with an increase in the volume of buccal fat pad (BFP).</li> <li>- There was an association between BFP and abdominal circumference in both men and women, and between BFP and hip circumference only in women.</li> <li>- A significant positive correlation was found between buccal fat areas and visceral fat.</li> </ul>
[3]	Cross-sectional observational	<ul style="list-style-type: none"> <li>- Individuals with more buccal fat are more likely to have increased visceral fat.</li> <li>- The adipose tissue in these two deposits has similar metabolic properties, and these patients may be at higher risk of metabolic complications from obesity.</li> <li>- A relationship between cheek fat and abdominal visceral fat was reported.</li> </ul>
[4]	Narrative review (research methodology not specified)	<ul style="list-style-type: none"> <li>- It was concluded that individuals with more buccal adipose tissue may have a higher risk of metabolic complications from obesity.</li> <li>- The hypothesis was raised that facial fat may be a good predictor of insulin resistance.</li> <li>- The study identified that loss of facial fat (mid and lower face) is more closely related to loss of visceral fat than to loss of subcutaneous abdominal fat.</li> </ul>
[10]	Prospective study	<ul style="list-style-type: none"> <li>- Loss of visceral abdominal fat appeared to be more closely related to loss of mid-face fat than to lower face fat.</li> <li>- It was concluded that both mid-face fat volume and the simplified measurement of mid-face width are highly predictive of obstructive sleep apnea.</li> <li>- A relationship between facial structure and visceral obesity was suggested.</li> </ul>
[11]	Cross-sectional observational	<ul style="list-style-type: none"> <li>- The parameter that showed the most evidence was the measurement of the distance between the bottom of the earlobes.</li> <li>- The facial fat parameter was found to be a good predictor for BMI and body fat percentage.</li> </ul>
[1]	Cross-sectional observational	<ul style="list-style-type: none"> <li>- Facial fat could potentially be used as an obesity parameter in telemedicine consultations.</li> </ul>
[6]	Case report	<ul style="list-style-type: none"> <li>- Increased visceral fat described as a strong predictor of cardiovascular</li> </ul>

Study	Methodology	Main Findings
[9]	Central randomized controlled trial	<p>disease.</p> <ul style="list-style-type: none"> <li>- Buccal fat is similar to visceral adipose tissue.</li> <li>- The authors suggest that facial obesity may be associated with a premature risk of coronary artery disease.</li> <li>- During weight loss, the reduction of subcutaneous chin adipose tissue was independently associated with an improved glycemic profile, possibly suggesting a new role for subcutaneous chin adipose tissue in obesity-related insulin resistance.</li> </ul>
[5]	Case report	<ul style="list-style-type: none"> <li>- The authors propose the presence of bitemporal obesity as a new physical exam sign that can be used as a potential marker for identifying visceral obesity.</li> <li>- This sign may also help identify patients at increased risk of subsequent metabolic syndrome.</li> </ul>

#### 4. Review

The buccal fat pad (BFP) was first described in 1801 by the anatomist Xavier Bichat [5]. In 1997, a study conducted by Gravante, G., and Grasso, S. Lo hypothesized that visceral and subcutaneous fat would be associated with the BFP. This study confirmed the relationship between BFP and abdominal circumference in both genders, as well as between BFP and hip circumference in women, suggesting that measuring BFP via ultrasound could be used to monitor and evaluate the effectiveness of weight loss treatments [7].

The following year, in 1998, Levine [3] identified for the first time a significant correlation between buccal fat areas and visceral fat. By evaluating 25 abdominal and cranial CT scans, the authors suggested that individuals with greater buccal fat are more likely to have increased visceral fat. This is due to the fact that the adipose tissue in these two anatomically separated deposits has similar metabolic properties [2]. In 2004, Sierra-Johnson et al. [4] reported a correlation between cheek fat and visceral abdominal fat. The study concluded that individuals with higher buccal adipose tissue might have a greater risk of metabolic complications from obesity. Additionally, it was observed that cheek fat and visceral fat in the abdomen accumulate together, which creates a stronger predictor of metabolic complications from obesity [3].

In 2010, Sutherland et al. [10] established that the blood supply of buccal adipose tissue comes from deep branches of the maxillary artery and the superficial temporal artery. The microcirculation in this adipose tissue shows a network similar to other areas of white adipose tissue, such as the abdomen. Despite its simple structure, the white adipocytes present in the BFP store large amounts of triacylglycerols and provide fatty acids to other tissues as needed. Based on these observations, it was hypothesized that facial fat could be a good indicator of insulin resistance. It is likely that the accumulation of facial fat is an active source of free fatty acids, similar to visceral abdominal adipose tissue, and that, either alone or in conjunction with visceral adipose tissue, it plays an important role in the development of insulin resistance [6].

It was also observed that the loss of facial fat (middle and lower region) is more closely related to the loss of visceral fat than to the loss of subcutaneous abdominal fat. The loss of visceral abdominal fat appears to be more associated with the loss of fat in the middle region of the face than with the loss of fat in the lower face. Therefore, it was concluded that both the volume of fat in the center of the face and the simplified measure

of the width of the middle third of the face are highly predictive of increased visceral fat [8].

In another study, Lee et al. [11] tested the relationship between visceral obesity and facial anthropometric measures. They concluded that the best parameter for young women, middle-aged women, and men of all age groups is the distance between the earlobes. For women over 50 years old, the best parameter is the width of the jaw. This study's relevance lies in determining the presence of visceral obesity through facial characteristics in emergency services and telemedicine [11]. Furthermore, in another study, Abraham et al. [6] also associated bilateral obesity in the sideburn region of the face with premature coronary artery disease. Visceral abdominal adipose tissue was strongly associated with buccal adipose tissue, based on ethnic, dietary, and hormonal explanations. This relationship seems specific to visceral fat rather than general adiposity (5).

Tsaban et al. [9] described in their study that cervical and mentonian subcutaneous adipose tissue (SAT) are known phenotypes of obesity. In the trunk, deep SAT is a highly heterogeneous deposit correlated with cardiometabolic risk, while superficial SAT is associated with an improved metabolic state. It was concluded that the two mentioned SAT deposits have a direct relationship with lifestyle changes and long-term weight loss [9]. Regarding clinical use, Chanda et al. [1] suggested the use of facial photographs of patients to determine the presence of visceral obesity through an app to be developed. This would facilitate the diagnosis of overweight during virtual consultations, where common anthropometric measurements cannot be obtained [1].

Abraham et al. [5] described this marker as a new facial physical sign called bitemporal obesity. This sign is characterized by the symmetrical bilateral prominence of the temporal fossae, with a clear deep demarcation of the superior temporal line and is associated with visceral obesity. It is worth noting that this condition can occur in individuals of normal weight. Observing and determining the sign of bitemporal obesity can alert doctors to investigate the presence of visceral obesity in patients with this sign [4].

The articles found and used for this study were mostly cross-sectional observational studies and case reports, which may have some limitations, such as selection bias, where the sample included in the study may not be representative of the entire population. Furthermore, they cannot capture changes, limiting the ability to understand how variables might change or influence each other over time. Even though we selected the most recent articles found that aligned with this study, the last to be published was released in 2022, highlighting the lack of more updated data on the subject.

## 5. Discussion

In this scoping review, we identified 9 primary studies addressing the relationship between increased facial fat and the increased risk of Metabolic Syndrome published between 1998 and 2022. Our findings indicate a lack of research specifically focused on determining a parameter to be used in clinical practice as a marker of increased metabolic risk and a limited number of studies on the real applicability of this marker in screening for obesity-related complications. We also found that there is a well-established and proven relationship between increased buccal subcutaneous fat and increased visceral abdominal fat. However, although important and feasible, this marker is still not being routinely used and its existence is still little discussed. Additionally, the included studies clearly support a greater effort for larger studies to be developed in this area.

The reviewed studies offer an interesting insight into the relationship between facial adipose tissue, especially the buccal fat pad (BFP), and visceral obesity, revealing important implications for clinical practice and understanding the underlying mechanisms of insulin resistance and metabolic complications. The results suggest that the BFP can be a useful indicator for assessing overweight and its effectiveness in monitoring obesity-related treatments. Additionally, it was observed that there are metabolic similarities between the BFP and visceral adipose tissue, which may contribute to the development of insulin resistance.

The correlation between buccal and visceral fat areas indicates that individuals with greater BFP are more likely to have an increase in visceral fat, making this marker potentially valuable in the early identification of metabolic risks. The relationship between buccal fat and abdominal visceral fat, and the joint accumulation of these fats, highlights the relevance of this marker in predicting metabolic complications from obesity. Furthermore, facial parameters such as the distance between the earlobes or jaw width were identified as relevant for detecting visceral obesity, which can be particularly useful in emergency services and telemedicine scenarios.

Regarding the clinical applicability of assessing Bichat's fat pad in medical offices, the methods used are reliable and validated, such as ultrasound or direct clinical evaluation. Additionally, there is ease in implementing the measurement technique, without requiring special technical skills or resources. Therefore, there is an opportunity to provide valuable information for early diagnosis, treatment planning, or monitoring of medical conditions associated with metabolic syndrome.

Other studies have related the BFP to premature coronary artery disease, strengthening the association between the BFP and visceral abdominal fat. The relationship between different deposits of subcutaneous adipose tissue and cardiometabolic risk was also discussed. Additionally, proposals for diagnostic apps based on facial photographs and the introduction of the "bitemporal obesity" concept emphasize the clinical importance and potential utility of the BFP as a metabolic risk marker, even in individuals with apparently normal weight. These findings suggest that the analysis of BFP and facial characteristics can complement traditional anthropometric measures in the assessment of metabolic risks and in the prevention of obesity-related complications, offering promising opportunities for future research and clinical application.

It is worth noting that despite the assessment of Bichat's fat pad offering significant impact on early diagnosis of metabolic syndrome, there are still limitations in the studies included in this review. For instance, confounding variables are not adequately controlled in all studies, such as age, sex, body mass index (BMI), diet, and physical activity, which could distort true associations. Additionally, differences in methods for measuring Bichat's fat pad, such as ultrasound versus clinical evaluation, may introduce variations in results and interpretation of data.

Therefore, the BFP can be used as a non-invasive and easily accessible indicator during routine clinical exams to identify individuals at risk of developing metabolic syndrome, being especially useful in contexts where more invasive or expensive methods are not feasible. Monitoring changes in the BFP can help healthcare professionals track the effectiveness of weight loss interventions and dietary adjustments, providing an additional indicator beyond traditional anthropometric measures. In telemedicine scenarios, where quick and non-invasive measurement is essential, the BFP can be a practical tool for initial assessments and ongoing patient monitoring. The BFP can complement diagnoses based on other anthropometric measures and laboratory tests, providing a more comprehensive view of the patient's metabolic health status. Furthermore, the use of the BFP can aid in personalizing therapeutic interventions, allowing healthcare professionals to tailor treatment programs based on each patient's facial and visceral fat levels. However, the lack of specific parameters for clinical use and its limited application in current practice indicate the need for further research in this area. Future studies should focus on developing standardized protocols for measuring the BFP and validating its clinical uses, aiming to integrate this tool more broadly and effectively into healthcare practices.

## 6. Conclusion

The studies reviewed in this context provide valuable and intriguing insights into the connection between facial adipose tissue, especially the buccal fat pad (BFP), and visceral obesity. These findings have significant implications for clinical practice. The established relationship between the BFP and traditional anthropometric measures such

as abdominal and hip circumference suggests that the BFP can be a useful tool in assessing overweight and monitoring the effectiveness of obesity treatments. Additionally, the metabolic connection between the BFP and visceral abdominal adipose tissue highlights the potential of the BFP as a marker of insulin resistance and metabolic risks.

Studies correlating buccal and visceral fat areas demonstrate that individuals with greater BFP are more susceptible to an increase in visceral fat, emphasizing the relevance of this marker in the early identification of metabolic risks. These findings suggest that the assessment of BFP and facial characteristics can complement conventional anthropometric measures in identifying metabolic risks and preventing obesity-related complications. This opens exciting prospects for future research and practical application of these markers in healthcare. However, despite the evidence, there is a lack of studies focused on determining specific parameters for the clinical use of BFP as a metabolic risk marker, as well as a lack of practical and routine applicability of this marker. Therefore, larger and more comprehensive studies are needed in this area to ensure that physicians are adequately trained to perform and interpret Bichat's fat pad measurement, as well as to communicate the results to patients in an understandable manner.

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## References

1. Chanda A, Chatterjee S. Predicting Obesity Using Facial Pictures during COVID-19 Pandemic. *Biomed Res Int.* 2021;2021:6696357. DOI: 10.1155/2021/6696357.
2. Brasil. Ministério da Saúde. O impacto da obesidade. Disponível em: <https://www.gov.br/saude/pt-br/assuntos/saude-brasil/eu-quer-ter-peso-saudavel/noticias/2022/o-impacto-da-obesidade#:~:text=Traduzindo%20em%20n%C3%BAmeros%2C%20aproximadamente%2060,Nacional%20de%20Sa%C3%BAde%20PNS%2F2020>. Acesso em: 09/03/2023.
3. Levine JA, Ray A, Jensen MD. Relation between chubby cheeks and visceral fat. *N Engl J Med.* 1998;339(26):1946-1947. DOI: 10.1056/NEJM199812243392619.
4. Sierra-Johnson J, Johnson BD. Facial fat and its relationship to abdominal fat: a marker for insulin resistance? *Med Hypotheses.* 2004;63(5):783-786. DOI: 10.1016/j.mehy.2004.06.020.
5. Abraham M. Bitemporal Obesity: An Overlooked Sign of Visceral Obesity? *Cureus.* 2022;14(6). DOI: 10.7759/cureus.25575.
6. Abraham M. Sideburns Obesity Syndrome: Is Sideburn Fat the Window to the Heart? *Cureus.* 2021;13(1). DOI: 10.7759/cureus.12706.
7. Tostevin PM, Ellis H. The buccal pad of fat: a review. *Clin Anat.* 1995;8(6):403-406. DOI: 10.1002/ca.980080606.
8. Gravante G, Lo Grasso S. Bichat's fat-pad: correlations with some anthropometric parameters. *Ann Hum Biol.* 1997;24(2):181-185. DOI: 10.1080/03014469700004912.
9. Tsaban G, Bilitzky-Kopit A, Yaskolka Meir A, Zelicha H, Gepner Y, Shelef I, Orr O, Chassidim Y, Sarusi B, Ceglarek U, Stumvoll M, Blüher M, Stampfer MJ, Shai I, Schwarzfuchs D. The Effect of Weight-Loss Interventions on Cervical and Chin Subcutaneous Fat Depots; the CENTRAL Randomized Controlled Trial. *Nutrients.* 2021;13(11):3827. DOI: 10.3390/nu13113827.
10. Sutherland K, Lee RW, Phillips CL, Dungan G, Yee BJ, Magnussen JS, Grunstein RR, Cistulli PA. Effect of weight loss on upper airway size and facial fat in men with obstructive sleep apnoea. *Thorax.* 2011;66(9):797-803. DOI: 10.1136/thx.2010.151613. Epub 2011 Jun 15.
11. Lee BJ, Kim JY. Predicting visceral obesity based on facial characteristics. *BMC Complement Altern Med.* 2014;14:248. DOI: 10.1186/1472-6882-14-248.