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REVIEW ARTICLE

Concept of Medas- A Deciphering Gateway

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Abstract

Medas, one among the *saptadhatu* generally has an undesirable image, as it is involved in the pathology of various diseases especially when *medovriddhi* leads to *dushchikitsyaroga* such as *atisthaulya*. In fact, *medas* is essential for health, as it provides overall strength to the gross physical body. Balance of *medas* is the most important key to maintain *swasthya* and it helps in the prevention of many lifestyle disorders. The current article puts light on the measurability of medas that can deliver an engaging all-new step towards the diagnosis and prevention of non-communicable diseases.

Introduction

Medas, the fourth among the *saptadhatu* (seven tissues), is characterized by *snehana* and has the attributes of *vatanashitva, bala-pitta-kaphakaratwa, balakaritwa and brimhana.*[1,2]Multidimensional activity of *medas* ranges from imparting strength at the cellular level to the gross level of human body.[2] It is involved in varied stages of growth, development and metabolism.[2,3].The controversial image of *Medas* among the *saptadhatu.*is attributed to its undeniable role in NCD causation.[2]Meanwhile, the measurability aspect [4] of *medas* can be judiciously converted into an opportunity for early detection of lifestyle diseases. Understanding *medodhatu* entity, in parallel with adipose tissue and newer concepts like Metabolically Healthy Obesity and Metabolically Unhealthy Obesity[5] is also intended by this study. The modifiable health behaviour of *dinacharya* (daily regimen) and *ratricharya* (night regimen), has an embedded strategy for optimum *medas* maintenance which is also explored in this study.[2]

Methodology

Literary review was done referring Ayurvedic classical texts and information was collected regarding the concept of *medas*,- physiology and pathology. Review was done following using key words – 'Adipose tissue, Lipid metabolism, Metabolically healthy obese' in scientific papers and contemporary research journals, mainly on PubMed, to extract information regarding Adipose tissue and relevant pathophysiological aspects .

REVIEW OF LITERATURE

Medas

Medas, the fourth among the *saptadhatu*, is a *matrija bhava* (maternal origin), and one among the *sleshmasthana* (seat of kapha) has its origin from *mamsadhatu* (muscle tissue).[1, 6, 7, 8] *Vasa* and *vapa* are synonymous to *medas*.[2]Properties of *medas*, when used as food or medicine can be summarized as *vatanashitwa, bala-pitta-kaphakaratwa, balakaritwa* and *brimhana*. [2]

Formation of *Medas*

Rasa (the end-product of digestion) undergoes *ranjana* (assumes color) due to the heat of *pitta* and forms *rakta*. *Rakta* again being acted upon by *agni* and *vayu- ambu- tejo bhoota* acquires *sthiratwa* (solidification) and transforms to *mamsa*, after it is processed by *mamsadhatwagni*. *Medas* is then formed,by the action of *medodhatwagni* combined with increased *snehabhava* of *jalabhoota*.[2]

Quantity of *medas* in body is summed up to be 2 *anjali*. [4]The *medas* which fills in minute pores of *asthi* (bones) is termed as *Majja*.[2]

Extremely *guru* (heavy) and *snigdha* (oily) *medas* is located in the *udara* (abdomen) and *asthi* (bones) of every living being explaining, the increased abdominal girth in its increased state.[3]

Functions of *Medas*

Medas, provides strength to the body in diverse forms, ranges from imparting *snehan*a (oiliness) and *dridatwa* (firmness) to the body, to being the precursor of *asthi dhatu* (bone tissue)- the major building block of the physical body.[2] *Medo dhatu* percolates as strength, diffusely and concretely in the human body.[2] Subtle entity is understood by, fourth of the six *patala* (layers) of eye having *medas* as its *asraya* (base).[2] *Sira* and *Snayu* evolve from *medas* owing to *Vayu*, whereby *snehabhava* is sucked from fluid prominent *medas* and transforms it into structurally compact *sira* and *snayu*.[4]

Further *sweda* (sweat) is the *mala* (waste product) of *medas* and *snayu* is its *upadhatu,* denoting its phased involvement in varying levels of body development, functioning and metabolism. [3, 4]

Similarity to Adipose tissue

Adipose tissue, as described by contemporary science has a striking similarity to the concept of *medas* described in Ayurveda. Adipose tissue (body fat), is a connective tissue that extends throughout the body as subcutaneous fat, visceral fat and bone marrow adipose tissue.[9] Adipose tissue is primarily known for storing and releasing energy and providing insulation. Lately studies have revealed that adipose tissue is also an active organ in the endocrine system. It consists of blood vessels and nerve endings and communicates with the other organs through hormone signals.[5] Both *medas* and adipose tissue are involved in the proper functioning of the body from the minute cellular to the gross physical body level. Their involvement in the proper maintenance of optimal health, also implies that a deviation from the optimal state either quantitatively or qualitatively for *medas* or adipose tissue would result in ill health.

Medosaara purusha

Medosaara purusha defines the most refined state of *medodhatu.* Susrutha points out that though *Medosara purusha* is endowed with fine qualities, still succumbs to inefficiency of carrying out heavy exercise.[10] Arguably, in *medosara purusha, medas* is assumingly in supreme state, and hence the preceding *dhatu* like *rasa, rakta* etc must also be assumed as being intact and prospective well-being of succeeding *dhatu* may be anticipated. Yet, vulnerability towards entropy, cannot be ruled out and deliberate need to be disciplined by tools of *ahara* (food) and *vihara* (activities) serves a hint towards its modifiable capacity. This also calls for a parallel deliberation focusing on *Kapha prakriti, medosara purusha* and contemporary chapters of Metabolically Healthy (MHO) versus Metabolically Unhealthy (MUO) Obesity.[5]

Measurability of *Medas*

Quantifiable property of *Medas* is echoed by its measurable entity- 2 *anjali* in a healthy adult.[4] Consequently, the variability, attributed as *medovriddhi* (increased *medas*) and *kshaya* (reduced *medas*), impacts upon homeostasis. Hence, signaling that balancing *medas* within its normal limits is cardinal for health maintenance. Exploring whether lipid profile can be accommodated, under domain of *anjali pramana* of *medas* is an interesting endeavor. The features of *medodushti* (vitiation of *medas*) explained in the literature are conventionally subjective .[11] Hence, an objective parameter for assessing *medodushti*, would befit as a tool for diagnosing the existence or predisposition to develop lifestyle disorders (like diabetes, obesity etc), and thereby, aid in their active prevention.

A Standard Operative Definition(SOD)for Diagnosing *Atisthaulya* (obesity) was designed as a part of PhD research protocol of the first author- 'Association of selected Ahara and Vihara factors with Atisthaulya – a Case Control Study'.The developed SOD was subjected to content validity, among four Ayurveda experts having more than five years of teaching experience(from Departments of Kayachikitsa,, Samhita Siddantha, Rachana Sharira).

The Scale-level-Content Validity Index (S-CVI) is calculated as total Item content validity (ICV by the total number of items 0.93, which indicates the questionnaire has excellent content validity in terms of clarity of the questions.

Standard Operative Definition

1.*Medomamsa vriddhi* – excessive fat and muscle

Appearance of increased amount of fat tissue subcutaneously and muscle tissue on areas like arms, thighs, breasts, abdomen, flanks and buttocks, double chin, large broad shoulders, which in turn increases the overall body weight with flabby body parts.

2.*Chala sphik udara stana*

Pendulous stomach, increased size of buttock, flabby breasts, or increased chest fat with visible movements while walking / mild, moderate, fast movement/ change of posture noticeable movement of hip, abdomen, pectoral region while walking due to increased fat and decreased muscle tone while doing activities.

3.*Udara parshwa vriddhi*

Round, fat abdomen protrudes excessively, increase in anterior posterior length of abdomen Areas of skin extending outward from hip indication fat accumulation around hip and abdomen, body fat extends horizontally over the edges of the waistline, wider waist due fat build-up around abdomen.

4.*Ayatha upacaya utsaha*

Disproportionate growth of body parts. Level of enthusiasm and stamina of the individual not in in proportion with evident growth of the body, which includes individual or combination of features, such as increased fat, flabby over-grown upper arm, distended abdomen, inflated cheeks, double chin, stout neck, bulky thighs cause asymmetry of body parts and loss of natural body curves and contour.

5. *Javoparodha*

Routine activities are hampered, lack of enthusiasm or motivation to start or do activity, lethargy, sleepiness, difficulty in waking up early in the morning, sluggish movements, slow pace, usually adhering to sedentary habits.

6. *Snigdhaangata*

Excess oil on skin and body parts producing a persistently shiny or greasy appearance with increased unction of body parts, increased development of pimples.

7.*Ksudraswasa*

Exertional dyspnoea, get exhausted easily, shortness of breath, difficulty in breathing even after food intake or brisk walk, mild to moderate activity, sometimes even in resting position.

8. *Dourgandhyata*

Bad body odor not removed after bathing, difficult to suppress with deodorants, foul smell sometimes felt from distance, even intolerable to oneself, resorts to change of dress.

9. *Daurbalya*

Lack of strength, weakness irrespective of large body size and weight. Inability to perform everyday tasks effortlessly, difficulty to do a task or exercise and reduced immunity, weakness does not subside with rest.

10.*Ksudha atipravritti*

Abnormally strong sensation of hunger or desire to eat, increased appetite without exertion or exercise, does not disappear with food intake in more quantity or more than regular times.

The quantitative categorization of adipose tissue into the healthy and unhealthy domains is done in a subjective manner in contemporary science too. The representation of the amount of body fat is done in relation to the total body mass of an individual. Certain anthropometric indicators are often used as predictors of total body fat percentage and assess associated risks and pathologies.

Body Fat Percentage

In the contemporary science, whole body fat percentage (%FM), and Visceral Adipose Tissue mass (VAT) specifically are correlated with and potentially implicated in disease trajectories. Commonly used anthropometric predictors of %FM are Body Mass Index (BMI), Waist Circumference (WC), Waist to Hip Ratio (WHR), Waist to Height Ratio (WHtR) and waist/height$^{0.5}$ (WHT.5R).[12]

The body fat percentage is categorized as follows

Figure:1

ACE Body Fat % Chart		
Description	**Women**	**Men**
Essential fat	10-13%	2-5%
Athletes	14–20%	6-13%
Fitness	21–24%	14–17%
Average	25–31%	18–24%
Obese	32%+	25%+

MEDAS: PATHOLOGICAL INVOLVEMENT

Both *kshaya* and *vriddhi* of *medas* can happen, among them *vriddhi* is the more perplexing to manage.[13] An increase in *medas* induces symptoms, that are described in *mamsavriddhi* (increased *mamsadhatu*) like *Ganda (galaganda/ gandamala/gandamasaadhyata* as per *Arunadatta*- can be big cheeks, enlarged lymphatics, etc), *arbuda* (abnormal cellular growth), *granthi* (lumps), *ganda-uru-udara vriddhi* (big-sized cheeks, thighs and abdomen) *and adhimamsa* (excess musculature) in sites like *kantha* (neck) etc.[14] Susruta explains *medovriddhi lakshana* to be *snigdhaangata* (oily skin), *udaraparswavriddhi* (enlarged abdomen and flanks), *kasa* (cough), *swasa* (dyspnoea) *and dourgandhya* (foul smell from body).[15] The features of *Medakshaya* (reduced *medas*) are *Katiswapa* (numbness over hip), *plihavridhi* (enlarged spleen), *krisaangata* (lean body), *sandhisphutana* (joint disorders), *akshiglani* (reduced vision), *ayasa* (easy exhaustion) and *udaratanutwa* (thin abdomen).[16, 17]

Medas in *Pramehasamprapti* (pathophysiology of prameha)

Due to the etiological factors, *tridosha* (three bodily humors) along with *medas*, occupies the *mootravahasrotas* (channels of urine) avow *adhogamitwa* (downward movement) and causes *prameha* (increased urination) resorting to *vastimukha* (urinary bladder).[18] *Medas* is one among the *dushya* (liable to be soiled) in *prameha*.[19] *Medas* is vitiated in *Avritamadhumeha samprapti* (pathophysiology of avritamadhumeha).[20] The *pramehapidaka* (skin eruptions in prameha) that are commonly found in a patient with *prameha* can also manifest in people who do not have the disease. *Saravika, kacchapika a*nd *jalini* (types of *pidaka*) are found in people who are in *prabhootasleshmamedo avastha* (aggravated *kapha* and *medas*) and *Sarshapi, alaji, vinata and vidradhi* are found in those who have *alpamedas* (low level of medas).[21]

The 10 types of *kaphaja prameha* having similar features and locations as that of *medas* are *sadhya* (curable) due to *samaanopakramatwa.*[22]

Medas in *Sthaulya* (obesity)

The *apakwa* (*aama*) *annarasa* (chyle) with properties like *madhurya* (sweetness) and *atisnehatwa* (oiliness), increases *medas* and causes *sthaulya*.[23] Later on it is described as to how *medas* is a factor in manifesting all the other symptoms of *sthaulya. Javoparodha* (slow movements) is caused due to the *saukumarya* (delicacy), *saithilya* (looseness) and *gurutva* (heaviness) of *medas*[24].

As there is blockage of channels due to *kapha* and *medas,* the *dhatu* other than *medas* will be undernourished for a *sthoola* which results in *ayurhani* (reduced life expectancy). He will be *krichhravyavayi* (feels difficulty in sexual intercourse) due to *alpasukrata* (less amount of sperm/ ovum) and *srotorodha* (blocked channels). This inequality in the nourishment of *dhatu* will result in weakness of body. *Medaswabhava* (the peculiarity of *medas*), *medodosha* (vitiation of medas) and *sweda* (sweat) will cause bad odour from body.[25] Sweat will be increased due to the association of *medas* with *kapha*, its *vishyandi swabhava* (melting nature), *bahutwa* (abundance) and *gurutwa* along with *vyayamaasahatwa* (intolerable to exertion) of *sthoola* [24]. The other diseases that manifest in *sthoola* will also be results of blockage of channels by medas.[26]

Atisthoulya, grouped under *ashtanindita*, is fertile receptor for multiple disease encroachment.[27]

Secondary prevention of *atisthoulya* is difficult because diet and lifestyle modification (especially exercise) are recommended to manage the condition. *Atisthoola* cannot withstand exercise and hunger, hence rendering treatment difficult and compromises compliance.[24]

Dushchikitsya status of *atisthaulya,* reinforces the importance of primordial and primary prevention, which pivots around balancing the *medas* both qualitatively and quantitatively.

Sweda vriddhi is a peculiar sign of *medovriddhi.*[24] Increased body weight is not the single most reliable sign of *medovriddhi*, because lean people also can have vitiated *medas* with varied symptoms. Studies exploring relation between amount of perspiration and *medas* vitiation can give practical insights about *Swedavriddhi* – designed parameter for self-assessment of *medovriddhi*.

Adipose tissue in the pathology of Obesity and T2DM

Contemporary researchers have identified endocrine actions of adipose tissue. [28, 29, 30, 31] That makes it not just a source and storage of energy but an interactive organ which communicates with other visceral organs through specific signals.

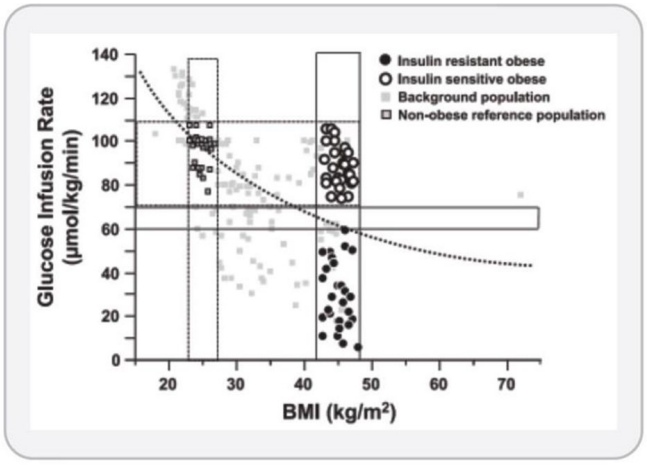
Fat mass is the greatest of body constituents affected in maintenance of stable body weight. With long-term changes in food availability, change in body fat accounts for 90% of resulting body weight change. In times of food excess or deprivation, the amount of fat stored as triacylglycerol within cells of adipose varies and accounts most for the mass of adipose. The number and size of adipocytes increases with accretion of triacylglycerol, whereas when body fat is lost, adipocyte size decreases while adipocyte number is little affected.[32]

In addition to the subcutaneous and visceral fat depots, adipocytes are associated with many organs and tissues including heart, kidney and bone marrow and the degree of adiposity can vary with obesity and ageing.[33] The mechanisms by which adipose depots expand in response to an excessive caloric intake represent a crucial determinant of the risk of metabolic dysfunction and CVD. This expansion is mediated by an increase in adipocyte numbers (hyperplasia) and/or an enlargement of adipocyte size (hypertrophy). It has been classically accepted that hyperplasia allows a "healthy" expansion of the adipose tissue, since it is mediated by the formation of functional adipocytes from progenitor cells (adipogenesis). In contrast, adipocyte hypertrophy typically leads to lipid-laden, dysfunctional adipocytes that undergo cell death and contribute to adipose tissue inflammation, dysfunction and associated pathologies.[34]

Glucose effectiveness is the ability of glucose to stimulate its own disposal at higher than basal concentrations, in a manner that is independent of insulin.[35] There is some evidence to suggest that an increase in adiposity reduces glucose effectiveness in mice but not enough evidence to support the same in humans.[36]

Studies have proved that increased adiposity is associated with insulin resistance which is involved in the development of type 2 Diabetes Mellitus.

Figure:2



Adipose tissue inflammation, particularly in visceral fat depots, is clearly a contributor in the etiology of systemic insulin resistance, glucose intolerance, and T2DM.[37] But it has to be understood that adipose tissue inflammation is neither necessary nor sufficient to cause insulin resistance. Other pathologies like ectopic fat deposition and inflammation of other metabolically active tissues can also be underlying pathologies.

PREVENTION OF *MEDOVRUDDHI*

Medas is developed from its precursor *mamsa*. The precursor of *mamsa* is *rakta* and that of *rakta* is *rasa*.[38] Hence, the uninterrupted chain of transformation aids the development of supreme quality of *medas. Rasadhatu* must be of good quality to produce healthy *medas*. It emphasizes the importance of diet in the prevention of *medodushti.*

The balanced state of *vata-pitta-kapha* is the base of health, which is achieved by *dinacharya*, *ratricharya* etc.[2] The primordial prevention of *medodushti* is achieved by balancing *kapha dosha* by specific procedures in *dinacharya, ratricharya, ritucharya*, healthy diet etc. Primary prevention can be incorporated for those who are at a risk of *kapha vriddhi* due to vocational (eg: desk-top works) or lifestyle peculiarities.

Medovaha srotodushti is often caused by sedentary lifestyle, day sleep, excessive intake of food items that increase *medas* (eg: oily food, sweet items, *pishta vikara* etc.[39] *Nidana parivarjana* is the primordial and primary prevention technique. Creative implementation of exercise (eg: work-place yoga) in vocational settings is an effective method of tackling *medovriddhi* due to sedentary habits.

Use of *madhura rasa* in Ayurveda, is a revered practice. However, it also plays most influential role in *medodusthi*, when consumed incoherently and in excess.[18] The anabolism promoting food strategy is intended for maintaining body alkalinity and reducing oxidative stress and free radicals.[40] Further, detailing of food intake in terms of quantity, quality, awareness of digestion, time duration and practice daily of *vyayama* (exercise), calls for accepting and practicing *Ahara and Vihara* in conjugation. Maintaining circadian rhythm is a silent embedded method of *dinacharya* and ratricharya, to check upon optimum maintenance of *medas* and check upon awareness of accumulating *medo dhatu. Dinacharya* advocates measures of early awakening, *abhyanga* (oil massage), *udvartana* (scrubbing with medicinal powders), *chankramana* (brisk walking), avoiding day sleep, refraining from water intake after food, bath after food for avoiding *medo dushti*.[2] *Ratricharya* doctrine of easily digestible food in sober quantity of easily digestible food in early night hours serves the purpose of enhanced digestion and metabolism, which is key to avoiding *medodushti.*[41] Post meal walking and *triphala* consumption serves a metabolic correction, in primordial, primary and secondary prevention strategy of disease like obesity and diabetes, where *medodusthi* is the target.[42]

Conclusion

Medas is one of the major building blocks of the physical body, and is essential for carrying out several bodily functions. But the optimal quantity and quality of *medas* must be maintained for a healthy life. Contemporary research also concurs with that. The involvement of *medas* in the pathologies of the metabolic disorders like T2D and Obesity, which are the leading causes of morbidity and mortality, indicates that keeping a healthy balance is crucial. Here is where Ayurveda, especially *Swasthavritta* become increasingly important. The proper implementation of the preventive measures in *Swasthavritta* including *dinacharya* and *ritucharya* can be effectively used to tackle the problem. The *ahara dravya* and *vihara krama* mentioned for *medoja vikara* can be implemented. In short, *medas* is not a villain but the essential factor for homeostasis, if balanced well.

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