Original Research Article

Nutritional assessment and body composition analysis of women faculty in Madurai

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ABSTRACT

Working woman has extra workload along with her regular household work. Women who have a good health are capable to handle this workload.

Context: Women Professors usually do not perform their meals and physical activities with little regularity which predispose them for overweight. In this sense, it is necessary to carry out studies that evaluate the health conditions of women professors, especially regarding anthropometric indices which can be affected due to the exhaustive work routine. To be healthy and fit proper diet and healthy food is required.

Aims: With this context, study of the nutritional status and body composition analysis of 50 women faculty in Arul Anandar College is carried out.

Methods and Materials: In this regard body composition analysis such as Height, weight, BMI, Waist Circumference, Hip circumference, WHR, subcutaneous fat % and skeletal % in whole body, trunk, arm and leg, Body fat %, visceral fat %, resting metabolism, body age were assessed using omron karada scan body composition monitor and biochemical parameters such as blood haemoglobin also estimated.

Statistical analysis used: The mean and standard deviation was employed to analyze the data.

Results: BMI of the women faculty shows that they are overweight. Waist hip ratio is close to the ideal values, excess and high body fat risk and healthy visceral fat levels. The mean blood haemoglobin levels were near the standard values in all the age groups. On the whole 70 per cent of the women faculty were normal, 22 per cent were mildly anaemic, remaining 4 per cent were moderately anaemic.

1. Introduction

Nutrition is both a physiological and psychosocial event and varies under many factors. Work The introduction should state why the study was carried out and what the specific aims of the study were, its importance and goals Life plays highly important roles in eating style and individuals' working conditions affect their health. Work intensity and its related stress have impacts on individuals' nutrition. When a person do not keep a balanced diet, their health gets worse, their resistance to diseases reduce, their attention decreases, their movements slow down, their absence from work increases, required productivity is not given and production goes down. Nutrition problems are resulted in workday losses, occupational diseases, occupational accidents and increasing health expenses.

The improvement of services in the health area has been essential for the progress of the quality of life, as well as for the improvement in the competence of teachers' work. In the area of education, an increase in the number of health-related injuries relating to characteristics of work requirements has been well documented in faculty of Colleges. One of these factors is obesity, defined by the accumulation of adipose tissue, caused by several factors,

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such as sedentary lifestyle, physical inactivity, excessive and unhealthy food intake. Women Professors usually do not perform their meals correctly, as well as perform physical activities with little regularity which predispose them for overweight and/or obesity. In this sense, it is necessary to carry out studies that evaluate the nutritional status of women professors, which can be affected due to the exhaustive work routine. It is hypothesized that academic health professors may present low rate of health related problems due to high health literacy; Considering the health behaviours of women professors, since they are the backbone of family and society and least bothered about their own health and nutritional status and highly considering their families health and nutrition.

Measuring body-composition provides a quantitative description of the amount and distribution of fat, muscle, bone, and water in the body and helps identify areas to work on to improve overall physical health and fitness level. The bioelectrical impedance (BIA), which measures the opposition to the flow of a weak electric current through electrodes attached to the hands and feet of a subject, is one of the most precise and reliable techniques for measuring body composition.[1]

Hence, Nutritional assessment and body composition analysis of women faculty is framed and carried out with the following objectives

2. Objectives

1. Study the nutritional status of women faculty in Arul Anandar College
2. Assess the Height, weight, BMI, Waist Circumference, Hip circumference, WHR, subcutaneous fat % and skeletal % in whole body, trunk, arm and leg, Body fat %, visceral fat %, resting metabolism, body age of women faculty were assessed using omron karada scan body composition monitor.
3. Assess the biochemical parameters like blood haemoglobin of the women faculty
4. Statistically analyse the data's.

3. Subjects and Methods

This research was done at the Arul Anandar College, Karumathur, Madurai. From this college, total 50 women faculty were agreed to participate in the study and so the sampling group consisted of them. For carrying out this research, the institution and the participants were received approval.[2]

3.1. Body composition measurements

3.1.1. Height and body weight measurement
The participants' body weights were measured with the omron karada scan body composition monitor (model HBF-375) as kilogram, their heights were measured with a rigid measure as well. Height measurements were done without shoes, feet next to each other.

3.1.2. Body mass index (BMI)
BMI is the ratio of the body weight in kilograms (kg) by the square of height in meters (BMI= weight (kg) / height (m2). Their height was entered in the omron karada scan body composition monitor.

3.1.3. Estimation of body fat percentage
Body fat percentage was determined with the omron karada scan body composition monitor. Waist-hip ratio **(WHR).**

Waist circumference was measured from the thinnest part of the area between the lowest rib and crista iliac. Hip circumference was measured from the trochanter major. From both measurement results, waist-hip ratio was estimated. WHO' waist-hip ratio reference values; waist circumference in females ≥80 cm, risk of metabolic complication, in females ≥88 cm high risk of metabolic complication, waist - hip ratio in females ≥0.85 cm high risk of metabolic complication.

3.1.4. Subcutaneous fat
Subcutaneous fat is the fat visible just under the skin. Subcutaneous fat is normally harmless and may even protect against some diseases. Visceral fat is fat that surrounds the organs. It is possible to lose both subcutaneous and visceral fat.[3]

3.1.5. Skeletal muscle mass
Skeletal Muscle Mass is an important component reflecting the human body's long-term health, which is responsible for posture, mobility, and strong immunity. A body-composition analyzer gives precise numerical estimates of segmental (i.e., upper limbs, trunk, and lower limbs) and total contents of Skeletal Muscle Mass.

3.1.6. Resting metabolism
Resting metabolic rate is the total number of calories burned when body is completely at rest. It supports breathing, circulating blood, organ functions, and basic neurological functions. It is proportional to lean body mass and decreases approximately 0.01 kcal/min for each 1% increase in body fatness. Average Resting metabolic rate of women is1400 kcal.

3.1.7. Body fat
Body Fat is a more correct measure of human health than body weight or BMI since it quantifies the exact fat content of the viscera and total body weight. It is estimated for a healthy body fat level, PBF should be within 18 — 28% for females.

3.1.8. Visceral fat

Visceral fat is stored in a person's abdominal cavity and is also known as 'active fat' as it influences how hormones function in the body. An excess of visceral fat can have potentially dangerous consequences. Because visceral fat is in the abdominal cavity, it is close to many vital organs, such as the pancreas, liver, and intestines. The higher the amount of visceral fat a person stores, the more at risk they are for certain health complications, such as type 2 diabetes and heart disease.[4]

3.1.9. Body age

Body age is a measurement of age biologically based upon on health and fitness level as opposed to birth certificate indicates.

3.2. Analysis of biochemical parameters

Davidson (1990) has reported that biochemical estimation is the most sensitive indicator of the health condition of an individual. Blood haemoglobin was estimated for all the 50 women faculty.

3.3. Analysis of data

Data Coding and their statistical analysis were done with the SPSS 12.0 package program on computer. In evaluation of data, mean and standard deviation were calculated.

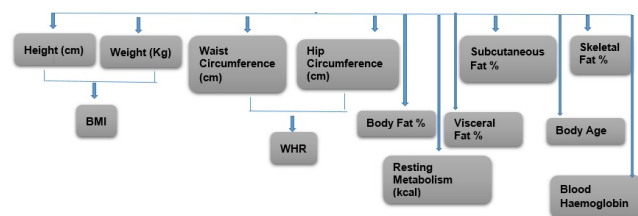### 3.3.1. Phase- I Assessment of Socioeconomic and Health Status of Women Faculty

Fig. 1: Flow chart for methodology

4. Results

4.1. A Nutritional anthropometry of the selected women faculty

The anthropometric measurements namely height, weight, waist and hip circumference were recorded and Body Mass Index (BMI), and Waist hip ratio were calculated and body composition parameters such as subcutaneous fat % (whole body, trunk, arm, leg), skeletal % (whole body, trunk, arm, leg), resting metabolism, body fat, visceral fat, body age was determined using omron karada scan body composition monitor for all the 50 women faculty and used for assessing the nutritional status.

4.1.1. Mean height

The mean height of women faculty is given in Table 1.

Table 1: Mean height (cm) of the selected subjects (n=50).

Height (cm)	Number	Per cent	ICMR *Standard (cm)
<150	7	14	
151-160	33	66	161.5
161-170	10	20	
Total	**50**	**100**	

* ICMR 2010

The mean height of the selected women faculty reveals that 14 per cent had their height range less than 150 cm, 66 per cent were their height ranging from 151-160 cm and 20 per cent had their height ranging 161-170 cm.

4.1.2. Mean weight

The mean weight of women faculty are given in Table 2.

Table 2: Mean weight (kg) of women faculty (n=50).

Weight (kg)	Number	Per cent	ICMR* Standard
41-50	2	4	
51-60	13	26	
61-70	17	34	
71-80	12	24	55
81-90	3	6	
>91	3	6	
Total	**50**	**100**	

With regard to the weight measurements, 4 per cent of women faculty had their weight in the range of 41-50 kg. Twenty per cent of them had their weight range in the range of 51-60 kg. Mainly 34 per cent of them had their weight in the range of 61-70 kg and 24 per cent of them had their weight in the range of 71-80 kg. It was shocking to note that around 6 per cent of them had their body weight in the range of 81-90 kg and above 91 kg respectively.

4.1.3. Body mass index

The Body Mass Index is used to assess how much a weight departs from what is normal or desirable for a person of his or her height. The WHO regards a BMI of less than 18.5 as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI greater than 25 is considered overweight and above 30 is considered obese (WHO 2013). BMI was computed using height and weight and classified on the basis of NIN Methodologies (2011) and given in Table 3.

4.1.4. Waist to hip ratio

The following Table 4 presents the Waist to hip ratio as per the classification for normal and obese grades of the selected women faculty.[1]

Table 3: BMI grades of the selected women faculty (n-50)

BMI Classification*	Obesity grade	Number	Percent
>18.5	Underweight	0	0
18.5-25	Normal	14	28
25.00-29.9	Overweight/ Pre obesity	26	52
30.00- 34.9	Obesity class I	7	14
35.00- 39.9	Obesity class II	2	4
≥40.00	Obesity class III	1	2
	Total	**50**	**100**

* ICMR, 2020

According to BMI values the obesity grades were recorded from normal to obese class III. The above table reveals that around 28 per cent were in the normal grade of BMI. Fifty two per cent were in the Overweight/pre obese category which is considered as "At risk of obesity", It is to be noted that 14 per cent were in the mild obesity class I category, 4 per cent were in the mild obesity class II category and 2 per cent of were in the obesity class III category.

Table 4: Waist to hip ratio (n-50).

WHR classification*	Number	Percent
≤ 0.85 Normal	40	80
> 0.85 Obese	10	20
Total	**50**	**100**

* ICMR 2010

The above table presents the Waist to Hip Ratio of the women faculty as per the normal and obese grades. In the present study the WHR for all the 50 subjects reveals that only 20 per cent were in the obese grade with WHR ≥ 0.85 and 80 per cent were normal ≤ 0.85 Normal.

4.1.5. Body composition analysis

Body Composition Analysis of women faculty is given in Table 5.
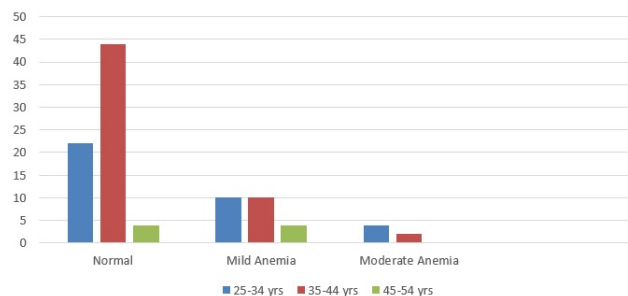
Fig. 2: Grouping of women faculty according to degree of Anemia.

Figure 2 None of the women faculty were severely anaemic, while 22 per cent of 25-34 years and 44 per cent of 35-44 years and 4 per cent of 45-54 years were normal. About 10 per cent of 25-34 years and 35-44 years, 2 per cent of 45-54 years were mildly anaemic. About 4 per cent of 25-34 years and 35-44 years respectively were moderately anaemic. On the whole 70 per cent of the women faculty were normal, 22 per cent were mildly anaemic, remaining 4

Table 5: Body composition.

Body Composition Parameters		25-34 years (n-18) Mean ±SD	Range	35-44 years(n-29) Mean ±SD	Range	45-54 years(n-3) Mean ±SD	Range
Height (cm)		157.52±5.27	147.5-165.7	157.24±5.35	148.0-168.0	144.2±1.76	143.0-145.5
Weight (kg)		71.84±15.60	40.5-113.6	66.75±10.77	48.7-91.3	55.35±7.566	50.0-60.7
BMI		29.14±6.00	18.5-45.6	27.09±3.44	21.6-36.1	26.65±4.31	23.6-29.7
WC(cm)		87.52±11.69	65-121	86.70±8.44	70.5-107	83.50±2.12	82.0-85.0
HC(cm)		109.17±13.12	81.5-136	105.47±8.84	93-119	98.00±16.97	86-110
WHR		0.79±0.06	0.69-0.94	0.81±0.04	0.75-0.92	0.86±0.12	0.77-0.95
Subcutaneous fat (%)	WB	33.41±6.19	25.5-44	31.91±3.84	24.2-40.9	34.10±5.23	30.4-37.8
	Trunk	29.83±5.65	23.7-43.1	28.13±3.60	20.6-36.4	31.20±4.94	27.7-34.7
	Arm	51.06±7.96	45.3-58.9	48.77±3.94	40.4-55.9	54.35±6.43	49.8-58.9
	Leg	47.90±8.40	37.6-59.4	44.4±4.94	34.5-55.6	47.90±8.62	41.8-54.0
Skeletal (%)	WB	22.90±2.54	19.9-25.2	23.24±1.08	21.6-24.9	19.55±1.48	18.5-20.6
	Trunk	17.03±2.52	12.4-19.4	17.31±1.37	14.3-19.9	14.35±1.62	13.2-15.5
	Arm	21.85±5.65	9.9-28.2	23.04±3.06	15.8-28.9	21.15±3.32	18.8-23.5
	Leg	36.13±3.74	31.9-39.3	36.40±1.19	34-38.4	32.10±0.84	31.5-32.7
RM (kcal)		1420.5±227.5	952-1987	1345.0±152.77	1170-1681	1146.0±93.33	1080-1212
Body Fat%		37.75±4.68	33-45	36.04±3.06	31.5-41.9	40.85±4.31	37.8-43.9
Visceral Fat%		10.69±6.59	2-30	8.81±3.50	4-18.5	10.25±4.59	7.0-13.5
Body Age (yrs)		48.44±7.44	30-61	52.22±6.80	42-66	62.50±6.36	58-67

WC – Waist Circumference, HC- Hip Circumference, WHR-Waist Hip Ratio, WB – Whole Body, RM- Resting Metabolism.

Table 6: Mean haemoglobin (g/dl) of women faculty (n=50).

Age Group (years)	n	Standard Values* (g/dl)	Mean Haemoglobin (g/dl)
25-34	18	12	12.09 ± 0.5
35-44	29	12	11.45 ± 1.42
45-54	3	12	11.9 ± 0.21

WHO, 2001

The mean blood haemoglobin levels of the women faculty were near the standard values in all the age groups. Among 25-34, 35-44 and 45-54 years the mean haemoglobin was 12.09, 11.45 and 11.9 g/dl which is near the standard value (12 g/dl) suggestive of IDA.

Table 7: Grouping of children according to degree of anemia (n=50).

Age in years	N	Normal (Hb>12g/dl)		Mild anaemia (Hb: 11-11.9 g/dl)		Moderate anaemia (Hb: 8-10.9 g/dl)		Severeanaemia (Hb: <8 g/dl)	
		No.	%	No.	%	No.	%	No.	%
25-34	18	11	22	5	10	2	4	0	0
35-44	29	22	44	5	10	2	4	0	0
45-54	3	2	4	1	2	0	0	0	0
Total	**50**	**35**	**70**	**11**	**22**	**4**	**8**	**0**	**0**

per cent were moderately anaemic.[5,6]

Table 5 The height of the subjects in three age groups ranged between 147.5-165.7, 148.0-168.0 and 143.0-145.5 cm with mean values of 157.52, 157.24 and 144.2 cm respectively. The weight of the subjects in three age groups ranged between 40.5-113.6, 48.7-91.3 and 50.0-60.7 kg with mean values of 71.84, 66.75 and 55.35 kg, respectively. BMI of the women faculty were 29.14, 27.09 and 26.65 respectively shows that they are overweight when compared to an ideal BMI of <25 kg/m2. The mean waist circumference of the subjects in three age groups was 87.52, 86.70 and 83.50cm, respectively. Similarly, 45-54 yrs age group had lesser waist circumference when compared to other age groups. The waist-to-hip ratio was maximum in 45-54 yrs age group followed by 35-44 years age group and 25-34 years age group. The ideal waist-to-hip ratio for women should be <0.8, the subjects, in all age groups had waist-to-hip ratio close to the ideal values. Body fat above 30% is excess fat and above 40% is high body fat risk, according to this, most of the women faculty in all age groups have excess and high body fat risk. Visceral fat at 1-12% is healthy and 13- 59 % is excessive according to this, most of the women faculty in all age groups have healthy visceral fat levels.[7]

4.2. Biochemical profile of the selected women faculty

4.2.1. Mean haemoglobin levels

The mean haemoglobin of selected women faculty were given in the Table 6.

4.3. Grouping of women faculty according to Degree of Anemia

Table 7 and Figure 2 represents the Grouping of women faculty according to degree of anemia.

*WHO standards (2001).

5. Discussion

The prevalance of obesity has been increasing all over the world day by day. When BMI reaches 25 and over it, the risks of hypertension, type 2 Diabetes Mellitus and cardiovascular diseases concerning the obesity degree show increases. According to the Turkey Nutrition and Health Research 2010 results, BMI average was found to be 28.9±6.4 in females. Berkel's research showed that the participant female academic staff's BMI average was 22.89.[8]

The waist circumference and waist/hip ratio are used for the risk evaluation in chronical diseases among the adults. The waist/hip ratio assses abdominal obesity. Abdominal obesity is more closely related with metabolic complications rather than BMI. According to the Turkey Nutrition and Health Research 2010 results, the waist circumference was over, >88 cm in 53.9% of females. This research determined that the females' waist circumference was 78.99±11.21. Also, the females' waist/hip ratio was 0.82±0.12, in our study. The result of the study shows the metabolic complication.

The waist/height ratio is seemed to be a better scale rather than the waist circumference and BMI in scanning cardio metabolic risk factors in adults. When the waist circumference / height ratio is over 0.5 and below 0.4, the metabolic disease risk occurs. According to the Turkey Nutrition and Health Research 2010 results, the waist/height ratio was 0.59 in females aged 19 and over, 0.55 in males. From this research, it was seen that waist/height ratios of all workers were over 0.50. So it can be said that all personnels under the risk of metabolic disease.

Regular activities have positive effects on body composition as well as health. Energy expenditures develop

due to activities, so decreases are seen in body weight and other measurements. Özenoğlu et al. suggested that the females' waist-height ratio was 0.52±0.7 before exercises, it was 0.51±0.6 after exercises in their research about females.

6. Source of Funding

None.

7. Conflict of Interest

The author declares that there is no conflict of interest.

References

1. Kyle UG, Melzer K, Kayser B, Picard-Kossovsky M, Gremion G, Pichard C, et al. Eight-Year Longitu- dinal Changes in Body Composition in Healthy Swiss Adults. *J Am Coll Nutr*. 2006;25(6):493–501. doi:0.1080/07315724.2006.10719564.
2. Sharan S, Puttaraj S. Prevalence of Upper Body Obesity as Determinant by Waist Hip Ratio (WHR) and Risk Factors Associated with It. *I J of Nutr and Dietetics*. 2006;43(9):378–384.
3. Schutz Y, Kyle UUG, Pichard C. Fat-Free Mass Index and Fat Mass Index Percentils in Caucasians Aged 18-98. *Int J Obes Relat Metab Disord*. 2002;26(7):953–60. doi:10.1038/sj.ijo.0802037.
4. Jelliffe DB, World Health Organization . The Assessment of Nutritional Status of Community. Geneva; 1966. Available from: https://apps.who.int/iris/handle/10665/41780.
5. Proper K, Van Mechelen W, World Health Organization. Waist Circumference and Waist–Hip Ratio: Report of a WHO Expert Consultation . In: Annex A: Current uses of waist circumferences and waist–hip ratios, and recommended cut-off points ; 2008. Available from: http://apps.who.int/iris/bitstream/handle/10665/44583/9789241501491_eng.pdf?sequence=1.
6. Lallukka T, Sarlio-Lähteenkorva S, Roos E, Laaksonen M, Rahkonen O, Lahelma E, et al. Working conditions and health behaviours among employed women and men: the Helsinki Health Study. *Preventive medicine*. 2004;38(1):48–56. doi:10.1016/j.ypmed.2003.09.027.
7. Ashwell M, P Gunn SG. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. 2012;13(3):275–86. doi:10.1111/j.1467-789X.2011.00952.x.
8. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Church TS. The Role of Exercise and Physical Activity in Weight Loss and Maintenance. *Prog Cardiovasc Dis*. 2014;56(4):441–7. doi:10.1016/j.pcad.2013.09.012.

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