

*Original Research Article*

# Trend of physical activity, dietary intake and body composition among women with high breast adiposity

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## Abstract

**This study aims to determine the magnitude of breast adiposity and its predictors among women residing in Klang Valley, Malaysia. Subjects were women aged 30 to 65 years old who participated in health screening at designated community centers. Their breast adiposity was assessed via EIT and extremum value of  $\leq 0.2$  cu indicated high breast adiposity. They were interviewed to obtain socio-demography, health status and lifestyle data and their body compositions were measured. Result indicated that the magnitude of breast adiposity among subjects was 35.1%. Menopausal status [Adjusted OR: 4.5 (95% CI: 2.7 – 7.2,  $p < 0.05$ )], body fat [Adjusted OR: 3.0 (95% CI: 1.9 – 4.8)] and low activity score of leisure time activity [Adjusted OR: 5.8 (95% CI: 3.5-9.6,  $p < 0.05$ )] were strong predictors of breast adiposity respectively. Therefore, breast adiposity affect at least one third of the subjects and associated with menopausal status, body fat and low physical activity.**

**Keywords:** Adiposity, body composition, dietary, physical activity

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## INTRODUCTION

In recent decades, there was increased trend of obesity which resulted global phenomenon of increased non-communicable metabolic diseases and cancers (Jan Mohamed et al., 2015). Based on the year of 2007 report on Food, Nutrition and Physical Activity and the Prevention of Cancer, adiposity increased risk of breast cancer by providing favorable environment for cancer cells proliferation (Veer and Kampman, 2007). It was evidence that adipose tissues are not just a storage site of excess energy, but also an endocrine organ with broad

biological activities including activities that promote cells malignancy (Heidari et al., 2015).

The evidence however does not support the incidence of cancer for those with normal body weight. The capability of adipose tissues to secrete broad range of protein families as well as many fatty acids and prostaglandins in situ may provide possible theory that not obesity in general but breast adiposity is the main culprit that prepares pro-inflammatory at specific site which is the breast (Cauley et al., 1999). Therefore,

capabilities of detecting specific adiposity particularly at the breast may provide a new perspective on the influence of diet, physical activity and body composition towards breast cancer (Choi et al., 2013).

Over nutrition and sedentary lifestyle are modifiable risk factors for breast cancer (Carmichael et al., 2010). Therefore, understanding these two factors are essential towards developing national strategies to improve health (Colditz and Rosner, 2000). To our knowledge, reported data on the prevalence of breast adiposity together with its predictors among Asian women was still scarce. Thus, this study aimed to determine the magnitude of breast adiposity among Malaysian women and its predictors from the perspectives of demography, socioeconomic, lifestyle practices and nutritional status.

## **MATERIALS AND METHODS**

### **Study design and Subjects**

The study was a cross-sectional study served to produce initial data of breast adiposity among Malaysian women (Malay, Chinese and Indian) aged 30 to 60 years old residing in Klang Valley. This study utilized convenient sampling with proportional allocation covering 6 regions of Klang Valley namely Federal Territory of Kuala Lumpur, Federal Territory of Putrajaya, Selangor district of Petaling, Selangor district of Klang, Selangor district of Gombak and Selangor district of Hulu Langat. Ethical approval was obtained from the Medical Research Secretariat, National University of Malaysia Medical Center (NN-136-2011) and informed consent was obtained from all participants prior data collection. Exclusion criteria included those who were pregnant, lactating, on electrically powered implanted device (e.g: pacemaker), diagnosed with breast cancer or other malignancy, previously underwent aggressive cancer treatment and those with mental disorder.

### **Demographic, body composition, dietary intake, physical activity**

Standardized pre-tested questionnaire was used by trained interviewers to obtain demographic data. The questionnaire includes age, ethnicity, religion, marital status, monthly household income, reproductive background, alcohol consumption, smoking habit, medical history, family history and education level.

In particular, subjects' dietary intake was assessed based on direct interview using diet history questionnaire (DHQ) (Shahar et al., 2000). NutriPro software was used to obtain energy intake and nutrient intake. Physical activity questionnaire used was the Short Questionnaire to Assess Health-enhancement activities (SQUASH)

(Wendel-Vos et al., 2003). SQUASH was selected because the design complement the physical activity recall and provide information on 4 separate domains namely commuting, leisure time activities, house-hold activities, and activities at work. The physical activity level was presented in total minutes per-week and activity score (Wendel-Vos et al., 2003).

Anthropometric measurements included body weight using TANITA digital lithium scale HD319 (TANITA Corporation, Tokyo, Japan), standing height using Leicester Height Measure (CMS Weighing Equipment, UK), waist circumference using SECA measuring tape (SECA Corporation, Humberg, Germany), fat percentage and fat free mass was measured using Maltron Bioscan 916 (Maltron International Ltd, UK) (Ulijaszek and Kerr, 1999; WHO, 2004; Jha et al., 2006). Those instruments were calibrated each time before measurement.

### **Identification of Adiposity at the Breast via EIT**

EIT procedure was handled by a single operator throughout this study to avoid any operator bias. Device used in this study was the 3D EIT MEIK 404 (Mobecom Inc, Canada) which includes a pre-downloaded software in a laptop (ACER, Aspire 3935). EIT examination was done in supine position. Wet cloth was dabbed at the examined breast to moisture the surface area of contact with the electrodes. Then the device was placed on the breast with intention of maximizing electrode contact to the surface. Scoring of the data was accomplished using a post-processing algorithmic calculation of the electrical conductivity through breast tissues.

There were four important values taken which include; mean of the conductivity value, extremum value, distribution discrimination (percentage difference of the tested breast tissue composition with normal curve generated by the software), tomogram comparison (percentage difference of subjects' right and left breast). The extremum value is the conductivity values that most frequently occurring at the tested site, therefore, the value indicated specific tissue that highly disperse at the breast as each tissue has specific range of conductivity. Extremum value of less than 0.2 cu was identified as high adiposity at the breast.

### **Statistical analysis**

All analyses were performed using Statistical Analysis for Social Sciences (SPSS) software version 18.0. Descriptive analysis was carried out on demography, anthropometry, dietary intake, physical activity and EIT quantitative values. Prevalence of breast adiposity was presented in percentage. Wald' chi-square was employed

**Table 1.** EIT quantitative values of subjects according to age groups

	n	Age groups: 30-39	Age groups: 40-49	Age groups: 50-59	Age groups: > 60	F	p value	$\eta^2_p$
Mean (Cu)	900	0.25 ± 0.11	0.28 ± 0.10	0.34 ± 0.10	0.37 ± 0.10	58.31	<0.001*	0.15*
Extremum (Cu)	900	0.19 ± 0.12	0.22 ± 0.15	0.28 ± 0.13	0.30 ± 0.14	22.73	<0.001*	0.05
Distribution discrimination (%)	900	22.8 ± 12.9	26.6 ± 15.5	27.9 ± 16.3	35.0 ± 17.1	22.73	<0.001*	0.07
Tomogram comparison (%)	450	10.5 ± 7.7	14.5 ± 10.5	13.4 ± 12.8	12.8 ± 10.4	2.20	0.088	0.015

The values are described as mean ± SD. Mean difference were analysed using ANCOVA.

All values are referring to 450 subjects, n: 900 were due to each breast were analysed separately as each breast gave distinct value.

The tomogram comparison (n: 450) was between right and left breast of each subjects.

\* Significant at level of  $p < 0.001$

Controlled with age at menarche and menopausal status.

$\eta^2_p$ ; partial eta squared for effect size

to determine the association of related factors to breast adiposity. Binary logistic regression (Enter Method) analysis was employed to determine the relative predictors of breast adiposity at  $p < 0.05$ .

## RESULTS

A total of 450 women were involved in this survey; consisted of Malays (68.0%) followed by Chinese (25.1%) and Indians (6.1%). The majority of subjects were women with an age ranged from 40 to 59 years old (69.6%) and mean age of  $51.3 \pm 5.8$  years. Most of them were married (92.4%) and received education level of Malaysian Certificate of Education (national examination taken by all fifth-year secondary school students in Malaysia, equivalent to eleventh grade in American K–12 education) and higher (61.6%). 46.0% of the subjects were still working whilst the rest of them were not working.

Overall, the EIT values (mean ± SD) were; mean =  $0.32 \pm 0.11$  cu, extremum =  $0.25 \pm 0.14$  cu, distribution discrimination =  $28.1 \pm 16.2\%$  and tomogram comparison  $13.3 \pm 10.2\%$ . There were significant differences in mean of all EIT values of different age groups except for the tomogram (Table 1). Relatively, based on the post hoc test, breast composition of women aged 30- 49 years old was significantly different from women aged 50 and above.

### Prevalence of Breast Adiposity and Factors Associated with Breast Adiposity

Out of the 450 subjects voluntarily participated in the study, 158 (35.1%) had been identified as having breast

adiposity based on EIT extremum value of less than 0.2 cu. The age (mean ± SD) of subjects with breast adiposity was  $49.5 \pm 5.3$  years old did not significantly differ from the normal subjects of  $52.3 \pm 2.1$  years old. Prevalence of subjects with breast adiposity was the highest among Chinese (55.8%), followed by the Indians (32.3%) and Malays (27.8%). Breast adiposity was also found to be highest among subjects aged 30-49 years old.

Table 2 showed that mean of body mass index (BMI), waist circumference, and body fat percentage were significantly lower in subjects without breast adiposity ( $p < 0.05$ ). Physical activity parameters for total minutes/week of commuting, leisure time activities, were significantly higher among subjects with normal EIT extremum value as compared to those with breast adiposity except for household activities ( $p < 0.05$ ). However, conversion towards activity score showed that only mean of household activity score was significantly higher among normal subjects compared to those with breast adiposity ( $p < 0.05$ ).

Mean of total calorie, protein and fat intake was significantly lower among normal subjects as compared to those with breast adiposity ( $p < 0.05$ ). Fat consumptions for both groups were higher than the Malaysian RNI recommendation contributing to 37.1% of total calories.

Results from the  $\chi^2$  analyses to investigate the association between various independent variables and the incidence of breast adiposity are shown in Table 3. Based on this study, menopausal status (crude OR: 4.5; 95% CI= 2.7 – 7.2), body fat percentage (crude OR: 3.0; 95% CI= 1.9 – 4.8) and leisure time activity (crude OR: 5.8; 95% CI= 3.5 - 9.6) of lower than 150 minutes/week significantly increased the odds of high adiposity at the breast.

**Table 2.** Mean difference of body composition, dietary and physical activities between normal group and group with high adiposity of the breast. Result is presented as mean  $\pm$  SD

Items	Normal (n = 292)	Adiposity of the breast (n= 158)	t	p <sup>a</sup> value
<b>Body composition</b>				
BMI (kg/m <sup>2</sup> )	25.9 $\pm$ 4.4	27.3 $\pm$ 6.6	2.39	0.017*
Waist circumference (cm)	79.2 $\pm$ 8.9	82.3 $\pm$ 12.1	2.82	0.005*
Fat free mass (kg)	38.1 $\pm$ 3.9	38.4 $\pm$ 5.1	0.698	0.486
% fat (%)	37.3 $\pm$ 7.5	38.9 $\pm$ 8.3	2.13	0.034*
<b>Physical activities (minutes/ week)</b>				
Total item	4146.7 $\pm$ 2621.6	2834.7 $\pm$ 1000.5	5.91	<0.05*
Commuting	102.7 $\pm$ 93.7	75.8 $\pm$ 39.8	4.39	<0.05*
Leisure time activities	245.7 $\pm$ 169.3	187.3 $\pm$ 125.2	2.04	0.042*
Household activities	1009.9 $\pm$ 923.8	955.7 $\pm$ 803.4	1.00	0.317
Activities at work (n=207)	2687.6 $\pm$ 2028.4 (n= 119)	1637.1 $\pm$ 994.6 (n= 88)	5.10 <sup>b</sup>	<0.05*
<b>Physical activities (activity score)</b>				
Total item	9834.2 $\pm$ 6799.5	4739.5 $\pm$ 2730.0	2.57	0.011*
Commuting	305.4 $\pm$ 226.0	138.0 $\pm$ 62.9	3.57	<0.05*
Leisure time activities	1071.9 $\pm$ 705.2	876.9 $\pm$ 535.1	1.75	0.081
Household activities	2404.7 $\pm$ 999.2	2308.3 $\pm$ 995.8	0.91	0.363
Activities at work (n=207)	4315.4 $\pm$ 4120.8 (n= 119)	3926.9 $\pm$ 2621.1 (n= 88)	0.873 <sup>b</sup>	0.383
<b>Nutritional intake</b>				
Total calorie (kcal/day)	1414 $\pm$ 405	1537 $\pm$ 386	3.16	0.002*
Carbohydrate (g/day)	162.7 $\pm$ 46.5	171.3 $\pm$ 55.9	1.66	0.099
Protein (g/day)	59.2 $\pm$ 21.3	70.0 $\pm$ 37.9	3.29	0.001*
Fat (g/day)	58.3 $\pm$ 22.5	63.5 $\pm$ 21.7	2.37	0.018*
Vitamin C (mg/day)	166.3 $\pm$ 149.1	145.9 $\pm$ 113.5	1.50	0.135
Vitamin E (mg/day)	5.5 $\pm$ 2.9	5.7 $\pm$ 3.9	0.67	0.505

<sup>a</sup>independent t test, df = 448, <sup>b</sup>df = 205.

\*significant mean difference at level of  $p < 0.05$

BMI = Body mass index

**Table 3.** Factors associated with high breast adiposity using univariate analysis (n= 450), n(%)

Factor	N = 450	Normal n = 292	Breast adiposity n = 158	Crude OR	95%CI	p value
<b>Family history</b>						
Yes	67	22 (32.8)	45 (67.2)	0.2	0.1 – 0.4	<0.01 <sup>β</sup>
No	383	270 (70.5)	113 (29.5)			
<b>Menopausal status</b>						
Yes	165	140 (84.8)	25 (15.2)	4.5	2.7 – 7.2	<0.01 <sup>β</sup>
No	285	152 (53.3)	133 (46.7)			
<b><sup>a</sup>History of pregnancy</b>						
At risk	93	35 (37.6)	58 (62.4)	0.2	0.2 – 0.4	<0.01 <sup>β</sup>
No risk	357	257(72.0)	100 (28.0)			
<b>Lactation history</b>						
Yes	332	217(65.4)	115 (34.6)	0.9	0.6 – 1.4	0.725
No	118	75 (63.6)	43 (36.4)			
<b>Body composition</b>						
BMI (kg/m <sup>2</sup> )						
Normal	149	106 (71.1)	43 (28.9)	1.5	1.0 – 2.3	0.051
High	301	186 (61.8)	115 (38.2)			
Waist circumference (cm)						
Normal	151	110 (72.8)	41 (27.2)	1.7	1.1 – 2.6	0.012*
High	299	182 (60.9)	117 (39.1)			
% fat						
Normal	150	121(80.7)	29 (19.3)	3.0	1.9 – 4.8	<0.01 <sup>β</sup>
High	300	171 (57.0)	129 (43.0)			

Table 3. Continue

Factor	N = 450	Normal n = 292	Breast adiposity n = 158	Crude OR	95%CI	p value
<b>Nutritional intake</b>						
<b>Total intake</b>						
Meet RNI	227	152 (67.0)	75 (33.0)	0.8	0.5 – 1.2	0.260
Does not meet RNI	223	140 (62.8)	83 (37.2)			
<b>Carbohydrate intake</b>						
55-75% intake	78	52 (66.7)	26 (33.3)	1.0	0.6 – 1.7	0.920
High	372	240 (64.5)	132 (35.5)			
<b>Protein intake</b>						
10-35% intake	150	104 (69.3)	46 (30.7)	1.3	0.9 – 2.0	0.236
High	300	188 (62.7)	112 (37.3)			
<b>Fat intake</b>						
25-35% intake	71	38 (53.5)	33 (46.5)	1.7	1.0 – 2.8	0.057
High	379	254 (67.0)	125 (33.0)			
<b>Vitamin C intake</b>						
≥ 70	351	229 (65.2)	122 (34.8)	1.0	0.6 – 1.6	0.954
< 70	99	63 (63.6)	36 (36.4)			
<b>Vitamin E intake</b>						
≥ 7.5	108	12 (11.1)	96 (88.9)	0.9	0.6 – 1.5	0.803
< 7.5	342	304 (88.9)	38 (11.1)			
<b>Physical Activity (minutes/week) Total item</b>						
<2119.9	200	120 (60.0)	80 (40.0)			
≥2119.9	250	172 (68.8)	78 (31.2)	1.3	0.6 – 2.8	0.452
Factor	N = 450	Normal n = 292	Breast adiposity n = 158	Crude OR	95%CI	p value
<b>Communting</b>						
<70.7	199	137 (68.8)	62 (31.2)	1.6	0.9 – 3.0	0.103
≥70.7	251	155 (61.8)	96 (38.2)			
<b>Leisure Time activity</b>						
<150.0	236	123 (52.1)	113 (47.9)	1.3	0.9 - 1.9	0.215
≥150.0	214	169 (79.0)	45 (21.0)			
<b>Household activity</b>						
<840.0	246	143 (58.1)	103 (41.9)	0.5	0.2 – 1.0	0.048*
≥840.0	204	149 (73.0)	55 (27.0)			
<b><sup>b</sup>Activity at work</b>						
<1550.0	111	66 (59.5)	45 (40.5)	0.4	0.2 – 0.8	0.013*
≥1550.0	96	20 (20.8)	76 (79.2)			
<b>Physical Activity (Activity score) Total item</b>						
<4483.0	198	101 (51.0)	97 (49.0)	0.6	0.4 – 1.0	0.056
≥4483.0	252	191 (75.8)	61 (24.2)			
<b>Communting</b>						
<123.2	199	137 (68.8)	62 (31.2)	1.3	0.8 – 2.1	0.224
≥123.2	251	155 (61.8)	96 (38.2)			
<b>Leisure Time activity</b>						
<450.0	315	197 (62.5)	118 (37.5)	5.8	3.5 - 9.6	<0.01 <sup>β</sup>
≥450.0	135	95 (70.4)	40 (29.6)			
Factor	N = 450	Normal n = 292	Breast adiposity n = 158	Crude OR	95%CI	p value
<b>Household activity</b>						
<1942.0	245	145 (59.2)	100 (40.8)	0.6	0.4 – 0.9	0.006 <sup>β</sup>
≥1942.0	205	147 (71.7)	58 (28.3)			
<b><sup>b</sup>Activity at work</b>						
<4100.0	111	66 (59.5)	45 (40.5)	0.4	0.2 – 0.9	0.023*
≥4100.0	96	20 (20.8)	76 (79.2)			

<sup>a</sup>at risk = women with no history of child bearing, women with history of child bearing after the age of 35.

<sup>a</sup>no risk= women with history of child bearing at the age of 35 and lower.

<sup>b</sup>n=207 for working women; \*  $\chi^2$  significant at p<0.05; <sup>β</sup>significant at p<0.01

## DISCUSSION

This present study revealed that the prevalence of breast adiposity was 35.1% and this study was the first of its kind to document women breast adiposity based on the extremum conductivity value of the EIT among a multi-ethnic Asian women. Obesity and high adiposity were both risk factors of cancer including breast cancer, those who gained more than 55 pounds after the age of 18 were found to have 50% increased risk of developing breast cancer (Eliassen et al., 2006). The main mechanism remains unexplained. However, high adiposity of the breast may contribute towards breast carcinogenesis, the condition that exposes mammary epithelium to excessive bioactive substances produced by the adipose tissue (Stephenson and Rose, 2003; Wu et al., 2009). Distinct breast tissues have different range of electrical conductivity. In principle, adipocytes have low conductivity, thus low conductivity of the extremum value (value that was most read by the software) showed that the tested area was high adiposity (Kantartzis et al., 2013).

The significant difference of EIT mean conductivity in different age range was expected as breast composition change with age, pregnancy and menopausal status. Women at fertility age (20-40 years old) had a higher glandular tissue volume with the fibrous component and adipocytes were still continuously developing as compared to women aged 40 years old and above (Ellis and Mahadevan, 2013). Based on these physiological differences, the EIT quantitative values of mean conductivity and extremum conductivity differ in different age range (Hammann-Kloss et al., 2014). Fibrous loose connective tissues were predominant tissues that substitute the loss of alveolar epithelium with increasing age and the conductivity of these fibrous tissues were higher than the parenchyma (Sadleir et al., 2013). Therefore, theoretically the conductivity gets higher with aging and the result of this study reflected the predicted theory.

Nutrition plays a big impact in promoting adiposity, which may later result in alteration of various metabolic processes in the body. Our study indicated that most of the subjects consumed high fat daily. Therefore, their high intake showed parallel affect with their body composition (Wang and Beydoun, 2007). These women also showed high protein but low carbohydrates intake. However, their current dietary plan was unhealthy because consumption of a low carbohydrate and high protein diet for 6 weeks may lead to kidney burden, decreased estimated calcium balance and increased risk of bone loss (Juraschek et al., 2013). Overall, subjects showed low total energy intake and the result was in symphony with previous study (Rampal et al., 2007). However, their energy intake and basal metabolic rate (BMR) ratio indicated that the intake was under-

reported (<25% of BMR). The scenario reflected common risks of self-reported diet method which was prone to gain under-reported data (Rennie et al., 2007).

Physical activity had been highlighted as part of important environmental factors that may have important impact on carcinogenesis. Previous study had found that women with greater leisure time activity had a lower risk of breast cancer than sedentary women (Magné et al., 2011). Subjects with normal EIT extremum values scored higher minutes per week of leisure time activities but overall, everyone claimed to comply with the WHO recommendation of 150 minutes per week of leisure time activities (Gebel et al., 2014). Physical activity promotes positive biological mechanisms which include improvement of hormone level, reduction of body fat, enhancement of immune system, and alteration of free radical damage by scavenger systems (Kruk and Aboul-Enein, 2006). Besides leisure time activity, this study revealed that commuting and work related physical activity may also have protective value against breast adiposity as those without breast adiposity also spent more time on these activities. Hence this finding was in concordance with previous studies which showed that high physical activity may reduce the risk of breast cancer (Kruk and Aboul-Enein, 2003; Kruk, 2007; Wu et al., 2013).

## CONCLUSION

In summary, this was the first study to document the variation of EIT quantitative values among Malaysian women and mapped differences in body composition, nutritional intake and physical activity based on breast adiposity. There were significant differences found in various parameters between the normal women and women with breast adiposity. Three strong predictors that showed increased risk towards breast adiposity were menopausal status, body fat percentage and leisure time activity score. There is a need to plan for an intervention to determine whether breast adiposity is a reversible condition.

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## Competing interests

All author(s) declare that they have no competing interests.

## Conflict of Interest

The EIT device was loaned by MobecommSdn. Bhd.

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