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Use of food intake and body mass index (BMI) in the assessment of adult nutritional status in Viet Nam including a maternal-child analysis

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The authors have used food intake and Body Mass Index (BMI) to assess Vietnamese adult nutritional status. Chronic Energy Deficiency (CED) is prevalent in Vietnamese adults with an average percentage about 40%. The mean value of BMI in the 26-40 year old age group is 19.7 but it decreases thereafter except in urban areas. The change in the BMI curve distribution varies among adults living in rural, urban and mountainous areas. There seems to be a relationship between the BMI of mothers and the nutritional status of their children under the age of 5. Some findings revealed a relationship between maternal BMI and birth weight and between CED and health status. The proposed cut-off point of Ferro-Luzzi-James in the classification of CED was applied to data from Vietnam.

Introduction:

There are some common indices, such as Broca and Lorentz, used to assess the nutritional status of adults. The calculated values for these weight-stature indices differ although they are highly correlated. Comparison between available data is difficult when different indices are used. Recently, to assess the nutritional status of adults, WHO/FAO has recommended the use of the Body Mass Index (BMI) [$Weight (kg)/height (m)^2$] calculated and classified as follows¹:

BMI	MEN	WOMEN
Low	< 20.0	< 18.6
Desirable range	20.1-25.0	18.7-23.8
Overweight	25.1-30.0	23.9-28.6
Obese	> 30.0	> 28.6

In a report by a Working Party of the International Dietary Energy Consultative Group², new criteria were proposed for classifying Chronic Energy Deficiency (CED) in adults, involving measuring BMI, energy intake (or expenditure) and basal metabolic rate (BMR).

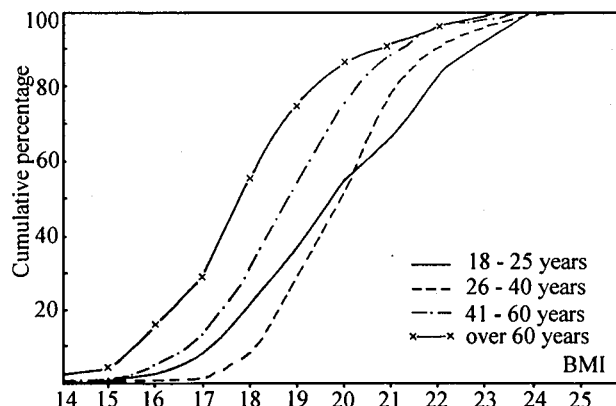
Recently a simplified approach using BMI alone has been proposed to assess adult CED³. In this approach, a BMI greater than 18.5 is classified as normal, from 17-18.4 is grade I CED, from 16-16.9 is grade II CED and below 16.0 is grade III CED. In this paper, we present the use of BMI as an indicator of adult nutritional status within this population. The results were collected from various surveys and studies.

Prevalence of CED in Vietnam.

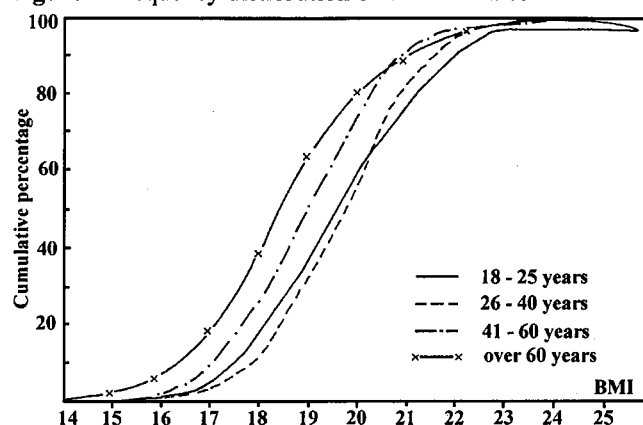
Study 1: During the period 1981-1985, the weights and heights of 12,800 rural adults were recorded in different age groups and ecological regions. The results of Study 1 are presented in Tables 1 and 2 and show that:

- BMI mean values decrease after 40 years in each gender
- CED is quite prevalent in Vietnam
- the average percentage of adults having BMI less than 18.5 is about 40%
- the highest percentage was shown in the oldest age group of both genders (Figures 1 and 2).

Figure 1 Frequency distribution of Body Mass Index (BMI) in women



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Figure 2 Frequency distribution of BMI in males

Table 1. Mean \pm SD value of BMI (kg/m^2) of adults

Age Group	Males	Females
18-25	19.2 \pm 1.9	19.8 \pm 1.9
26-40	19.7 \pm 1.7	19.7 \pm 1.8
41-60	19.0 \pm 1.8	18.6 \pm 2.0
>60	18.2 \pm 2.2	17.8 \pm 2.2

Table 2. Classification of nutritional status (%) using BMI as indicator

Age groups	BMI groups	< 16	16.0-16.9	17.0-18.4	Total <18.5
18-25	Male	1.2	2.4	22.4	26.0
	Female	2.7	5.3	20.5	28.5
26-40	Male	0.8	2.5	18.3	21.6
	Female	0.4	0.8	16.6	17.8
41-60	Male	1.4	7.9	28.4	37.7
	Female	5.0	7.7	29.7	42.4
>60	Male	5.8	12.6	32.6	51.0
	Female	15.8	12.6	36.8	65.2

Study 2: From 1987-1989 we carried out a general nutrition survey of a sample of 12,789 households in different regions of the country including Hanoi and Ho Chi Minh City. The survey findings of Study 2 consist of: measurement of household food composition during 3 consecutive days for household members and the recording of socioeconomic factors⁵.

The survey results (Tables 3 to 7 and Figures 3 and 4) show that the pattern of change in BMI is similar in rural

Table 3. Food consumption (grammes per capita per day) (mean \pm SD)

Foodstuffs	Urban (n = 1655)	Rural (n = 9135)	Mountainous (n = 1634)
1. Rice-- cooked	421.3 \pm 112.3	457.1 \pm 133.9	498.0 \pm 129.2
2. Other cereals	14.2 \pm 30.2	3.7 \pm 26.7	7.4 \pm 33.6
3. Tubers	11.8 \pm 33.2	47.5 \pm 118.9	38.8 \pm 119.9
4. Beans & Peas	2.4 \pm 10.2	1.6 \pm 10.1	4.0 \pm 20.5
5. Tofu	16.5 \pm 33.7	4.9 \pm 18.8	8.7 \pm 24.2
6. Nut & Sesame	4.2 \pm 10.6	3.0 \pm 13.0	9.4 \pm 20.8
7. Veg. leaves	108.5 \pm 77.3	145.2 \pm 113.9	169.0 \pm 106.3
8. Veg. tubers	39.4 \pm 49.2	49.4 \pm 87.3	68.5 \pm 78.7
9. Fruits	10.2 \pm 33.8	1.2 \pm 13.1	0.2 \pm 3.7
10. Sugar	1.8 \pm 6.9	0.3 \pm 2.8	0.1 \pm 1.2
11. Sauces	22.3 \pm 25.8	30.2 \pm 31.7	23.5 \pm 34.8
12. Oil & Fat	6.4 \pm 9.8	2.6 \pm 6.6	2.7 \pm 8.3
13. Meats	49.3 \pm 50.2	13.7 \pm 31.1	28.5 \pm 40.9
14. Eggs & milk	9.6 \pm 18.6	1.4 \pm 6.6	2.0 \pm 11.2
15. Fish	62.2 \pm 81.1	29.3 \pm 40.8	8.1 \pm 18.1
16. Other aquatics	7.8 \pm 16.4	8.8 \pm 21.1	1.8 \pm 8.3

Table 4. Nutritive value of dietary intake (per capita per day) (mean \pm SD)

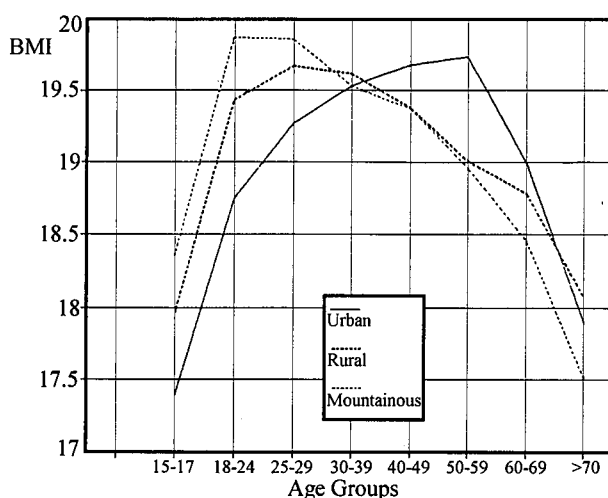
Nutrients	Urban (n = 1655)	Rural (n = 9153)	Mountainous (n = 1634)
Protein (g)	62.5 \pm 19.8	53.9 \pm 18.6	57.7 \pm 18.3
-Animal protein	22.7 \pm 14.6	11.2 \pm 12.4	7.8 \pm 9.9
Lipids (g)	28.7 \pm 17.5	13.9 \pm 12.4	18.8 \pm 15.5
-Vegetable lipids	7.0 \pm 7.8	6.6 \pm 6.6	10.3 \pm 9.6
Carbohydrate (g)	336.2 \pm 85.4	375.4 \pm 102.2	411.1 \pm 93.7
Energy (KCal)	1905.2 \pm 485.2	1892.8 \pm 524.4	2101.5 \pm 498.2
Calcium (mg)	464.6 \pm 266.7	553.0 \pm 471.9	408.3 \pm 216.6
P (mg)	789.0 \pm 229.3	702.5 \pm 223.2	758.8 \pm 229.8
Fe (mg)	9.8 \pm 2.8	9.5 \pm 3.1	10.3 \pm 3.5
Vitamin A (mg)	0.1 \pm 0.4	0.0 \pm 0.1	0.0 \pm 0.1
Carotene (mg)	2.1 \pm 1.9	2.8 \pm 3.1	2.6 \pm 2.7
Vitamin B1 (mg)	0.8 \pm 0.3	0.7 \pm 0.3	0.8 \pm 0.3
Vitamin B2 (mg)	0.5 \pm 0.3	0.3 \pm 0.2	0.4 \pm 0.2
Nicotinic Acid (mg)	10.7 \pm 3.8	9.7 \pm 3.5	11.4 \pm 4.8
Vitamin C (mg)	48.7 \pm 44.0	61.2 \pm 59.4	73.7 \pm 55.8

and mountainous areas but is different in urban areas. In the first two groups, the BMI mean values were highest at the age of 25-29 years for males and 18-24 years for females; they were lower in the urban group during these ages. The urban BMI mean values increased up to the age group of 50-59 years and decreased thereafter. This fact may be due to differences in food intake, energy expenditure and lifestyle of the populations in these regions.

Table 5. Balanced characteristics of the dietary intake

Nutrients	Urban	Rural	Mountain
	n = 1655	n = 9153	n = 1634
Energy (Kcal)	1905.2 ± 485.2	1892.8 ± 524.4	2101.5 ± 498.2
Protein energy (%)	13.5%	11.7%	11.3%
Lipid energy (%)	14.0%	6.8%	8.3%
Carbohydrate energy (%)	72.3%	81.3%	80.2%
Animal Protein/ Total Protein (%)	36.3%	20.9%	13.6%
Veg Lipid/ Total Lipid (%)	24.4%	47.9%	54.8%
Ca/ P	0.59	0.79	0.54
B1 (mg)/ 1000 Kcal	0.49	0.37	0.43

Figure 3. BMI of males by age group



As shown in Tables 3, 4, and 5, there are not significant differences in total caloric intake but the percentage of lipid energy to total energy and animal protein to total protein is higher in urban populations than in the other

Table 6. BMI of males by age group

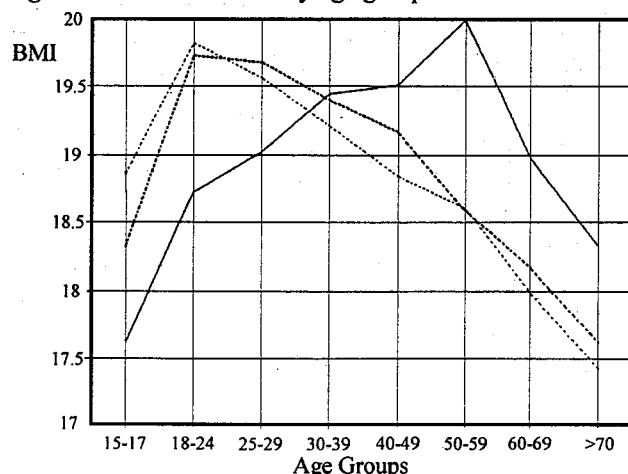
Age group	For all	Urban	Rural	Mountainous
15-17	17.919 ± 2.811 n = 2236	17.402 ± 2.007 n = 394	17.962 ± 3.114 n = 1488	18.357 ± 2.05 n = 333
18-24	19.397 ± 1.943 n = 3006	18.755 ± 2.118 n = 483	19.435 ± 1.904 n = 1975	19.877 ± 1.722 n = 520
25-29	19.682 ± 1.791 n = 2322	19.271 ± 1.911 n = 239	19.678 ± 1.719 n = 1653	19.87 ± 1.943 n = 400
30-39	19.603 ± 1.914 n = 3213	19.539 ± 2.087 n = 363	19.623 ± 1.892 n = 2347	19.54 ± 1.91 n = 459
40-49	19.476 ± 2.698 n = 1908	19.683 ± 4.129 n = 515	19.385 ± 1.897 n = 1142	19.372 ± 1.947 n = 224
50-59	19.129 ± 2.022 n = 1989	19.739 ± 2.337 n = 368	19.004 ± 1.943 n = 1341	18.956 ± 1.771 n = 265
60-69	18.75 ± 3.063 n = 1338	18.992 ± 2.412 n = 154	18.774 ± 3.37 n = 949	18.448 ± 1.864 n = 226
>70	17.942 ± 2.277 n = 711	17.887 ± 2.422 n = 95	18.059 ± 2.154 n = 495	17.504 ± 2.594 n = 119

Table 7. BMI of females by age groups

Age group	For all	Urban	Rural	Mountainous
15-17	18.261 ± 2.263 n = 2303	17.623 ± 2.002 n = 461	18.328 ± 2.36 n = 1501	18.861 ± 1.942 n = 331
18-24	19.609 ± 1.987 n = 4312	18.726 ± 1.957 n = 605	19.724 ± 1.964 n = 3031	19.823 ± 1.903 n = 636
25-29	19.599 ± 1.888 n = 2856	19.023 ± 2.015 n = 337	19.675 ± 1.857 n = 2086	19.561 ± 1.811 n = 381
30-39	19.363 ± 1.98 n = 3921	19.446 ± 2.204 n = 611	19.395 ± 1.927 n = 2781	19.206 ± 1.909 n = 469
40-49	19.22 ± 2.069 n = 2320	19.503 ± 2.227 n = 590	19.164 ± 1.933 n = 1446	18.841 ± 2.329 n = 261
50-59	18.691 ± 2.165 n = 2271	19.988 ± 2.556 n = 278	18.585 ± 2.069 n = 1691	18.605 ± 2.234 n = 294
60-69	18.244 ± 2.266 n = 1591	18.975 ± 2.624 n = 199	18.164 ± 2.153 n = 1166	17.983 ± 2.375 n = 219
>70	17.695 ± 2.335 n = 920	18.314 ± 2.726 n = 142	17.605 ± 2.276 n = 639	17.412 ± 2.044 n = 134

groups. In general, rice is the main cereal of the diet, the intake of other cereals, tubers, beans and nuts rich in lipid is low. The consumption of animal food as meat, fish, eggs and fat is higher in urban areas than in rural and mountainous areas (Tables 3 and 4). It should be mentioned that the average height and weight of urban residents is generally higher than that of rural and mountainous areas.

Figure 4. BMI of females by age group



BMI index of mothers and nutritional status of children younger than 5 years.

Data from Study 2 were analysed to establish the relationship between the BMI index of mothers and the nutritional status of their young children within different categories of BMI. There is a significant relationship between the two parameters (Table 8). Weight for age was used to assess nutritional status with the data from National Center for Health Statistics of United States (NCHS) as reference population⁶⁹ and classified as the first degree when below -2 SD, the 2nd degree when below -3 SD and the 3rd degree when below -4 SD of NCHS value.

Table 8. Relation between BMI of mothers and nutritional status of children younger than 5 years

Classification BMI	Normal	CED			Total
		I	II	III	
Weight by age					
Normal %	53.20	48.10	44.00	44.30	51.40
N	1162	324	77	35	1598
1st degree %	32.40	33.60	35.40	29.10	32.70
N	707	226	62	23	1018
2nd degree %	12.90	16.30	17.70	24.10	14.20
N	281	110	31	19	441
3rd degree %	1.60	1.90	2.90	2.50	1.70
N	34	13	5	2	54
Total %	70.20	21.60	5.60	2.50	
N	2184	673	175	79	3111

The relationship between the BMI of women and the economic status of their families was not significant. The economic status of families was classified into 3 categories (low, middle, high) according to data relating to their main properties-- house and precious goods, because accurate incomes are difficult to collect.

Effect of low BMI on health status

In study 3, carried out on 1990, we followed the change in food intake and mothers' weight gain during pregnancy, and recorded some biochemical indicators of nutritional status of the newborns including weight. The result of study 3⁶ indicated that the average gain in weight of mothers during pregnancy in rural areas is 6.4kg and in Hanoi City 8.5kg. The study also revealed a significant relationship between the weight of the new born and the pre-pregnancy BMI values of the mothers (Table 9).

Table 9. Relation between weight gained during pregnancy and birth weight for mothers grouped by pre-pregnancy BMI

Weight gained during pregnancy	Newborn weight (g) by mothers' BMI levels		P
	< 18.5	> 18.5	
< 8kg	2770 n = 21	3020 n = 34	< 0.01
> 8kg	2880 n = 19	3050 n = 40	< 0.05

Another study on the effect of parity on BMI in women at procreative age in two communities in rural North Vietnam has been carried out (N = 400; age 18-49 years). It shows that mothers with high parity more commonly have low BMI value⁷ (Table 10).

Summarising our results, since the WHO proposal in 1985¹, we have used BMI with WHO classification in our studies on nutritional status of adults. It shows that CED as indexed by BMI is quite prevalent in Viet Nam but more scientific measurements are needed to define levels and the cut-off value for CED.

Table 10. Relation between mothers' BMI and number of children.

Number of children	Percentage of BMI values			
	> 18.5	18.4-17.0	16.9-16.0	<16.0
1	55.6	35.5	7.3	1.6
2	51.7	37.4	8.2	2.7
3	40.6	46.9	9.1	3.7
> 4	39.3	46.0	12.2	2.6

We have found that:

1. BMI has relationships with age, sex, socioeconomic condition and pattern of food intake and is a good indicator of nutritional status and health development.
2. BMI decreases with age in rural populations but increases in urban ones. Such different patterns can be the result of various factors but are most likely linked to rural populations having little fat reserve and often a negative energy balance due to heavy physical work.
3. Body mass decreases with the number of pregnancies, independent of age.
4. These findings are important because the nutritional status of adults directly affects productivity, work performance and well-being of the community. It should be receive more attention in both methodology and practice.

Conclusion

By using the Body Mass Index (BMI) as an indicator for evaluation of nutritional status of adults, we find out:

1. The mean value of BMI of adults aged from 26 to 40 is about 19.7 kg/m² in both sexes, thereafter it decreases in rural areas.
2. CED is widespread in Vietnam according to the Ferro-Luzzi-James classification. The mean value of CED for

adults is about 40% but this percentage varies with age, sex and socioeconomic condition.

3. There is a significant relationship between the grade of CED in mothers and the nutritional status of their children younger than 5 years. Some findings also revealed a relationship between BMI and health status.
4. The proposed cut-off-point of Ferro-Luzzi-James in the classification of CED is useful for monitoring change.

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**飲食和體重指數 (BMI) 在評估越南成人營養狀況
(包括母親—子女分析) 的應用**

摘要

作者用飲食與體重指數去評估越南成人的營養狀況。慢性能量缺乏 (CED) 的越南成人平均約 40%。26-40 歲年齡組的平均 BMI 值為 19.7，除城市居民外，40 歲以後 BMI 下降。生活在農村、城市和山區的居民，其 BMI 曲線分佈的變化是不同的。母親的 BMI 與他們少於 5 歲的孩子營養狀況似有相關。某些發現揭示了母親 BMI 和嬰兒出生體重，和 CED 間的關係。作者根據 Ferro-Luzzi-James 的 CED 分類準則，並用在越南數據。

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