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□Original Article□

Validity of Weight and Height as a Nutritional Status Measurement for Adults in Kuri City

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ABSTRACT

Anthropometric measurements, particularly weight and height, are the most commonly employed measures of nutritional status in epidemiologic studies because of their simplicity and ease of collection. However, the usefulness of the anthropometric indicator is controversial. The aim of this study was to evaluate the usefulness of the anthropometric indicator to represent the nutritional status of individual adult in epidemiologic studies. In order to evaluate the usefulness of the anthropometric indicator to represent the nutritional status of individual, the validity in terms of sensitivity and specificity of anthropometric indicators was estimated by comparing the biochemical indicators to the reference indicators. The relative validity of dietary intake indicators was also measured for comparison between the three indicators of biochemistry, anthropometry and dietary assessment. The results showed that sensitivity of weight and height and dietary indicators were 16.7 and 50.5, respectively comparing the reference value of 100 as biochemical indicator in identifying anemic adults. Whereas the sensitivity of weight and height and dietary indicators were 63.6 and 36.4, respectively comparing reference value of 100 in identifying hyperlipidemic individuals(obesity). In conclusion, the validity of weight and height is much lower than that of biochemical indicator, but weight and height still has some usefulness in identifying anemic individuals. Especially, it is more useful in identifying hyperlipidemic individual adults than in identifying anemic individuals. (*J Community Nutrition* 1(1) : 39~43, 1999)

KEY WORDS : validity · weight and height · nutritional status.

Introduction

The most common objectives of the nutritional assessment of individuals is discovering the nutritional problems to suggest the need of health promotion of individuals through nutritional status improvement(Foltz et al. 1993 ; Habicht et al. 1982 ; Jeejeebhoy et al. 1990).

Nutritional status of individuals can be assessed by direct and indirect assessment. Dietary assessment is regarded as one of the indirect assessments of individuals' nutritional status(Jelliffee 1996). Biochemical assessment is regarded as the most objective way of measuring the nutritional status of individuals. For instance, serum cholesterol strongly predicts the risk of cardiovascular disease, although the association of serum cholesterol with dietary cholesterol is weak due to the influence of nondietary factors such as genetic variation, exercise, and obesity on serum cholesterol(Lee 1993 ; Zaky et al. 1996). However, employment of biochemical tests in assessing nutritional status of individual has been limited by many factors, including difficulties of collecting blood and urine samples and the high cost of analysis, and so on. Generally, biochemical tests are expensive and time-consuming to carry out especially in mass community surveys(Arroyave et al. 1982 ; Willet 1998 ; Yong et al. 1994). Anthropometric assessment, particularly that of weight and height, are the most commonly employed measures of nutritional status in epidemologic studies because of their simplicity and ease of collection(Jebb & Elia 1993). In adults, measurese of body dimension and body mass are used to represent nutritional status directly(Abe et al. 1994). However, the interpretation of anthropometric assessment of individuals in identifying the degree of malnutrition is always complex and often controversial(Gomez-Almaguer

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1998 ; Halton 1998 ; Revicki & Israel 1986 ; Weir 1998). The normal healthy well-fed human body can vary so much that interpretation of the nutritional significance in physical dimensions is peculiarly difficult. Therefore, the purpose of this study was the evaluation of the usefulness of weight and height to represent the nutritional status of individual adults in epidemiologic studies.

The usefulness of weight and height to represent the nutritional status of individuals was evaluated by measuring the relative validity of sensitivity and specificity(MacMahon & Pugh 1990). To measure the relative validity of weight and height, biochemical indicator was used as a reference measure of the nutritional status of individuals. The relative validity of dietary assessment indicators was also measured for comparison between three indicators of biochemistry, anthropometry and dietary assessment.

Materials and Methods

1. Study subjects

The study population included 52 participants aged 20–69 years who resided in Galmae-dong, Kuri City in Kyunggi province. The participants were drawn randomly from a population-based list of men and women in the area within the age group. The initial contact with the subjects was by telephone. At least, six phone calls were made before acceptance was confirmed. Participants were interviewed, measured and had blood samples taken between July and August 1998.

2. Methods of measurement taking

1) Weight and height

Weight was measured using a beam balance scale measuring up to a maximum of 200kgs with increments of 100grams. The subjects were allowed only to wear underwear with a weight of less than 100g. Readings were taken to the nearest 100grams. The height of the subjects was measured while the subjects stood on a flat surface by the scale with feet paralleled and with heels, buttocks, and shoulders touching the backboard. The subjects' head was to be held comfortably erect, with the lower border of the orbit of the eyes in the same horizontal plane as the opening of the canal into the ear(Jeejeebhoy 1998 ; Kirby & Dudrick 1994 ; William 1993). The subjects' arm was to be hanging loosely at their sides. Readings were taken to the nearest 0.1cm.

2) Biochemical test

For hemoglobin and cholesterol determination, trained clinical pathologists carried out blood sampling. The Hitachi 747 Blood Autoanalyser was used for the determination of serum hemoglobin and cholesterol.

3) Dietary assessment

A trained dietary interviewer conducted a 24-hour dietary recall method for three consecutive days on the subjects. Detailed information about everything that the subject had to eat and drink over the previous 24 hours had been collected. Then the nutrient intake was calculated based on the database of the Food Composition Table (The Office of Rural Development 1991). The computer program, "Nutrition Assessment System" which was developed by Seoul National University was used for the nutrient estimation for dietary data.

3. Data analysis

1) Data set required for the estimation of relative validity and cut-off point of each indicator

Tha data set required to estimate the relative validity between the nutrition indicators for undernutrition identification was ; (1) anemia prevalence based on hemoglobin(biochemical indicator), (2) prevalence of underweight based on body mass index(anthropometric indicator), (3) prevalence of deficiency in iron consumption based on dietary assessment(dietary indicator). Another data set required to estimate the relative validity between nutrition indicators for identification of overnutrition was ; (1) prevalence of hyperlipidemia based on serum cholesterol, (2) prevalence of obesity based on body mass index(BMI), (3) prevalence of overconsumption of cholesterol based on dietary assessment.

Table 1 below shows the cut-off point of each of the indicator for malnutrition determination.

2) Estimation of relative validity

Validity refers to the extent to which a situation as observer reflects the "true" situation, or the situation as evaluated by other criteria that are thought to reflect the true situation more accurately. In the present context the term was used to refer to the extent to which subjects in an alternative indicator(weight and height or dietary assessment) are correctly identifying as to the presence or

Table 1. Criteria of cut-off point for nutrition indicators

Nutrition indicator	Nutrition status	Measurement	Cut-off point		
			Male	Female	Sex combined
Biochemical indicator	Anemia	Hemoglobin(g/100ml)	< 13	< 12	
	Hyperlipidemia	Cholesterol(mg/100ml)			> 240
Anthropometric indicator	Underweight	Body mass index			< 20
	Obesity	Body mass index			> 25**
Dietary indicator	Iron deficiency	Iron intake			< 50% RDA*
	Over cholesterol	Cholesterol intake			< 80 percentile

*RDA : Recommended Dietary Allowances
**Based on Cut-off point used by HANES(1995)

absence of malnutrition(anemia or hyperlipidemia) comparing the biochemical indicator as an reference indicator.

Sensitivity and specificity were the two components measuring the validity. Sensitivity is the extent to which subjects who are truly malnourished are so classified. Specificity is the extent to which subjects who are not malnourished are correctly classified.

Mathematical description of :

sensitivity=[subjects who are classified as malnourished by the alternative test(weight and height or dietary assessment) / subjects who are classified as malnourished by biochemical assessment]×100.

specificity=(subjects who are classified as not malnourished by alternative assessment / subjects who are classified as not malnourished by biochemical assessment)× 100.

3) Statistical analysis

The chi-square test was carried out to test the association between the prevalence estimated by biochemical assessment and by alternative assessment.

Data processing was carried out using the Statistical Analysis System(SAS) computer program.

Statistical analysis was performed using the microcomputer software program, software of SAS. Results were considered to the statistical significance at $\alpha < 0.05$.

Results and Discussion

1. General characteristics of study subjects

Table 2 shows the age and sex distribution of the study subjects. 59.6% of the subjects were female and 59.6% of the subjects were in their fifties. This distribution implies that the majority of participants were aged female subjects.

2. Weight and height

The mean weight and height of female subjects was 54.2kg and 153.8cm respectively(Table 2). The mean value was lower than that of National Nutrition Survey (Health and Social Welfare Department 1995). The aged characteristics of the study subjects may contribute to the lower mean value. The mean weight and height of male subjects was 53.8kg and 153.2cm, respectively. The values were similar to those of the National Nutrition Survey.

Table 2. Age and sex distribution of study subjects

unit : person(%)

Sex \ Age	20 – 29	30 – 39	40 – 49	50 – 59	Total
Male	1	2	6	12	21(40.4)
Female	2	3	7	19	31(59.6)
Total	3(5.8)	5(9.6)	13(25.0)	31(59.6)	52(100.0)

Based on BMI, 0.6% of the study subjects were underweight and 40.4% of them were obese.

3. Dietary assessment

The average energy intake of male subject was 1,604kcal, this value was similar to that of the National Nutrition Survey(1,770kcal). Whereas the mean energy intake of the average female subject was 1,200kcal which was far lower than the results of the National Nutrition Survey. Similar findings were observed in most of the nutrient intakes of female subjects. Vitamin C and thiamin were the only two nutrient areas of consumption that showed more than Korean Recommended Dietary Allowances(Korean Nutrition Society 1995). Based on the recommended dietary allowance or iron, 46.2% of the study subjects had an iron deficiency and 20.6% of the subjects belonged to the overconsumption category(Table 3).

4. Biochemical test

11.5% of the subjects belonged to the anemia category and 21.1% of the subjects had hypercholesterolemia (Table 5).

5. Association between indicators

The association between weight and height and the biochemical indicator was statistically significant(Table 4) in identifying anemic individuals. The association was also significant in hyperlipidemia identification. The association between the dietary indicator and the biochemical indicator was also statistically significant in both the identification of anemic and hyperlipidemic individuals.

6. Relative validity between nutritional status indicators

Regarding the validity of the biochemical indicator as 100, the relative validity(based on sensitivity) of weight and height in identifying anemic individual was only 16.7. The relative validity of the dietary indicator in identifying iron deficiency was 50.5. These results may imply that dietary assessment was more useful than weight and height as an alternative method of biochemical assessment in identifying the anemic adult. Whereas for the identification of hyperlipidemia, the relative validity of weight and height was 63.6 and that of dietary indicator was 36.4 comparing the reference indicator of biochmical assessment(Table 5). The above two findings imply that both weight and height and dietary assessment had a lower ability in identifying the malnourished adult individuals than that of biochemical assessment. And in identifying anemic adults, dietary assessment is more useful than weight and height as an alternative method of biochemical testing. However, weight and height is a more useful tool in identifying the hyperlipidemic adults than dietary assessment. Dietary assessment, however, is an alternative method of biochemical assessment.

The word 'indicator' itself is defined in dictionaries as 'that which serve as an indication of something'. A normal characteristic of an indicator is that it is used to show a number of different aspect of the performance of a system. Nutritional status indicators based on weight and height are to some extent shorthand indicators. Weight and height are taken as estimates of body nutrition stores. But in addition, weight and height are most commonly used as proxies for 'nutritional status' an imprecise notion that covers the outcome of a wide range of different processes, including the effect of different nutritional deficiencies, and of non-nutritional factors such as infection. Similarly, biochemical indicators such as serum iron and serum cholesterol show information about both

Table 3. Mean nutrition intake of study subjects (% RDA*)

Nutrient	Male		Female	
Calorie(kcal)	1604.2 ± 145.7	(69.9)	1200.7 ± 103.2	(62.3)
Protein(g)	54.3 ± 6.7	(73.6)	36.9 ± 3.8	(61.5)
Fat(g)	25.8 ± 4.5		16.8 ± 2.7	
Carbohydrate(g)	265.1 ± 23.4		218.9 ± 18.3	
Vitamine C(mg)	85.2 ± 8.0	(154.8)	64.9 ± 9.0	(118.1)
Thiamine(mg)	1.0 ± 0.1	(102.9)	0.8 ± 0.1	(80.0)
Riboflavin(mg)	0.7 ± 0.2	(55.7)	0.5 ± 0.1	(50.0)
Niacin(mg)	11.5 ± 1.7	(74.7)	7.8 ± 1.2	(60.4)
Calcium(mg)	430.0 ± 109.6	(61.4)	293.2 ± 49.4	(41.9)
Phosphorus(mg)	747.6 ± 116.1	(106.8)	562.2 ± 60.7	(80.3)
Iron(mg)	8.3 ± 1.5	(69.5)	6.6 ± 0.8	(48.7)

*RDA : Recommended Dietary Allowances of Korean

Table 4. Association beween anthropometric indicator and biochemical indicator Unit : Person(%)

Anthropometic indicator (based on BMI)	Biochemical indicator (based Hemoglobin)		Total	χ^2
	Anemia	Normal		
Undernutrition	1(2.0)	2(3.8)	3(5.8)	
Normal	5(9.6)	44(84.6)	44(94.2)	4.81*
Total	6(1.2)	46(98.8)	52(100)	

*$p<0.05$

Table 5. *Estimated relative validity between nutrition indicators*

Measurement	Nutrition indicator(prevalence)	Measurement	Prevalence	Relative validity(%)	
				Sensitivity	Specificity
Biochemical test	Anemia prevalence	Hemoglobin	11.5% (A_1)	$A_1=100$	$A_1=100$
	Hyperlipidemia	Cholestrol	21.1% (B_1)	$B_1=100$	$B_1=100$
Anthropometry	Under weight	BMI*	0.6% (A_2)	$A_2=16.7$	$A_2=95.6$
	Obesity prevalence	BMI	40.4% (B_2)	$B_2=63.6$	$B_2=65.8$
Dietary assessment	Iron deficiency	RDA**	46.2% (A_3)	$A_3=50.0$	$A_3=58.7$
	Iron overconsumption	RDA	20.6% (B_3)	$B_3=36.4$	$B_3=85.4$

*BMI : Body Mass Index (weight : Kg) / (height : m)^2 **RDA : Recommended Dietary Allowances
A_1 : Biochemical indicator based on anemia prevalence B^1 : Biochemical indicator based on hyperlipidemia
A_2 : Anthropometric indicator based on underweight prevalence B_2 : Anthropometric indicator based on obesity prevalence
A_3 : Dietary indicator based on deficiency prevalence of iron consumption
B_3 : Dietary indicator based on overconsumption prevalence of iron

state and flow of nutritional status. Nutrient intake per day is a flow measurement but it is commonly taken also as a shorthand indicator of current or likely future nutritional status(Dowler et al. 1982). Therefore selection of Nutritional status indicator should be done based on the purpose of the indicator to be used.

Summary and Conclusion

The validity of weight and height is much lower than that of biochemical indices, but the nutritional status indicator still has some usefulness in identifying malnourished individuals. Especially, it is more useful in identifying hyperlipidemic adults than in identifying anemic ones.

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