Original Article

Alternative anthropometric measurements for the Thai elderly: Mindex and Demiquet

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This cross-sectional study examined the relationship between alternative anthropometric indices and the nutritional and metabolic status of the Thai elderly. Four rural communities, each from the 4 main regions of Thailand were surveyed. A total of 2324 subjects, 60 years old and over were included in the study. Mindex and Demiquet had a very strong relationship to body mass index with the r values of 0.93 and 0.88, respectively. Fat weight had the highest correlation with body mass index in older women, r = 0.94 (P<0.001) and with Mindex, r = 0.93 (P<0.001). In regard to anthropometric measurements, the mid-arm circumference had the strongest relationship to all three Quetelet indices, r = 0.76-0.87 (P<0.001), while subscapular skinfold thickness performed best among skinfold measurements, r = 0.69-0.74 (P<0.001). BMI achieved a significantly higher degree of correlation with triceps and supra-iliac skinfold thickness, mid-arm circumference and fat weight than Demiquet (P<0.001 for all variables). The lymphocyte count was the only laboratory test that related rather well to all three Quetelet indices. All three Quetelet indices had nearly the same pattern of relationship to various nutritional parameters. The cut-off points of Mindex denoting under-nutrition, overweight and obesity I in women were 55.95, 69.55 and 75.60 kilogram/metre, respectively. At the same time, the cut-off points of Demiquet denoting under-nutrition, overweight and obesity I in men were 75.60, 93.98 and 102.16 kilogram/metre^2, respectively. All this information supports the benefit of using Mindex and Demiquet as alternatives to body mass index for nutritional assessment in older Asian people, especially for the malnourished ones.

Key Words: Mindex, Demiquet, anthropometric, elders, rural, Thai

Introduction

Apart from nutritional assessment, there is an increasing use of anthropometric indices among older people to predict physical functions and mobility.[1] According to a recommendation given by the Report of a WHO Expert Committee on the use of anthropometry in the elderly in 1995, future research should seek a better index than body mass index (BMI) which would be one in which body weight is related to some parameters other than height.[2] The three main reasons for the disadvantage of BMI are, firstly, the loss of height with age due to age-related osteoporosis, kyphoscoliosis and degenerative disc changes, secondly the inconvenience of measuring height in non-ambulant elderly patients or those who may not be able to stand erect with their eyes at right angles to the ground and, finally, an increase in the fat to lean ratio in older people.[3]

The COMA committee (1992) recommended that a demi-span measurement should be included in all nutritional surveys of older people as it declines less with age than does height.[4] According to a survey in 890 men and women aged over 65 years, weight has been shown to increase proportionately with arm-span squared in men and arm-span in women.[5] Two alternative anthropometric measurements designed for older men (Demiquet = body weight divided by arm-span squared) and older women (Mindex = body weight divided by arm-span) were sequentially developed.[5]

Although there were some studies indicating the usefulness of Demiquet and Mindex in older adults,[6-7] there is a paucity of population-specific reference data for older Asian people. Even the anthropometric reference data for assessing the nutrition of elderly people in Britain could not be used in Edinburgh.[8] In addition, because the body mass index has been widely used, to verify the validity of these alternative measurements for older Thai adults needs the study of the relationship patterns of correlation between these two alternative measurements and the standard one,

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body mass index, to other nutritional parameters specifically relating to older Thai people.

Although abdominal obesity is well recognized as the main risk factor of metabolic syndrome and waist circumference can be easily measured, the alternative Quetelet indices, if their validity is proved, can still be useful for nutritional assessment in a malnourished older adult.

Materials and methods

This cross-sectional study was done after it was approved by the Research Committee of Mahidol University. The whole project finished in the year 2000. One district in each of the four regions of the country was randomly selected, namely, Huay-Plu District in Nakorn Pathom Province representing the central region, Hang-Chat District in Lumpang Province representing the northern region, Muang District in Sakolnakorn Province representing the northeastern region and Graburi District in Ranong Province representing the southern region. Approximately 500 older people aged 60 years old and over in each region were randomly recruited, leading to a total number of 2336 subjects. Twelve subjects were excluded due to an inability to stand erect, resulting in a total number of 2324 subjects. However, because the survey was done separately in each region, and was subject to the availability of human resources and laboratory services, the number of each laboratory tests varied. After background characteristics were assessed, the subjects underwent anthropometric measurements and body composition analysis as well as blood tests to measure biochemical data and various vitamin levels, namely, vitamin A, beta-carotene, thiamin, cyanocobalamin, folic acid, ascorbic acid and α-tocopherol.

Weight was measured to the nearest 0.1 kilogram in the morning before breakfast, with the subject clothed only in light clothes. Calibrated balancing scales placed on firm ground were used. Standing height was measured to the nearest 0.1 cm. with the examinee wearing no shoes, standing straight on a horizontal surface with the heels together, the shoulders relaxed, arms at the sides and the head in the Frankfort horizontal plane. The height scale was attached to the weighing scale so the subject would have weight and height measured at the same time. To measure demi-span, the examinee stood against a flat wall, with the arms extended laterally and kept at shoulder height during the measurement. A standard measuring tape approved by the Ministry of Commerce, number: 11596-25 at least 2 metres long, was used. The starting point was at the center of the suprasternal notch stretching laterally and ending at the metacarpophalangeal joint between the third and fourth fingers. The reading was recorded to the nearest 0.1 cm. Sequentially, Demiquet and Mindex could be calculated as follows:[5]

Demiquet (for older men) = body weight (kilogram)/ demi-span (metre)^2

Mindex (for older women) = body weight (kilogram)/ demi-span(metre)

The circumference of the upper arm (mid-arm circumference) was measured at its mid-point, located after bending the right elbow at a 90^o angle and placing the forearm palm down across the trunk. By placing a measuring tape between the tip of the acromion process and the tip of the olecranon process, the mid-point of the upper arm could be identified. The right arm was then extended alongside the body, with the palm facing upwards. At this mid-point the tape was pulled snug around the arm without compressing the tissue. The circumference was recorded to the nearest 0.1 cm. Mid-arm muscle circumference (MAMC) has been used widely as a simple measure of lean body mass using the formula:

MAMC = mid-arm circumference - (π x triceps skinfold)

Subcutaneous skinfold thickness was determined at four sites, namely, the triceps, biceps, subscapular and supra-iliac skinfold. A trained nutritional nurse who was skilled in using the Hapenden skinfold caliper did all these measurements throughout the study to avoid any inter-observer bias. The Hapenden skinfold caliper was calibrated before being used in the morning; three successive measurements within 0.5 cm. of each other were required before the actual reading was recorded to the nearest 0.1 mm.

Body composition was measured by the near-infrared interactance technique and computerized spectrophotometer, Futrex-5000/XL®, approved by Human Performance Centers, USA, during the survey.[9] Optical Standard and Light Shield were used for zero adjustment and to ensure that no external light interfered with the measurement of body fat. The measurement point was located at halfway between the antecubital fossa and the acromion at the belly of the biceps muscle.

All the biochemical measurements and complete blood count were done on the day of venipuncture. Low density lipoprotein (LDL) cholesterol was calculated by Friedewald equation if triglyceride was below 400 mg/dl.[10] Whole blood and serum were kept at -20^{o}C before the laboratory measurement of all vitamin levels which were completed within 6 weeks after the day of venipuncture. Vitamin A, beta-carotene, ascorbic acid and α-tocopherol were measured by an isocratic high performance liquid chromatography.[11] Erythrocyte transketolase activity and the thiamin pyrophosphate effect (TPP) were used to identify thiamin status.[12] A microbiological assay using Lactobacillus casei ATCC 7469 was used to measure the folic acid level.[13] Since red cell folate reflects the tissue level of folic acid, it was also included in the analysis. The laboratory technique used in the cyanocobalamin measurement was a radioisotope dilution and coated charcoal technique.[14] Serum ascorbic acid was measured by a high performance liquid chromatography.[15]

SPSS version 10.0 was the main statistical package for statistical analysis and the level of statistical significance was set at *P* value of less than 0.05. The Pearson product moment correlation coefficient was used to establish a relationship between the two measurements. A very good to excellent relationship was achieved if the correlation coefficient (r) was greater than 0.75.[16] As the number of each variable studied varied, the statistical analysis of the correlation between each group of nutritional parameters and Quetelet indices was done separately according to the availability of the data. In addition, the degree of correlation between the Quetelet indices and the nutritional and metabolic status were also compared individually between BMI and the alternative anthropometric indices by the MedCalc statistical program.

Results

The age range and mean age of overall subjects were 60-97 and 68.93 ± 6.75 years old. The ratio of male to female was 885: 1439 (1:1.63). The percentages of participants from the central, northeastern, northern and southern regions were 26.1%, 25.3%, 25.5% and 23.1%, respectively. Around fifty-seven percent still lived with their spouses while 6.4% lived alone. Regarding the educational background of the subjects, 24.6% had never been to formal school and 65.8% achieved only a primary education.

Although 14.4% had a satisfactory financial status, 18.6% admitted that they had inadequate income for daily life. As far as the underlying medical conditions were concerned, 45.1% suffered from arthralgia, 18.2% had chronic hypertension and 6.4% had diabetes mellitus while up to 74.8% revealed that they had a chronic illness.

As far as the gender difference was concerned, some nutritional variables were higher among the older female adults with statistical significance (P<0.001), namely, body mass index, all skinfold thickness measurements, cholesterol, triglyceride, low-density lipoprotein (LDL), fat weight and percent of body fat. The variables which were lower among the older women with statistical significance (P<0.001) were mid-arm muscle circumference, hemoglobin, uric acid and lean weight. The ones without statistically significant differences were lymphocyte count, blood glucose, albumin, globulin and high-density lipoprotein (HDL). Of all vitamin levels, only folic acid levels in both serum and red cell, beta-carotene and α-tocopherol were significantly higher among older women (P<0.01). The 5^{th},50^{th} and 95^{th} percentiles of BMI in men were 16.1, 21.4 and 28.8 kilogram/metre^2 and in women 16.2, 22.8 and 30.8 kilogram/metre^2, respectively. Accordingly, the 5^{th},50^{th} and 95^{th} percentiles of Demiquet were 59.4, 88.1 and 123.6 kilogram/metre^2 while they were 45.7, 69.3 and 96.8 kilogram/metre for Mindex. Both Demiquet and Mindex had an excellent relationship with BMI with the r value of 0.88 and 0.93, respectively (Table 2). Regarding the pattern of degree of correlation with various skinfold thicknesses, all three Quetelet indices had the same pattern, i.e., the correlation coefficient was the highest at the subscapular site while it was the lowest at the biceps site. Mid-arm circumference achieved the highest correlation with BMI in men (r = 0.85), BMI in women (r = 0.86), Demiquet (r = 0.76) and Mindex (r = 0.87). When the alternative Quetelet indices and BMI were compared in terms of their correlation with skinfold thickness, BMI achieved a higher degree of correlation than Demiquet, significantly at triceps and supra-iliac skinfold thickness and mid-arm circumference.

Table 1. Characteristics of subjects recruited during each correlation study regarding anthropometry, blood tests, body composition and vitamin measurements.

	Male		Female	
	N	mean ± SD	*N*	mean ± SD
Body mass index (kg/m^2)	644	21.54 ± 3.99	1013	22.76 ± 4.45
Demiquet (kg/m^2)	644	86.74 ± 20.22	n/a	n/a
Mindex (kg/m)	n/a	n/a	1013	68.27 ± 15.48
Triceps skinfold thickness (mm)	644	9.91 ± 4.81	1013	16.12 ± 7.23
Biceps skinfold thickness (mm)	644	5.10 ± 2.76	1013	8.43 ± 5.19
Subscapular skinfold thickness (mm)	644	13.82 ± 6.68	1013	16.08 ± 7.95
Suprailiac skinfold thickness (mm)	644	14.07 ± 9.73	1013	18.40 ± 10.30
Mid-arm circumference (mm)	644	267.9 ± 36.4	1013	270.8 ± 40.4
Mid-arm muscle circumference (mm)	644	236.7 ± 28.4	1013	220.2 ± 27.0
Hemoglobin (gm/dl)	403	14.49 ± 1.82	597	13.04 ± 1.66
Lymphocyte count	403	2845.7 ± 1046.2	597	2993.5 ± 1082.8
Blood glucose (mg/dl)	729	103.7 ± 38.1	1177	105.7 ± 42.4
Cholesterol (mg/dl)	729	221.1 ± 54.4	1177	240.7 ± 52.0
Triglyceride (mg/dl)	729	168.4 ± 86.1	1177	184.7 ± 94.6
High-density lipoprotein (mg/dl)	729	40.39 ± 12.21	1177	41.15 ± 13.01
Low-density lipoprotein (mg/dl)	729	147.4 ± 51.0	1177	162.7 ± 50.4
Albumin (gm/dl)	729	4.25 ± 0.54	1177	4.27 ± 0.48
Globulin (gm/dl)	729	3.53 ± 0.62	1177	3.59 ± 0.61
Uric acid (mg/dl)	404	6.50 ± 1.65	588	5.89 ± 1.65
Fat weight (kg)	813	16.01 ± 6.46	1311	20.66 ± 6.40
Lean weight (kg)	813	38.87 ± 6.61	1311	29.99 ± 5.52
Percent of body fat (%)	813	28.35 ± 6.69	1311	40.12 ± 5.29
Thiamin pyrophosphate effect (%)	567	12.35 ± 7.93	896	11.74 ± 8.19
Serum folate (ng/dl)	567	4.76 ± 4.32	896	5.89 ± 5.48
Red cell folate (ng/dl)	567	261.0 ± 129.6	896	287.1 ± 130.9
Cyanocobalamin (pg/dl)	567	673.2 ± 247.9	896	689.9 ± 230.5
Ascorbic acid (mg/dl)	567	1.11 ± 0.53	896	1.07 ± 0.54
Beta-carotene (μg/dl)	567	10.06 ± 14.15	896	12.86 ± 15.96
Vitamin A (μg/dl)	567	66.93 ± 34.05	896	65.12 ± 32.45
α – tocopherol (μg/dl)	567	549.7 ± 340.0	896	604.1 ± 367.2

Meanwhile, there was no significant difference between BMI and Mindex in this regard (Table 2). This indicated that Mindex was a better index of obesity than Demiquet.

In respect to the correlations between Quetelet indices and blood chemistry and hematological results, Demiquet and Mindex had a higher degree of correlation with these parameters than BMI did. However, both of the alternative Quetelet indices correlated to albumin and globulin in a higher degree than BMI did with statistical significance (Table 3).

All variables of body composition analysis by the near infrared interactance technique revealed a very strong relationship with all three Quetelet indices, giving rise to the r value ranging from up to 0.94 between fat weight and BMI in older women to 0.55 between the percentage of body fat and Demiquet. In general, the highest degree of correlation was revealed between fat weight and all three Quetelet indices. The lower degree of correlation was seen between all three Quetelet indices and lean weight and percentage of body fat, respectively.

However, when the alternative Quetelet indices and BMI were compared in terms of their correlation with fat weight and percent of body fat, BMI performed significantly better than the alternative Quetelet indices (Table 4). On the other hand, Mindex achieved a significantly higher degree of correlation with lean body weight than BMI.

Of all hematological measurements and blood chemistry, the lymphocyte count related best to all three Quetelet indices with the highest correlation coefficient by Demiquet (r=0.37). Hemoglobin had the poorest relationship with BMI in older men (r=0.12). Blood cholesterol and LDL had the best relationship with all three Quetelet indices both in men and women more than any other biochemical variables. In contrast, globulin and HDL had the poorest inverse relationship to all three Quetelet indices both in men and women. Likewise, all the vitamin levels had little or no relationship to all three Quetelet indices ($r < 0.25$). Most of them also had inverse relationships, especially in older women.

Table 2. The Pearson correlation coefficients of body mass index, Mindex and Demiquet with various anthropometric measurements. The comparisons of correlation coefficients of BMI and Demiquet and Mindex to other anthropometric measurements were also shown in the *P* value column

	Male *N* = 644			Female *N* = 1013		
	BMI	Demiquet	*P*	BMI	Mindex	*P*
BMI	n/a	0.88*	-	n/a	0.93*	-
Mid-arm circumference	0.85*	0.76*	<0.001	0.86*	0.87*	0.372
Subscapular skinfold thickness	0.74*	0.69*	0.066	0.72*	0.74*	0.336
Mid-arm muscle circumference	0.71*	0.66*	0.091	0.69*	0.72*	0.180
Triceps skinfold thickness	0.70*	0.59*	<0.001	0.71*	0.69*	0.378
Supra-iliac skinfold thickness	0.70*	0.59*	<0.001	0.72*	0.73*	0.636
Biceps skinfold thickness	0.60*	0.59*	0.782	0.65*	0.65*	1.0

* $P < 0.001$

Table 3. The Pearson correlation coefficients of body mass index, Mindex and Demiquet with blood chemistry and hematological measurements. The comparisons of correlation coefficients of BMI and Demiquet and Mindex to blood chemistry and hematological measurements were also shown in the *P* value column

	Male *N* = 403			Female *N* = 597		
	BMI	Demiquet	*P*	BMI	Mindex	*P*
Hemoglobin	0.12*	0.18**	0.385	0.23**	0.28**	0.357
Lymphocyte count	0.25**	0.37**	0.060	0.31**	0.35**	0.439
	N = 729			*N* = 1177		
Blood glucose	0.23**	0.27**	0.416	0.15**	0.19**	0.318
Cholesterol	0.27**	0.37**	0.034	0.27**	0.31**	0.290
Triglyceride	0.27**	0.21**	0.225	0.14**	0.15**	0.805
High-density lipoprotein	-0.22**	-0.23**	0.841	-0.09**	-0.13**	0.327
Low-density lipoprotein	0.25**	0.37**	0.011	0.24**	0.29**	0.193
Albumin	0.27**	0.42**	0.001	0.19**	0.27**	0.041
Globulin	-0.05	-0.16**	0.033	-0.10*	-0.19**	0.026
Uric acid	0.18**	0.21**	0.552	0.15**	0.14*	0.805

** $P < 0.001$ * $P < 0.02$

Table 4. The Pearson correlation coefficients of body mass index, Mindex and Demiquet with body compostion measurements. The comparisons of correlation coefficients of BMI and Demiquet and Mindex to body composition measurements were also shown in the *P* value column

	Male *N* = 813			Female *N* = 1311		
	BMI	Demiquet	*P*	BMI	Mindex	*P*
Fat weight	0.83*	0.74*	<0.001	0.94*	0.93*	0.042
Lean weight	0.65*	0.69*	0.144	0.77*	0.87*	<0.001
Percent of body fat	0.68*	0.55*	<0.001	0.69*	0.58*	<0.001

* $P < 0.001$

Table 5. The Pearson correlation coefficients of body mass index, Mindex and Demiquet with various vitamin level measurements. The comparisons of correlation coefficients of BMI and Demiquet and Mindex to various vitamin levels were also shown in the *P* value column

	Male *N* = 567			Female *N* = 896		
	BMI	Demiquet	*P*	BMI	Mindex	*P*
Thiamin pyrophosphate effect	-0.09*	-0.22*	0.025	-0.10*	-0.16*	0.197
Serum folate	0.11*	0.04	0.237	-0.09*	-0.15*	0.198
Red cell folate	0.07	0.07	1.0	-0.04	-0.05	0.832
Cyanocobalamin	-0.02	0.03	0.401	-0.004	0.02	0.612
Ascorbic acid	-0.01	-0.08	0.239	-0.03	-0.05	0.672
Beta-carotene	0.01	0.06	0.400	-0.02	-0.01	0.833
Vitamin A	-0.08	-0.20*	0.040	-0.10*	-0.18*	0.085
α - tocopherol	0.03	-0.10*	0.029	-0.08*	-0.15*	0.134

* $P < 0.05$

Discussion

Mindex and Demiquet are good alternative indicators of nutritional status as they are based on the concept that the relationship between arm-span and weight remain constant in older adults with normal morphology, since weight has been shown to increase proportionately with arm-span squared in men and arm-span in women.[5] According to the study by White *et al*, the changes in both Mindex and Demiquet with age are similar to those seen for BMI.[17] However, due to the ethnic differences leading to different body architecture, to adopt these alternative indices for practical use during nutritional assessment in Asian older adults needs specific study done in older Asian people. Compared to BMI, the current standard method, our results revealed that both Mindex and Demiquet had nearly the same pattern of relationship to various nutritional parameters as BMI had. In addition, both of them achieved an excellent relationship to BMI with the r value of 0.93 (P<0.001) and 0.88 (P<0.001), respectively. There was a study in Canada which also reported the same high degree of relationship, r = 0.96 and 0.81.[18]

In view of the poorer correlations between the alternative Quetelet indices and skinfold thickness and fat weight compared to the correlations between BMI and skinfold thickness and fat weight, these two alternative Quetelet indices did not perform as well as BMI in terms of their correlation with obesity indices, but performed better than BMI as general nutrition and metabolic indices, i.e., serum albumin, serum globulin and lean body weight. Our results also agreed with those reported by White *et al.*, which suggested that Mindex was a better index of obesity than Demiquet.[17] Although waist circumference is a better index of obesity than BMI,[19] to measure waist circumference in older people with severe kyphoscoliosis or those who are bed-ridden might be subject to error.

According to the Asia-Pacific regional guideline on using BMI, which suggests the cut-off points of $\leq$ 18.5, $\geq$ 23 and $\geq$ 25 kg/m^2 denoting under-nutrition, overweight and obesity I, respectively, for Asian people,[20] we can use these cut-off points of BMI to reveal the cut-off points of Mindex and Demiquet from our population data. Because the calculation formula for BMI, Demiquet and Mindex involve body weight, such an equation can be constructed as shown below.

$$\text{body weight} = \text{BMI} \times (\text{height})^2 = \text{Demiquet} \times (\text{demi-span})^2 = \text{Mindex} \times \text{demi-span}$$

$$\text{therefore, Demiquet} = (\text{height}^2/\text{demi-span}^2) \times \text{BMI}$$

$$\text{Mindex} = (\text{height}^2/\text{demi-span}) \times \text{BMI}$$

The mean value of height^2/demi-span^2 for men was 4.0863 while the mean value of height^2/demi-span for women was 3.0241. Sequentially, the cut-off points of Mindex denoting under-nutrition, overweight and obesity I in women were 55.95 (3.0241 x 18.5), 69.55 (3.0241 x 23) and 75.60 (3.0241 x 25) kilogram/metre, respectively. At the same time, the cut-off points of Demiquet denoting under-nutrition, overweight and obesity I in men were 75.60 (4.0863 x 18.5), 93.98 (4.0863 x 23) and 102.16 (4.0863 x 25) kilogram/metre^2, respectively.

For the purpose of widespread use of screening tools even in a primary health care setting, the best one should be practical and reliable as well as economical. Mindex and Demiquet measurements obviously meet these requirements especially in those whose height can not be validly measured, as in cases of severe osteoporosis and bed-ridden status. To measure arm-span with a measuring tape is still much more convenient than to measure height or knee height, since the measuring tape is much cheaper, smaller, lighter and even easier to carry in the pocket than the cumbersome wood board to measure height and knee height. Although skinfold thickness and its derivatives, e.g mid-arm muscle circumference, are also good indicators, its use is certainly limited to the research area due to its poor reliability with unskilled users. In addition, the altered compressibility of subcutaneous tissue has also been noted in some older persons as well as significant diurnal variations in skinfold thickness measurement, which may be attributed to observer error.[21]

BMI, Demiquet and Mindex were poorly related to various vitamin levels. These findings agreed with those found in a study in Aberdeen which showed that all three Quetelet indices were poor predictors of low micronutrient status.[22] In conclusion, Mindex and Demiquet may be the ideal indices for older Asian people since they have the same pattern of relationship to other nutritional indices as BMI does while at the same time overcoming some significant disadvantages of BMI in the elderly. These alternative Quetelet indices perform best when they are used to screen for malnourished older people rather than the obese ones.

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Original Article

The study of alternative anthropometric measurements for the Thai elderly: Mindex and Demiquet

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泰國老年人替代性體位測量方法: Mindex及Demiquet之研究

此橫斷性研究評估泰國老人之替代性體位指標、營養及代謝狀況之間的相關性。本研究調查泰國四個主要區域之四個鄉村社區，總共有2324名≥60歲的老年人納入研究。Mindex及Demiquet與身體質量指數之間具非常強的相關，相關係數分別為0.93及0.88。年齡較大的婦女其體脂重與身體質量指數之相關最高，相關係數為0.94 (*P*<0.001)，與Mindex之相關係數為0.93 (*P*<0.001)。就體位測量而言，中臂圍與三個Quetelet指數之相關最強，相關係數在0.76-0.87 (*P*<0.001)之間；而皮脂厚度的測量中以肩胛骨下皮脂厚度表現最好，相關係數在0.69-0.74 (*P*<0.001)之間。身體質量指數與三頭肌及腸骨上皮脂厚度、中臂圍及體脂重的相關程度顯著高於Demiquet (所有變項*P*<0.001)。淋巴球數是唯一與三個Quetelet指數相關還算良好的實驗室檢驗值。三個Quetelet指數與不同的營養相關的參數有幾近相同的模式。女性Mindex在營養不足、過重及肥胖I的切點分別為55.95、69.55及75.60 公斤/公尺；男性Demiquet在營養不足、過重及肥胖I的切點分別為75.60、93.98及102.16公斤/公尺。所有的訊息均支持Mindex及Demiquet當作一個替代身體質量指數來評估亞洲地區的老年人的營養狀況的優勢，尤其是營養不良的老人。

關鍵字：Mindex、Demiquet、體位、老年人、鄉村、泰國。