Use of body mass index of adults in assessing individual and community nutritional status

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Adult malnutrition is much more widespread than is commonly recognized. Described in this article is the use of body mass index (BMI = weight in kg/(height in metres)^2) as a measure of adult nutritional status, both of individuals and of communities. Concurrent assessment of the nutritional status of children and adults permits conclusions to be drawn about whether there is generalized undernutrition in a community or whether other factors (e.g., childhood infections or feeding practices) are more important in childhood malnutrition. Included is a tabular presentation that permits rapid assessment of both thinness or underweight (BMI values < 16, 17 and 18.5) and overweight (BMI >25, 30 and 40). Examples of the use of BMI in both clinical and public health practice are also given.

Introduction

In the assessment of the nutritional status of individuals and communities, anthropometric measurements play a very important role for the following reasons: departures from normal can often be detected earlier by anthropometry than by clinical examination; and anthropometric figures are more objective than clinical assessments.

In tropical countries, anthropometric assessments have most often focused on children under 5 years of age (*1, 2*) because such children are more often the victims of clinical malnutrition than other age groups. In the assessment of children, attention usually focuses on one of the following indices: weight-for-height, impairment of which reflects acute undernutrition or wasting; height-for-age, impairment of which reflects chronic undernutrition; and weight-for-age, which is affected in either acute or chronic nutrition. For the assessment of nutritional status in emergencies, WHO recommends use of weight-for-height of children, not only because under such circumstances acute-onset malnutrition is mainly involved, but also partly because of the supposed greater vulnerability to malnutrition of young children; also, this index is relatively insensitive to age and thus if a child's age is not known exactly, the assessment is not affected much.

Adult malnutrition has received much less attention than that of the child. This focus appears at least in part unjustified, and many public health workers report that parents often sacrifice their own feeding in times of serious food shortage (acute or chronic) in favour of young children in the family. The latter may also benefit from unusually prolonged breastfeeding. Moreover, if the ability of the adult breadwinner to function is compromised because of malnutrition, the children of the household are clearly at high risk of becoming malnourished themselves.

In 1992, a task force of the International Dietary Energy Consultative Group of the ACC Sub-Committee on Nutrition suggested that body mass index (BMI) be used to define adult chronic dietary energy deficiency (*3*). The BMI or Quetelet index has been known since the last century as a measure of body proportions and composition, thinness or undernutrition (*4–12*). Nevertheless, as the following examples show, adult anthropometry has had very limited uses:

— in pregnant women, whose weight gain or weight at delivery provides useful information on pregnancy outcome; and

— for the identification and classification of overweight and obesity, mostly in developed countries (there is a large body of evidence that links various grades of obesity, as defined by BMI, to functional deterioration and health risks (*13, 14*)).

Another obvious circumstance in which adult anthropometry could be employed more frequently and usefully is in the assessment of nutritional emergencies, especially famines.

Collecting information on the nutritional status of the adult family members may have further benefits since children are particularly susceptible to infections, which may impair their nutritional status.

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This phenomenon may become a serious confounding factor if decisions must be taken as to which type of intervention has priority. Measuring adults' BMI (weight in kg/(height in m)^2) in conjunction with the anthropometric assessment of children should make it possible to distinguish communities where there is an overall chronic dietary energy deficit from those where only young children are affected. In the latter case, childhood malnutrition would more probably be due to young-child feeding practices or infections rather than to an overall food deficit in the household or community (*15*). This has been suggested previously (*16*) but not yet implemented on a public health scale.

Evidence on the physiopathological meaning of a low BMI, and its functional and health implications, is continuing to be gathered. While the general implications of overweight and obesity on mortality and life expectancy are well known, the specific relationships between overweight status and various types of diet-related noncommunicable diseases have not yet been well established.

Reduced BMI: thinness or underweight

Recent detailed field studies on individuals with low BMI have been reported by James et al. (*16, 17*). While there is a modest chance that a low BMI may indicate only a physiological thinness, as in some athletes, this risk has been estimated to be <5% by Ferro-Luzzi et al. (*18*), who concluded that the BMI could be used by itself (without measuring physical activity levels) for classifying chronic dietary energy deficiency. BMI values of 18.5, 17.0, and 16.0, respectively, were proposed as universally valid thresholds below which a subject (male or female) could be described as mildly, moderately or severely energy-deficient (or grade 1, 2 or 3 underweight, resp.) with only 5% risk of error. The findings of Ferro-Luzzi et al. for Indian, Ethiopian, and Zimbabwean adults are summarized in Table 1.

Shetty & James have compiled the available data on BMI in various regions and countries (Table 2) (*17*).

For India, published data show that increased mortality is associated with low BMI (*19*) and an increased incidence of low birth weight with increasing reduction of the BMI of pregnant women (*20*).

Increased BMI: overweight

For overweight subjects, Garrow (*21*), James (*22*) and a WHO Study Group (*13*) have suggested grading obesity as grade 1, 2 or 3, corresponding to 25<BMI<30, 30<BMI<40, and BMI≥40, respectively. These grades of obesity are associated with progressively increasing risk of hypertension, coronary heart disease, diabetes mellitus, gallstones and overall mortality, the risks being moderate for grade 1, but severe for grade 3.

Table 1: **Prevalence of low and high BMI levels in selected populations**[a]

	% chronic energy deficient (BMI <18.5)	% overweight (BMI >30)
Indian:		
Men	70	< 1
Women	61	< 1
Ethiopian:		
Men	57	< 1
Women	50	< 1
Zimbabwean:		
Men	14	6
Women	11	18

[a] See ref. *18*.

Obesity is present among 7–15% of adults aged approximately 40 years in industrialized countries. However, it is not confined to affluent populations or high-income countries, also being prevalent in developing countries, particularly among the poor in middle-income countries and among the elite in low-income nations. Table 2 shows further examples.

Overview

The WHO Study Group (*13*) recommended that for population groups (rather than individuals) the mean BMI should be in the range 20–22, so that virtually all individuals will have a BMI in the range 18–25.

Using the data mentioned above, we have made a rough estimate of the average prevalences of individuals having BMI <18.5 or >30 in different regions of the world. For this purpose, we used the approach employed in regional classification adopted by the World Bank (*23*). The data are shown in Table 3; for comparison are included also the prevalences of underweight status (low weight-for-age) for children aged under 5 years.

Use of a BMI table

The data shown in Table A2 in Annex 2 could serve as an instrument for use in clinical and public health practice. Presented is the weight (in kg) that corresponds to each cm of height, at the three thresholds for reduced and for increased BMI. Below are shown examples of the use of BMI that are in accordance with the various objectives in the use of anthropometric indicators established by a WHO Expert Committee (*14*).

Table 2: **Distribution of adults by BMI category for selected country surveys**[a]

Location	Year[b]	No. of adults	% in BMI category: <16.00	16.00–16.99	17.00–18.49	<18.5	18.50–24.99	25.00–29.99	>30.00	Mean BMI
Africa:										
Congo (women)	1986–87	2 295	0.6	1.8	8.7	11.1	73.7	11.8	3.4	23.1
Ghana	1987–88	6 323	2.8	3.9	13.3	20.0	62.0	17.1	0.9	—
Mali	1991	4 868	1.9	3.2	11.2	16.3	76.5	6.4	0.8	21.1
Morocco	1984–85	41 921	0.5	1.1	5.4	7.0	69.1	18.7	5.2	22.97
Tunisia	1990	10 023	0.3	0.6	3.0	3.9	58.9	58.6	8.6	24.25
Europe and N. America:										
France	1980	14 233	0.4	0.7	3.8	4.9	62.7	26.2	6.2	24.00
Hungary	1985–88	14 012	3.6	0.2	1.3	5.1	43.5	36.1	15.3	25.03
USA	1976–80	13 760	0.2	0.6	2.7	3.5	41.3	41.6	13.6	25.3
Latin America:										
Brazil	1989	32 831	0.5	0.9	4.2	5.6	61.7	25.1	8.6	(22.8, 23.2)[c]
Cuba	1982	30 363	0.6	1.3	5.4	7.3	56.3	26.9	9.5	—
Peru	1975–76	3 145	0.2	0.2	2.6	3.0	63.2	24.8	9.0	—
Asia:										
China	1982	13 387	1.0	3.9	7.4	12.3	79.5	7.2	1.0	20.98
India	1988–90	21 361	10.2	12.7	25.7	48.6	47.9	3.0	0.5	

[a] Modified from ref. *17*; used with the agreement of FAO, Rome.
[b] Sources: Congo (ORSTOM); Ghana (World Bank); Mali (Direction Nationale de la Statistique et de l'Informatique (DNSI)); Morocco, Tunisia, France (Institut National de la Statistique (INS)); USA (National Health and Nutrition Examination Survey (NHANES II)); Hungary (Hungary National Survey (Budapest)); Brazil (IBGE/PNSN); Cuba (Instituto de Desarrollo de la Salud (IDS)); Peru (Encuesta Nacional del Poblador Peruana (ENPPE)); China (Institute of Nutrition and Food Hygiene (INFH, Beijing)); India (National Institute of Nutrition, Hyderabad).
[c] Median value (men, women).

Use in clinical practice

- To identify individuals at health risk due to thinness or overweight status, and the degree of abnormality (this interpretation has to take into account also the results of a clinical examination in order to assess correctly the significance of a particular BMI status; current illness, as well as dietary intake, may affect the body weight). Also the cut-off points for overweight may differ according to the type of diet-related noncommunicable disease.

Table 3: **Approximate prevalence of low and high BMI in adults, and underweight status in children under 5 years of age**[a]

Region	% prevalence: BMI <18.5	BMI >30	Underweight children <5 years of age
Established market economies	0–5	7–15	2–5
Former socialist economies	0–5	7–15	2–5
Middle Eastern Crescent	3–6	5–15	15
India	30–70	<1	60
China	12	1	1
Other Asia and Islands	5–50	1–15	20–40
Latin America and Caribbean	5–15	5–10	10–20
Sub-Saharan Africa	10–60	0–5	10–50

[a] A complete database on adult height, weight, and BMI is being compiled by WHO and FAO.

- To detect thinness or overweight early in pregnancy (first trimester, before there is significant weight change) and so identify patients at risk of pregnancy complications and/or low-birth-weight infants (this is a particular but specially important case of the first example above).
- To select individuals for an intervention, e.g., food supplementation, or educational action for prevention of obesity.
- To monitor progress towards normality for a patient undergoing treatment for severe thinness or overweight/obesity.
- To exclude individuals from an intervention that could be high-risk, e.g., for grossly underweight or overweight subjects; or from acceptance for certain employment, or from low life-insurance rates.

Use in public health practice and socioeconomic development programmes

- To assess thinness or overweight status of adults in a community believed to be at risk of one or both of these. Such an assessment should be made on an appropriate sample (usually random clusters) in any or every district (the smallest administrative unit that has all the major public services) of a country, and in appropriate ecological and dietary zones and socioeconomic groups.
- To identify particular groups (using geographical or socioeconomic criteria) that are more at risk of under- or overnutrition than the general population.
- To monitor trends in the energy status of populations, including secular trends over long periods, through periodically repeated measurements (e.g., monthly, annually, 5-yearly, etc).
- To select populations for an intervention, e.g., food supplementation, or educational action for prevention of obesity.
- To contribute to the causal analysis and management of undernutrition, by determining whether there is generalized undernutrition affecting all age groups or only children under 5 years of age. In the former case, a general food shortage and generalized food distribution are indicated; in the latter case, the undernutrition is most probably due to inappropriate feeding practices or the high prevalence of infectious diseases — consequently, supplementary feeding for children, nutrition education of the parents or prevention of infections are the appropriate intervention.
- To monitor trends in community nutrition, e.g., following an acute or chronic food shortage, to help determine whether there is a continuing need for total community feeding — and if it is stopped, to allow monitoring to continue.
- To provide normative information, e.g., as an anthropometric parameter, to be considered along with other biological parameters (e.g., biochemical) or dietary surveys in attempts to define the presence/absence or degree of under- or overnourishment in general or local populations.
- To help evaluate the impact of various types of developmental programmes, e.g., nutritional, health, agricultural, or environmental.
- As a practical exercise for a workshop or course, or during the basic training of health personnel of various categories, the BMI of the group itself can be measured quickly, or (preferably) a survey made rapidly in any suitable local community; the results can be presented and interpreted, and the implications determined, for example, for national health policies and programmes.
- As an instrument for establishing the degree of undernutrition and overnutrition in adult populations throughout the world, as a proxy indicator of both undernutrition and risk of diet-related noncommunicable diseases. The BMI could thus form a basis for future action and assessment in the follow-up of the International Conference on Nutrition and the World Declaration on Nutrition, at which 160 countries pledged, *inter alia*, the following:

  — to make all efforts to eliminate before the end of this decade: famine and famine-related deaths; and starvation and nutritional deficiency diseases; and

  — to reduce substantially within this decade: starvation and widespread chronic hunger; undernutrition, especially among children, women and the aged; and diet-related noncommunicable diseases.

Conclusions

The BMI is therefore a useful tool in both clinical and public health practice for assessing adult nutritional status. All physicians could usefully have a copy of Table A2 (Annex 2) or an equivalent table in their surgery to help them interpret the anthropometric and nutritional status of patients. Studies on adults should become regular components of national nutrition surveys and monitoring systems, with attention being paid to both the undernutrition and the overnutrition extremes of the range. The usual sampling procedures should be respected as regards the nutritional status of communities. Guidelines on the numbers of subjects required per sampling unit are shown in Annex 1.

Although BMI has been measured in a number of surveys, this has been mainly for research purposes. The index has had limited application in clinical medical practice and in public health practice. There is a widespread opinion that the BMI is complicated and not applicable as a public health tool. In contrast, we hope that the present article has demonstrated how easy it is to use the index, particularly in combination with Table A2 in Annex 2, and how it facilitates making group assessments in the context of a wide variety of important health and socioeconomic programmes. We urge investigators to use the tables in the Annexes and to report their results (% of subjects below the various thresholds) in order to increase the general availability of data for various populations.

The BMI also provides a basis for monitoring the achievement of several of the goals of the World Declaration on Nutrition. Use of this instrument, on a national and regional basis, would be valuable in almost every country, both for making an initial assessment and as a continuing monitoring system in the context of implementing this declaration — to identify and eliminate the widespread undernutrition and overnutrition that afflict at least some adult populations in the great majority of countries.

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Résumé

Utilisation de l'indice de Quételet chez l'adulte pour évaluer l'état nutritionnel de l'individu et de la communauté

La malnutrition est beaucoup plus répandue chez les adultes qu'on ne l'admet généralement, mais elle retient moins l'attention que la malnutrition chez le jeune enfant. Le présent article décrit l'utilisation de l'indice de masse corporelle ou indice de Quételet (poids en kg/(taille en m)^2) pour mesurer l'état nutritionnel de l'adulte au niveau individuel ou au niveau communautaire. L'évaluation parallèle de l'état nutritionnel des adultes et des enfants permet de tirer des conclusions et de savoir s'il y a dénutrition généralisée dans une communauté ou si d'autres facteurs (infections infantiles ou modes d'alimentation de l'enfant, par exemple) jouent un rôle déterminant dans la malnutrition infantile. Actuellement, très peu de pays disposent de données représentatives au plan national concernant l'indice de Quételet chez l'adulte.

On trouvera dans l'article une présentation sous forme de tableau du poids par centimètre de taille pour les tailles comprises entre 140 et 184 cm, en donnant des seuils pour le poids correspondant à différents degrés de maigreur (indice de Quételet = 16, 17 et 18,5) ou de surpoids (indice de Quételet >25, 30 et 40), et des indications sur la façon d'interpréter les résultats. L'indice de Quételet individuel est normalement compris entre 19 et 25; l'indice médian souhaitable pour les populations se situe entre 22 et 24. On trouvera également des exemples d'application de l'indice de Quételet en clinique ou dans les services de santé publique.

Il serait particulièrement intéressant de généraliser l'usage de l'indice de Quételet comme indicateur de substitution à la fois de la dénutrition et de la surnutrition (et, indirectement, du risque de maladies non transmissibles liées à l'alimentation: maladies cardio-vasculaires, diabète sucré non insulinodépendant, certaines formes de cancers, etc). La Déclaration mondiale sur la nutrition, adoptée par 160 pays lors de la Conférence internationale sur la nutrition de Rome en 1992, constitue un engagement à éliminer la faim et à réduire sensiblement la malnutrition chronique et les maladies non transmissibles liées à l'alimentation au cours de la présente décennie. Les Etats Membres de la FAO et de l'OMS mettent actuellement au point des plans d'action pour atteindre ces buts. L'indice de Quételet serait un indicateur précieux pour évaluer les progrès accomplis par les pays. Dans le cadre de ce processus de surveillance continue, les pays devront évaluer régulièrement, sur la base d'échantillons nationaux, l'indice de Quételet de leur population adulte. L'article définit les lignes directrices à suivre pour déterminer la taille de l'échantillon dans le cadre de ces enquêtes.

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Annex 1

Sample sizes for BMI surveys

• The confidence interval is determined with a specified level of confidence (or probability) that includes the population parameter to be estimated. Thus for the 95% confidence interval one would be 95% confident that it includes the true prevalence level.

• Precision is a measure of how close an estimate is, or is required to be, relative to the true population value.

• Table A1 shows sample sizes in terms of their relative precision, i.e., expressed as a proportion of the mean value (P) expected or obtained in the survey; the top row "P" shows the anticipated prevalence. For example, 0.05 corresponds to a prevalence of 5%, etc. The column labelled "ε" gives the desired relative precision. For example, a relative precision of ε = 0.10 for an expected prevalence of 0.50 implies a precision of $0.10 \times 0.50 = 0.05$ (or 5 percentage points); therefore, a minimum sample size of 384 randomly selected individuals would be required to be 95% confident that the range 45–55% includes the true prevalence.

• A relative precision of 10% indicates 10% above or below the observed mean value; if the mean were 50%, a 10% relative precision would correspond to ± 5%.

• *Depending on the type and circumstances of a survey, the degree of precision required may vary. If a single cut-off point is being used, e.g., BMI 18.5 or 25.0, and the expected prevalence is unknown but within a certain range, the sample size should be estimated assuming that the result will be at the lower end of the expected range — since this gives the largest sample size.*

• *Design effect.* The data in Table A1 refer to a survey with strict random sampling of a given population. Very often, however, cluster sampling procedures are used, and are more practical—this is the procedure followed, for example, in surveys on the coverage of children by immunization programmes. For phenomena such as abnormal BMI, whose distribution may be patchy or nonhomogeneous, cluster sampling may produce misleading results — if, for example, clusters of high prevalence are selected. To avoid errors of this type, a larger number of subjects must be examined. The data in Table A1 have to be multiplied by a "design effect" factor to allow for this possible lack of homogeneity in the population studied. This factor is estimated by calculating the ratio of the variance when *cluster sampling* is used to the variance when *simple random sampling* is used. A design effect factor of 2, as commonly used in other types of anthropometric surveys, may be used until studies have been undertaken to establish the exact design factor for a particular study.

• Since BMI data do not have a normal distribution, median rather than mean values should be cited and other forms of presentation of the distribution of values, e.g., according to the cut-offs given in Table A2, rather than the mean values.

• For other confidence intervals and more details, including guidance on types of studies other than simple prevalence surveys, please see the following publications:

— **Lwanga SK, Lemeshow S.** *Sample size determination in health studies.* Geneva, World Health Organization, 1991; and

— **Lemeshow S et al.** *Adequacy of sample size in health studies.* Chichester, John Wiley, 1990.

Table A1: **Sample sizes for estimating a population proportion with specified relative precision** (95% confidence level)[a]

ϵ[c] \ P[b]	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95
0.01	729 904	345 744	217 691	153 664	115 248	89 637	71 344	57 624	46 953	38 416	31 431	25 611	20 686	16 464	12 805	9 604	6 779	4 268	2 022
0.02	182 476	86 436	54 423	38 416	28 812	22 409	17 836	14 406	11 738	9 604	7 858	6 403	5 171	4 116	3 201	2 401	1 695	1 067	505
0.03	81 100	38 416	24 188	17 074	12 805	9 960	7 927	6 403	5 217	4 268	3 492	2 846	2 298	1 829	1 423	1 067	753	474	225
0.04	45 619	21 609	13 606	9 604	7 203	5 602	4 459	3 602	2 935	2 401	1 964	1 601	1 293	1 029	800	600	424	267	126
0.05	29 196	13 830	8 708	6 147	4 610	3 585	2 854	2 305	1 878	1 537	1 257	1 024	827	659	512	384	271	171	81
0.06	20 275	9 604	6 047	4 268	3 201	2 490	1 982	1 601	1 304	1 067	873	711	575	457	356	267	188	119	56
0.07	14 896	7 056	4 443	3 136	2 352	1 829	1 456	1 176	958	784	641	523	422	336	261	196	138	87	41
0.08	11 405	5 402	3 401	2 401	1 801	1 401	1 115	900	734	600	491	400	323	257	200	150	106	67	32
0.09	9 011	4 268	2 688	1 897	1 423	1 107	881	711	580	474	388	316	255	203	158	119	84	53	25
0.10	7 299	3 457	2 177	1 537	1 152	896	713	576	470	384	314	256	207	165	128	96	68	43	20
0.15	3 244	1 537	968	683	512	398	317	256	209	171	140	114	92	73	57	43	30	19	9
0.20	1 825	864	544	384	288	224	178	144	117	96	79	64	52	41	32	24	17	11	5
0.25	1 168	553	348	246	184	143	114	92	75	61	50	41	33	26	20	15	11	7	—[d]
0.30	811	384	242	171	128	100	79	64	52	43	35	28	23	18	14	11	8	5	—[d]
0.35	596	282	178	125	94	73	58	47	38	31	26	21	17	13	10	8	6	—[d]	—[d]
0.40	456	216	136	96	72	56	45	36	29	24	20	16	13	10	8	6	—[d]	—[d]	—[d]
0.50	292	138	87	61	46	36	29	23	19	15	13	10	8	7	5	—[d]	—[d]	—[d]	—[d]

[a] $n = (Z_{1-\alpha/2})^2(1-P)/\epsilon^2 P$
[b] P = anticipated population proportion (prevalence).
[c] ϵ = relative precision.
[d] Sample size less than 5.

Annex 2: Assessment of thinness and overweight status

Table A2: **Body mass index (BMI) for adults: body weight corresponding to a specified BMI, for a given height**

Height (cm)	BMI:[a] 16.0	17.0	18.5	20.0	22.0	25.0	30.0	40.0	Height (cm)
	Body weight (kg)								
140	31.4	33.3	36.2	39.2	43.1	49.0	58.8	78.4	140
141	31.8	33.8	36.8	39.8	43.7	49.7	59.6	79.5	141
142	32.3	34.3	37.3	40.3	44.4	50.4	60.5	80.7	142
143	32.7	34.8	37.8	40.9	45.0	51.1	61.3	81.8	143
144	33.2	35.3	38.4	41.5	45.6	51.8	62.2	82.9	144
145	33.6	35.7	38.9	42.1	46.3	52.6	63.1	84.1	145
146	34.1	36.2	39.4	42.6	46.9	53.3	63.9	85.3	146
147	34.6	36.7	40.0	43.2	47.5	54.0	64.8	86.4	147
148	35.0	37.2	40.5	43.8	48.2	54.8	65.7	87.6	148
149	35.5	37.7	41.1	44.4	48.8	55.5	66.6	88.8	149
150	36.0	38.2	41.6	45.0	49.5	56.3	67.5	90.0	150
151	36.5	38.8	42.2	45.6	50.2	57.0	68.4	91.2	151
152	37.0	39.3	42.7	46.2	50.8	57.8	69.3	92.4	152
153	37.5	39.8	43.3	46.8	51.5	58.5	70.2	93.6	153
154	37.9	40.3	43.9	47.4	52.2	59.3	71.1	94.9	154
155	38.4	40.8	44.4	48.1	52.9	60.1	72.1	96.1	155
156	38.9	41.4	45.0	48.7	53.5	60.8	73.0	97.3	156
157	39.4	41.9	45.6	49.3	54.2	61.6	73.9	98.6	157
158	39.9	42.4	46.2	49.9	54.9	62.4	74.9	99.9	158
159	40.4	43.0	46.8	50.6	55.6	63.2	75.8	101.1	159
160	41.0	43.5	47.4	51.2	56.3	64.0	76.8	102.4	160
161	41.5	44.1	48.0	51.8	57.0	64.8	77.8	103.7	161
162	42.0	44.6	48.3	52.5	57.7	65.6	78.7	105.0	162
163	42.5	45.2	49.2	53.1	58.5	66.4	79.7	106.3	163
164	43.0	45.7	49.8	53.8	59.2	67.2	80.7	107.6	164
165	43.6	46.3	50.4	54.5	59.9	68.1	81.7	108.9	165
166	44.1	46.8	51.0	55.1	60.6	68.9	82.7	110,2	166
167	44.6	47.4	51.6	55.8	61.4	69.7	83.7	111.6	167
168	45.2	48.0	52.2	56.4	62.1	70.6	84.7	112.9	168
169	45.7	48.6	52.8	57.1	62.8	71.4	85.7	114.2	169
170	46.2	49.1	53.5	57.8	63.6	72.3	86.7	115.6	170
171	46.8	49.7	54.1	58.5	64.3	73.1	87.8	117.0	171
172	47.3	50.3	54.7	59.2	65.1	74.0	88.8	118.3	172
173	47.9	50.9	55.4	59.9	65.8	74.8	89.8	119.7	173
174	48.4	51.5	56.0	60.6	66.6	75.7	90.8	121.1	174
175	49.0	52.1	56.7	61.3	67.4	76.6	91.9	122.5	175
176	49.6	52.7	57.3	62.0	68.1	77.4	92.9	123.9	176
177	50.1	53.3	58.0	62.7	68.9	78.3	94.0	125.3	177
178	50.7	53.9	58.6	63.4	69.7	79.2	95.0	126.7	178
179	51.3	54.5	59.3	64.1	70.5	80.1	96.1	128.2	179
180	51.8	55.1	59.9	64.8	71.3	81.0	97.2	129.6	180
181	52.4	55.7	60.6	65.5	72.1	81.9	98.3	131.0	181
182	53.0	56.3	61.3	66.2	72.9	82.8	99.4	132.5	182
183	53.6	57.0	62.0	67.0	73.7	83.7	100.5	134.0	183
184	54.2	57.6	62.6	67.7	74.5	84.6	101.6	135.4	184
Interval[b]	D	C	B	A		B'	C'	D'	—

[a] BMI = weight in kg/(height in m)^2.

[b] BMI < 16.0 (interval D) = severe thinness; BMI 16.0–16.9 (interval C) = moderate thinness; BMI 17.0–18.4 (interval B) = marginal thinness; BMI 18.5–24.9 (interval A) = normal range for an individual; BMI 20.0–21.9 = normal range of average BMI for a population; BMI 25.0–29.9 (interval B') = mild overweight, grade 1; BMI 30.0–39.9 (interval C') = moderate overweight, grade 2; and BMI ≥40.0 (interval D') = severe overweight, grade 3.