ANNALS OF HUMAN BIOLOGY,
SEPTEMBER–OCTOBER 2003, VOL. 30, NO. 5, 520–537

Taylor & Francis
healthsciences

Gender and adult undernutrition in developing countries

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Received 27 November 2002; in revised form 7 March 2003; accepted 25 March 2003

Summary. *Background*: Information on the prevalence of undernutrition in adults in developing countries is mainly restricted to data on women. Literature reporting on the occurrence of female deprivation in developing countries, in particular in South Asia, suggests that differences between undernutrition prevalence in adult men and adult women might occur, but systematic information on the subject is lacking.
Aim: The study compares undernutrition prevalence rates, based on prevalence of low body mass index (BMI < 18.5), in adult men and adult women in developing countries. Regional comparison is made between the main developing regions: Sub-Saharan Africa, South/Southeast Asia and Latin America.
Subjects and methods: The study uses data as reported in 75 samples from 31 countries (divided over the three developing regions), in which anthropometric information has been collected in adult men and women within one and the same community.
Results: Results indicate that, in general, prevalence rates of undernutrition are rather similar in adult men and women. However, there are regional differences. In communities in Sub-Saharan Africa, prevalence of low BMI is, on average, a few percent higher in men than in women; in South/Southeast Asia the reverse is the case. In some communities differences in undernutrition prevalence between men and women are exceptionally large.
Conclusions: It can be concluded that, in general, information on undernutrition prevalence in women can be considered a proxy for undernutrition prevalence in all adults, men and women together. However, the finding that in South/Southeast Asia women's nutritional status relative to men's nutritional status compares unfavourably with results from other developing regions, in particular Sub-Saharan Africa, provides some support for the concept of female deprivation in South/Southeast Asia. Where large differences between prevalence of low BMI in men and women occur, gender-specific policies aimed at reducing undernutrition should be considered.

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1. Introduction

Information on prevalence of undernutrition in developing countries tends to have a strong focus on infants and children. Thus, for most countries in the world nationally representative data are available on the prevalence rates of undernutrition in children, expressed as percentages of children, generally the under-fives, with a low weight-for-age or height-for-age, or a low weight-for-height. Also, for almost all countries in the world information is available on the occurrence of low birth weight.

With respect to other age groups, such as adolescents, adults or the elderly, anthropometric information is much less widely available. A main source of information on undernutrition in adults are the Demographic and Health Surveys (DHS)[1], which provide for a large number of developing countries nationally representative data on prevalence rates of undernutrition in women of reproductive age. A main reason for collecting such information are the possible linkages between

[1]The Demographic and Health Surveys are part of a worldwide programme, designed to collect data on fertility, family planning, and maternal and child health. The programme, funded by the US Agency for International Development, is implemented by Macro International Inc., Calverton, USA, in cooperation with institutes in the countries where the surveys are held.

Annals of Human Biology ISSN 0301–4460 print/ISSN 1464–5033 online © 2003 Taylor & Francis Ltd
http://www.tandf.co.uk/journals
DOI: 10.1080/0301446031000119601

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Table 1. Means of country averages for adult women's body weight, adult women's BMI, and percentage of women with BMI < 18.5, separately for countries in South/Southeast Asia, Sub-Saharan Africa and Latin America. Values in parentheses are standard deviations.

Developing region	Mean body weight, kg	Mean BMI	Mean % BMI < 18.5
South/Southeast Asia	47.1 (3.6)	20.3 (0.9)	25.7 (12.8)
Sub-Saharan Africa	54.4 (3.0)	21.7 (0.9)	14.3 (8.1)
Latin America	56.9 (2.2)	24.4 (2.2)	4.0 (2.0)

Source: DHS surveys (Macro International Inc., Calverton, USA)[1], except for Mauritania, Philippines, Sri Lanka, Venezuela and Vietnam, data from FAO Nutrition Country Profiles[2]; for Indonesia, Nurdiati *et al.* (1998), for Malaysia, Lim *et al.* (2000); and for Pakistan, Pappas *et al.* (2001).

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health and nutrition conditions of women and birth outcomes following pregnancy. The available anthropometric data based on nationally representative samples of adult women (age 15–50 years) indicate that for women in South/Southeast Asia mean body weight and mean body mass index (BMI; defined as weight in kg divided by square height in metres) are low when compared with women in Sub-Saharan Africa and Latin America, and that the prevalence rate of low BMI (< 18.5) is very high in South/Southeast Asian women when compared with the other developing regions (table 1). Nationally representative data on rates of undernutrition prevalence in adult males, however, are available for very few countries. However, there appear to be sufficient reasons to call for information on undernutrition prevalence not only in adult women, but also in adult men. First, from a strictly health point of view, hunger and undernutrition are equally unacceptable conditions both for men and women. Secondly, nutritional status is an important determinant of individuals' capacity for work (Kornejek 1992, van den Boom *et al.* 1996, Dasgupta 1997, Strauss and Thomas 1998). Clearly, in developing countries both males and females are often involved in physically demanding activities, and a poor nutritional status of adult women, adult men, or both, might severely affect households' productive capacities. Thirdly, there is a continuing debate on the occurrence of female deprivation in developing countries, in particular in countries in South Asia. In fact, it has been postulated that high levels of child undernutrition as they occur in South Asian countries are to a large extent the result of female deprivation (Ramalingaswami *et al.* 1997).

The main objective of the present study is to assess whether prevalence rates of undernutrition in adults, expressed on the basis of BMI, are generally of similar magnitude in both male and female adults, or whether sizeable gender differences occur. As nationally representative data on undernutrition in adult males are hardly available, the analysis is to a large extent based on small-scale studies, which are done for various reasons and with varying objectives, but which report on undernutrition prevalence in both adult males and adult females. In view of the fact that differences between adult male and adult female undernutrition might be region specific, throughout the analysis information on Asia, Africa and Latin America will be traced separately.

It may be noted that the present study does not deal with problems of overweight and obesity. Many developing countries are nowadays simultaneously affected both by problems of underweight and undernutrition and by problems of overweight, obesity and related disorders, for which often the term 'double burden' is being used. While in terms of monitoring and in terms of research activities, overweight and obesity in developing countries are currently given due attention (IDA 2000,

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Martorell *et al*. 2000, James *et al*. 2001, Uauy *et al*. 2001), information on prevalence rates, trends and characteristics of underweight and undernutrition in male and female adults in developing countries is insufficiently available.

2. Methods

For the comparison between adult men and adult women with respect to mean BMIs and prevalence rates of undernutrition, use has been made of a variety of studies and reports as published in scientific journals or otherwise publicly accessible documents (see the Appendix). The main commonality between the various study reports is that they provide information on prevalence rates of adult male and adult female undernutrition within one and the same community. Only those studies have been considered where adult undernutrition was expressed as the percentage of the population with a BMI < 18.5. To the extent possible from the various reports information has been extracted on the age group 20–50 years. However, as there is no uniform pattern of age-grouping that was used in the various studies, in many cases the anthropometric data used for the present analysis cover somewhat different age ranges.

In most cases, the samples in which the anthropometric data on both adult men and adult women have been collected are not representative at the national level. Where in the original publications information is presented separately by socio-economic group (e.g. urban and rural, poor and rich), such groupings have generally been left unchanged. Studies where sample populations only represent the higher socio-economic classes were generally not included, as in these population groups BMIs tend to be at the higher end of the range and undernutrition prevalence rates are normally very low. In some cases published data were regrouped, together with some recalculations, in order to arrive at samples of sufficient size, or in order to create age groups that are as close as possible to the 20–50 years age group. Reports and studies where reported anthropometric data were for samples consisting of less than 100 males and 100 females were not included.

In most studies it was explicitly stated that pregnant women were excluded from the population samples. While for most countries only one or two datasets could be traced in the literature, for some countries the number of available datasets was larger. The largest amount of anthropometric information was available for India. In the first place, the Food and Agriculture Organization (FAO) country profile for India[2] provides information on mean levels of BMI and on prevalence rates of adult undernutrition for 18 States and Union Territories (see table 4). These data were aggregated into anthropometric data for five regions (North, East, North East, West, and Union Territories). In addition, the analysis includes anthropometric data on adults from five other Indian studies, resulting in a total number of 10 datasets on India included in the Appendix. For practically all studies employed in the present analyses, data collection took place in the period 1990–2000, in a few cases in the mid and late 1980s. For some studies only the year of publication is known, not the year of data collection. The final data-file for the present analysis consists of 75 population samples distributed over 31 countries on which information is available on mean BMI in adult women and adult men, on the

[2]FAO nutrition country profiles are country reports summarizing countries' food and nutrition situations, utilizing statistical information from national and international sources. The reports are accessible through the FAO's web site (www.fao.org).

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prevalence rates of undernutrition in adult women and adult men, or on both. The analysis of the nutritional status and undernutrition prevalence among adult females and adult males employs statistical techniques, including the computation of means and variances, the plotting and regression of female on male outcomes, and the pairwise testing of a possible gender bias by region. The latter is done by comparing, for each of the three regions, results obtained for one region with the combined results for the other two regions.

3. Results

3.1. *Mean BMIs of adult males and females, small-scale non-representative samples*

The analysis of the relationships between mean levels of BMI in adult men and adult women is based on, in most cases, nationally non-representative small-scale studies which provide anthropometric information for both adult men and adult women belonging to one and the same community. The total number of datasets is 75, distributed over 31 countries. Results, shown graphically in figure 1, indicate for all datasets together a highly significant relationship between the means for adult female and adult male BMI. The regression of adult female on adult male mean BMI gives a good fit (83% of the variation of mean BMI of females can be explained from the variation of mean BMI of males). The estimated slope is very close to one and stable (estimate 1.002; standard error 0.061), while the estimated intercept is small and imprecise (estimate 0.64; standard error 1.30)[3]. This indicates that on average in

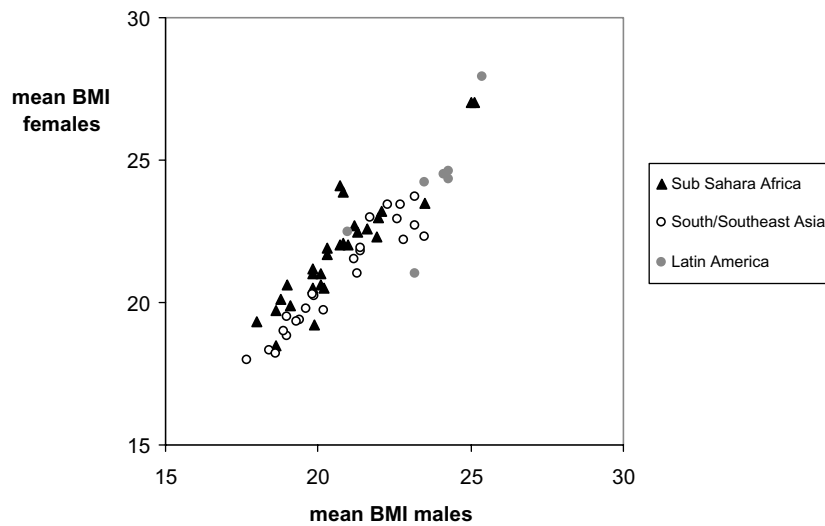

Figure 1. Relationship between mean BMIs of adult males and adult females in countries in Sub-Saharan Africa, South/Southeast Asia and Latin America (for data sources, see the Appendix).

[3]These are ordinary least squares estimates of the slope and intercept of a regression curve through the data points in figures 1 and 2. We also considered weighted regression as an alternative, using sample sizes as weights. This led to rather similar results. Weighted regression of mean female BMI on mean male BMI gives an R^2 of 0.87 (as compared with 0.83 in the unweighted case) with a highly significant slope of 1.025 very close to the unweighted estimate, and an insignificant intercept. Weighted regression of the prevalence of female on male malnutrition increased the fit from 0.83 to 0.86, and the estimated slope from 0.89 to 1.16, with a corresponding decrease of the statistically insignificant intercept.

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Table 2. Means of country averages for adult female and adult male BMI, and differences of means, for the whole sample and for South/Southeast Asia, Sub-Saharan Africa and Latin America separately.

	n	Mean of country averages for BMI, adult women	Mean of country averages for BMI, adult men	Difference between means (BMI) of country averages for adult women and adult men*
All	57	21.78	21.10	0.68
South/Southeast Asia	23	20.93	20.79	0.14† (23.8)
Sub-Saharan Africa	27	21.79	20.64	1.15† (25.0)
Latin America	7	24.51	23.91	0.60 (0.1)

* The symbol † indicates that the gender difference in the respective region is significantly different from the gender difference in the other two regions combined (*t*-test for pairwise comparison of means with $p < 0.001$, *t*-score in parentheses); for data sources, see Appendix.

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developing countries, the variation of mean BMI in adult females tends to concur with the variation of mean BMI in adult males, while the female mean BMI is slightly higher than the corresponding male mean BMI (table 2).

When considering the three main developing regions (table 2), the positive difference between female and male mean BMI seems smallest in South/Southeast Asia (only 0.14 points, as compared with an average difference of 0.68 in the sample as a whole). The difference in the samples from Latin America is close to the average (0.60 points), while the samples from Sub-Saharan Africa show a relatively large difference (1.15 points). A statistical analysis confirms this picture. The pairwise testing of gender differences indicates that in South/Southeast Asia the female–male mean BMI gap is significantly lower than elsewhere and in Sub-Saharan Africa significantly higher. The *t*-statistics that test for equality of the female–male BMI gap in the countries of one particular region and the corresponding gap in countries of the (combined) other two regions equal 25.0 and 23.8, for Africa and South/Southeast Asia, respectively ($p < 0.001$). There is no regional effect for Latin America (*t*-statistic of 0.1, $p = 0.754$). The latter is not surprisingly since the size of the female–male BMI gap is very close to the average gap, while the sample size is small.

Thus, when comparing the differences between mean BMIs of adult men and adult women in datasets from countries in the different developing regions, women in Sub-Saharan Africa are in relative terms better off than women in Southeast Asia. These results confirm data presented elsewhere (Pelletier and Rahn 1998).

3.2. *Prevalence rates of undernutrition in male and female adults*

The main focus of interest in the present study are the relationships between prevalence of undernutrition in adult males and adult females. Results are shown graphically in figure 2.

Again, the regression shows a good fit (83% of the variation of the prevalence of female undernutrition can be explained from the variation of the prevalence of male undernutrition). The estimated slope is now somewhat lower than one but remains stable (estimate 0.89; standard error 0.056), while the estimated intercept is now higher and relatively more precise (estimate 2.57; standard error 1.56)[3]. These results suggest that on average in developing countries, undernutrition patterns among adult females largely reflect undernutrition patterns among adult males.

As was the case with the male–female mean BMI pattern, the male–female undernutrition pattern exhibits marked differences among the three main developing

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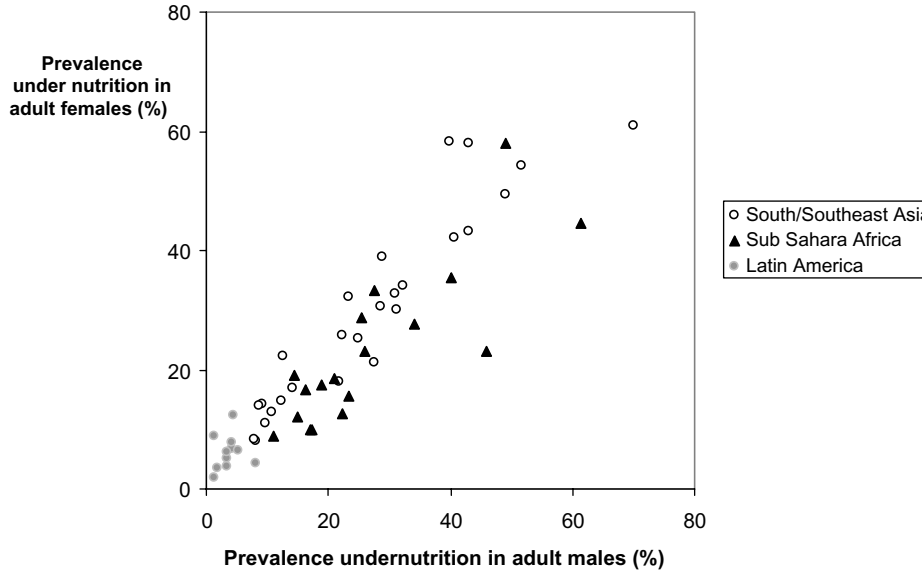

Figure 2. Relationship between the prevalence of undernutrition in adult males and adult females in Sub-Saharan Africa, South/Southeast Asia and Latin America (for data sources, see the Appendix).

Table 3. Means of countries' prevalence rates of undernutrition (BMI < 18.5) in adult women and adult men, and differences of means, for all datasets together and for datasets from South/Southeast Asia, Sub-Saharan Africa and Latin America separately.

	n	Mean of country results for % of adult women with BMI < 18.5	Mean of country results for % of adult men with BMI < 18.5	Difference between means of countries' undernutrition prevalence rates in adult women and adult men*
All	52	22.79	22.68	0.11
South/Southeast Asia	25	29.00	26.44	2.56† (9.2)
Sub-Saharan Africa	18	22.99	27.01	−4.02† (14.9)
Latin America	9	5.17	3.60	1.57 (0.7)

* The symbol † indicates that the gender difference in the respective region is significantly different from the gender difference in the other two regions combined (*t*-test for pairwise comparison of means with $p < 0.01$, *t*-score in parentheses); for data sources, see Appendix.

regions. As indicated in table 3, female undernutrition prevalence rates tend to exceed male undernutrition prevalence rates in South/Southeast Asia and Latin America (by 2.56 and 1.57 percentage points, respectively) and tend to be lower in Sub-Saharan Africa (by 4.02 percentage points). The testing of a possible gender bias confirms this picture of female deprivation in South/Southeast Asia and a relative favourable nutritional status of women in Sub-Saharan Africa. The *t*-statistics for equality of the female–male undernutrition gap in countries of one developing region and the corresponding undernutrition gap in countries of the (combined) other developing regions equal 14.9 and 9.2, for Africa and South/Southeast Asia, respectively (both with $p < 0.01$). However the gender bias for adult undernutrition in Latin America is not statistically significant (*t*-statistic of 0.7, $p = 0.396$), apart from the fact that in this region absolute levels of adult male and adult female undernutrition are much lower.

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3.3. *Samples revealing large differences between undernutrition in adult males and females*

The Appendix includes a limited number of survey results where differences between undernutrition prevalence rates in adult men and adult women are of considerable magnitude. The differences are particularly large in the datasets available for Mauritania, Senegal and Togo, in one dataset for Ethiopia, and also in one dataset for Zimbabwe, with reported undernutrition prevalence rates in datasets from these countries being between 1.5 and 2 times higher in men than in women. The differences are also very large in some datasets for India and Pakistan where observed prevalence rates of undernutrition are 1.5–2 times higher in women than in men. To illustrate further the occurrence of variations in the relationships between undernutrition prevalence rates in adult men and adult women at a more disaggregated level, table 4 gives the data for 18 States and Union Territories in India (FAO 1998). Apart from considerable differences in absolute levels of undernutrition prevalence, the table reveals large variations with respect to the ratios between undernutrition prevalence rates in adult women and adult men. The largest differences occur in the State of Mizoram and in the Union Territory Daman and Diu, where reported undernutrition prevalence rates are more than twice as high in women than in men.

Results clearly show that there are not only differences between developing regions with respect to the relationships between undernutrition prevalence

Table 4. Prevalence rates of adult undernutrition in adult men and adult women in 18 Indian States and Union territories.

State	% Adult males with BMI < 18.5	% Adult females with BMI < 18.5	Ratio % undernutrition in women divided by % undernutrition in men
North			
Delhi	19.6	18.3	0.93
Haryana	27.2	25.3	0.93
Himachal Pradesh	39.1	36.8	0.94
Punjab	22.0	22.7	1.03
Rajasthan	44.4	43.1	0.97
East			
Bihar	39.8	58.3	1.46
Northeast			
Arunachal Pradesh	7.8	7.6	0.97
Assam	16.0	18.1	1.13
Manipur	11.9	14.5	1.22
Meghalaya	10.8	15.0	1.39
Mizoram	9.8	20.6	2.10
Nagaland	8.9	12.5	1.40
Sikkim	9.9	13.3	1.34
Tripura	26.2	28.8	1.10
West			
Goa	28.8	38.8	1.35
Union Territories			
Dadra and Nagar Haveli	37.0	48.6	1.31
Daman and Diu	15.4	33.8	2.19
Chandigarth	17.6	21.8	1.24

Source: FAO 1998, India Nutrition Country Profile.

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rates in women and men, but that also considerable intra-country variation may occur. In fact, it can be expected that at a further disaggregated level within countries even larger differences between undernutrition prevalence rates in men and women will occur, but more detailed information is not available or not easily accessible.

4. Discussion

The present study is the first of its kind that presents a systematic comparison between prevalence rates of undernutrition in adult women and adult men in developing countries. The comparison, utilizing 75 dataset from 31 countries in South/Southeast Asia, Sub-Saharan Africa and Latin America, reveals that the distribution of adult female BMI and the distribution of adult male BMI are intimately related both through the generally strong correlation between the respective means and through a generally strong correlation between the respective prevalences of undernutrition. As a consequence, differences in undernutrition prevalence between males and females are generally small. These findings imply that information on prevalence rates of undernutrition in adult women can be considered a proxy for overall prevalence rates of undernutrition in adults, men and women combined. However, there are exceptions and differences between regions. Most importantly, result indicate that in South/Southeast Asia prevalence rates of undernutrition tend to be slightly higher in women than in men, while in Sub-Saharan Africa the reverse is the case. Also in Latin America prevalence rates of undernutrition are, on average, higher in women than in men, but absolute levels are much lower. Furthermore, it is important to note that some datasets exhibit exceptionally large differences between undernutrition prevalence in males and females. Where such large differences are observed, there is a clear need for in-depth gender-related analytical studies and for policies and programmes, if not yet already in place, to address these nutritional imbalances.

4.1. Vulnerability of women and female discrimination

Presented results provide moderate support, in a nutritional context, for the concept of the occurrence of female discrimination in South/Southeast Asia. There is a vast literature on gender differences and possible gender discrimination in developing countries, and there are numerous reports and studies in which various aspects of female deprivation have been documented and discussed (Okojie 1994, Svedberg 1996, Messer 1997, Miller 1997, Murthi *et al*. 1997, Smitasiri 1998, Haddad 1999).

Women in developing countries, and in particular women at reproductive age, are generally considered to be highly vulnerable with respect to their health and nutritional status. High workloads both in terms of household chores and in terms of agricultural or other income-generating tasks exert a heavy drain on their physical condition. In addition, there is the physiological burden of frequent pregnancies, short intervals between subsequent children, and long periods of breastfeeding. While these conditions may already by themselves be responsible for health differences between men and women, cultural factors may further affect women's position relative to men, and the disadvantaged position of women may come to expression in numerous fields, ranging from suppressed democratic and legal rights, denial of control over household assets or other aspects of ownership, or economic deprivation and reduced access to employment. Culturally defined customs such as

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bridewealth and polygyny can also be considered expressions of a subordinate position of women relative to men (Berger and White 1995).

With respect to health, the most widely presented quantitative information is on differences in life expectancy between males and females. First, various studies in children (1–5 years) have indicated that in Asian countries mortality rates are generally higher in girls than in boys (Haddad *et al*. 1996, Claeson *et al*. 2000). With respect to adults, there are many studies reporting on so-called 'missing women', in particular in South Asian countries, which is a reflection of higher mortality rates among women, in particular in the age groups up to approximately 40 years (Drèze and Sen 1989, Osmani and Bhargava 1998, Messer 1997). Also with respect to nutrition the occurrence of gender discrimination has been receiving considerable attention, as will be further discussed below.

4.2. *Food allocation*

Originally, most studies dealing with nutritional aspects of gender bias within households relate to patterns of food allocation, and in various studies it has been suggested that women receive a lower share of food requirements than men (Babu *et al*. 1993, Gittelsohn *et al*. 1997, Kramer *et al*. 1997, Piechulek *et al*. 1999, Luo *et al*. 2001). It should be noted, however, that there are serious problems in the assessment of levels of food energy adequacy or deficiency for households or for individual household members. The main reason is that levels of physical activity, a main determinant of energy requirements, are difficult to estimate (Backstrand *et al*. 1997, Bouis and Pena 1997, Harriss-White 1997). These as well as other difficulties in evaluating the occurrence of gender discrimination with respect to food allocation have been discussed extensively in the literature (Harriss 1995, Messer 1997). In fact, one of the most extensive surveys on the subject provides only weak evidence of unequal distribution of food, at the disadvantage of women, occurring mainly in India and Bangladesh (Haddad *et al*. 1996).

4.3. *Anthropometry*

In most studies in which gender-specific differences in anthropometric outcomes are being studied, it relates to children, and in a limited number of studies to adolescents or elderly people, but rarely to adults. With respect to children, at the national level differences in undernutrition prevalence rates between boys and girls are generally small (UNICEF 2002). However, there appears to be a pattern of somewhat lower nutritional status of girls in South and Southeast Asia in comparison with boys, while in other developing regions nutritional status of girls is on average slightly better (Haddad *et al*. 1996, Svedberg 1996). It should be noted that there are also a number of studies, often in poor rural communities, where much larger differences in undernutrition prevalence rates between boys and girls, at the disadvantage of girls, have been observed, again mostly in South/Southeast Asia (Rousham 1996, Miller 1997, Yadav and Singh 1999, Choudhury *et al*. 2000). The present study reveals for adult women a slightly higher prevalence rate of undernutrition in samples from South/Southeast Asia and Latin America, in comparison with prevalence rates in adult men. On the other hand, in communities in Sub-Saharan Africa prevalence of undernutrition in adults is, on average, lower in women than in men. Though it is perhaps premature to interpret these findings for Sub-Saharan Africa as male discrimination—there are no reports in the literature on

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the occurrence of male discrimination in Sub-Saharan Africa—results at least give further support to the concept that women in Sub-Saharan Africa are relatively better off than women in South/Southeast Asia. Findings such as, for example, those reported for Mauritania, where about twice as many men than women have a BMI below 18.5 definitely need further attention. Culturally defined traditions, according to which in particular for girls a certain degree of overweight or obesity is highly valued, might place a role in explaining these results (Ducorps *et al*. 1996).

4.4. *Consequences of low BMI and selection of cut-off point*

It is a main premise in undertaking the present study that a low BMI in adults has adverse health consequences. Low BMI has been associated with increased morbidity and increased mortality (Ferro-Luzzi *et al*. 1992, Campbell and Ulijaszek 1994, Rotimi *et al*. 1999) and, in relation to pregnancy, with poor birth outcome (Kusin *et al*. 1994, Oumachigui 2002). Also productivity has been shown to be affected by low levels of BMI (Thomas and Frankenberg 2002). Thus, while there appears to be little doubt that low levels of BMI may cause various forms of functional impairment, more problematic is the question of which BMI cut-off should be selected for assessing undernutrition prevalence. The most commonly cited cut-off point, and also the most widely used, is a BMI of 18.5, below which adult individuals are classified as undernourished (WHO 1995). For the present study this cut-off point has been selected, but it should be noted that also other cut-off points have been used or propagated (Swai *et al*. 1992, Pryer 1993, Sichieri *et al*. 1994, van der Sande *et al*. 2001).

Another question that can be raised, is whether similar cut-off points should be used for males and females, and also whether the same cut-off points are applicable for people from different regions in the world and from different ethnic background. In fact, this last issue is also highly debated at the higher end of the BMI range where overweight and obesity are associated with degenerative disorders and diseases, such as hypertension, diabetes, and cardiovascular disease (James *et al*. 2001). In various studies, it has been shown that differences exist in body composition between, for example, Asians, Africans and Caucasians, and propositions have been made to apply different cut-off points for people from different ethnic background (Norgan 1995, Long *et al*. 1998, Deurenberg *et al*. 2002), or to adjust BMI for differences in body build (Sánchez-Castillo *et al*. 2001). One approach in attempting to account for ethnic differences in body build in the assessment of undernutrition has been the introduction of the Cormic index, but its use appears not to be widely accepted (Norgan 1995, Collins *et al*. 2000, Khongsdier 2001, Salama *et al*. 2001). Finally, it should be noted that adult BMI can vary strongly with age. In low income countries, BMI tends to increase up to around 45–50 years after which it reaches a plateau or starts to decrease. Thus, also in relation to age the question can be asked whether a fixed cut-off point for undernutrition should be used or whether differentiation should be made in relation with age. In principle, when making comparisons between prevalence rates of undernutrition in different population groups, either the population groups should be of similar age composition, or the presented results should be age-adjusted. However, such an approach could not be followed in the present analysis because available information on age composition of survey samples was incomplete in many cases.

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4.5. The Asian enigma

A last issue, of relevance within the context of differences in undernutrition prevalence between adult males and females, is the proposition that female deprivation might well be a major determining factor of the overall very high levels of child malnutrition, in particular in South Asian countries (Osmani 1997). In fact, the term 'Asian enigma' has been used to indicate the almost paradoxical relationships that exist between levels of food consumption, levels of child mortality, and levels of undernutrition, when comparing South Asian countries with countries from other developing regions, in particular from Sub-Saharan Africa (Ramalingaswami *et al.* 1997, Klasen 2000, Nubé 2001). There is little doubt that high levels of low BMI in women in South Asia are indeed a major causative factor for high levels of child malnutrition, primarily as a result of the linkages between mothers' nutritional status and birth weight. However, results indicate that prevalence rates of undernutrition are also very high for male adults in South Asia, almost as high as in women, and much higher than in most countries in Sub-Saharan Africa. Therefore, female deprivation, as expressed by a low BMI, is unlikely to be a major explanatory factor for the much higher levels of child malnutrition in South Asia in comparison with other developing regions.

As a final note, the limitations of the present study should be considered. In view of the fact that nationally representative anthropometric surveys in both adult men and adult women are hardly available, the analysis had to be based on a very heterogeneous set of small-scale studies, which limits comparability. Furthermore, the anthropometric data used are mainly from adults in the 20–50 years age groups, and further analysis on other age groups such as adolescents and elderly people is needed to confirm current findings. Finally, BMI is not the only indicator which provides information on nutritional status, and in future studies information on, for example, micro-nutrient deficiencies would need to be considered as well.

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Appendix

Anthropometric data on adult men and adult women as reported in 75 datasets from 31 countries in South/Southeast Asia, Latin America and Sub-Saharan Africa.

No.	Country	Sample characteristics	Mean BMI, males	Mean BMI, females	Males, BMI < 18.5	Females, BMI < 18.5	Sample size, M/F	Age group, years	Source
1	Argentina	urban	24.8	23.6	1.4	8.9	147/357	19–64	1
2	Bangladesh	rich	21.7	23.0			600/250	> 20	2
3	Bangladesh	poor	18.4	18.3			367/329	> 20	2
4	Bangladesh	sub-urban	20.2	19.7			4252/2318	> 15	3
5	Bangladesh	urban poor	19.0	18.8	51.8	54.3	199/186	(36.5)*	4
6	Brazil	national			3.4	5.1	23 544 (M + F)	25–64	5
7	Brazil	national	24.3	24.6			4894/5786	> 20	6
8	Brazil	urban	23.5	24.2	4.2	6.6	333/488	20–50	7
9	Brazil	northeast and southeast			3.4	6.1	5272/5983	> 20	8
10	Cameroon	urban	25.0	27.0			458/584	25–75	9
11	Cameroon	rural	21.9	22.3			307/436	25–75	9
12	Cameroon	rural	23.5	23.5			742/717	adults†	10
13	Cameroon	urban	25.1	27.0			614/752	adults†	10
14	China	urban	22.6	22.9	8.1	8.0	8538/9934	> 20	1
15	China	rural	21.4	21.8	9.6	10.9	16 762/18 772	> 20	1
16	China	eight provinces	21.4	21.9	7.9	8.4	1831/2150	20–45	11
17	Congo	urban	22.1	23.2			1198/1806	> 18	12
18	Congo	rural	20.2	20.5			498/846	> 18	12
19	Ethiopia	famine area (Gode)	18.0	19.3	61.5	44.5	625 (M + F)	18–59	14
20	Ethiopia	rural	19.8	21.0	18.8	17.4	197/265	> 18	15
21	Ethiopia	four ethnic groups	18.6	19.7			884/822	18–50	16
22	Ethiopia	rural	18.6	18.5	49.0	58.0	193/145	> 18	17
23	Fiji	Indians	22.3	23.4	21.7	17.9	605/621	> 18	1
24	Gambia	urban	20.8	23.9			1028/1138	> 15	18
25	Gambia	rural	19.8	20.5			1200/2023	> 15	18
26	Ghana	national	20.8	22.1	16.2	16.6	4961/4252	20–65	19
27	Ghana	rural	19.1	19.9	40.1	35.4	n.a.§	adults†	20
28	Ghana	urban	19.8	21.2	34.1	27.6	n.a.§	adults†	20
29	Ghana	national			23.4	15.7	3060/3263	15–60	21
30	Guatemala	rural	21	22.5	8.0	4.4	661/707	42.7/34.2‡	22
31	Guinea	urban			11.1	8.8	2175/2217	adults†	1
32	India	urban	22.8	22.2			278/285	45–65	23
33	India	state (A. Pradesh)	19.9	20.1			456/663	18–75	24
34	India	rural	18.9	19.0	49.0	49.3	9447/11 914	adults†	25
35	India	rural	17.7	18.0	70.0	61.0	323/332	> 18	17
36	India	rural	21.3	21.1			894/875	> 18	26
37	India	north			31.3	30.0	27 934/44 945	adults†	1
38	India	east			39.8	58.3	24 739/32 285	adults†	1
39	India	northeast			14.1	17.0	17 533/19 211	adults†	1
40	India	west			28.8	38.8	806/1234	adults†	1
41	India	Union Territories			23.4	32.3	1449/1791	adults†	1
42	Indonesia	(sub) urban	23.5	22.3			118/109	adults†	27, 28
43	Malaysia	Malay	22.7	23.4	12.3	14.7	12 737 (M + F)	> 20	29
44	Malaysia	Chinese	23.2	22.7	9.2	14.1	7619 (M + F)	> 20	29
45	Malaysia	Indians	23.2	23.7	10.7	12.9	1941 (M + F)	> 20	29
46	Mali	national (unweighted)			14.5	19.1	4868 (M + F)	adults†	1
47	Mali	northeast	20.1	20.6	26.0	23.0	316/530	18–60	30

(*continues*)

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Continued.

No.	Country	Sample characteristics	Mean BMI, males	Mean BMI, females	Males, BMI < 18.5	Females, BMI < 18.5	Sample size, M/F	Age group, years	Source
48	Mauritania	national	20.7	24.1	22.2	12.6	882/1230	> 18	1
49	Mexico	rural	25.4	27.9	1.9	3.4	104/149	> 18	31
50	Mexico	urban			1.4	1.8	5930/8462	20–70	32
51	Namibia	northern region	19.9	19.2	27.5	33.2	300/178	18–65	33
52	Niger	national			25.4	28.7	n.a.§	18–60	1
53	Nigeria	urban			21.0	18.5	1743/2318	> 25	34
54	Nigeria	rural	21.0	22.0			1079/1076	(42.2)	13
55	Nigeria	urban	20.3	21.9			1135/1745	(40.4)	13
56	Nigeria	urban	21.3	22.5			502/649	(44.0)	13
57	Pakistan	national			25.0	25.3	18 315 (M + F)	25–65	35
58	Pakistan	urban (Karachi)			12.6	22.2	444/572	adults†	36
59	Pakistan	rural	19.8	20.3	32.3	34.1	n.a.	adults†	20
60	Philippines	rural			22.2	25.9	603/461	15–59	21
61	Philippines	rural	18.7	19.0	42.5	47.9	n.a.	adults†	20
62	Philippines	national			8.9	13.9	1556/1557.	20–39	1
63	Senegal	district	19.0	20.6	46.0	23.0	107/214	adults†	30
64	Sri Lanka	national, urban	21.2	21.5	27.6	21.1	667/735	adults†	1, 37
65	Sri Lanka	national, rural	19.6	19.8	43.0	43.3	412/411	adults†	1, 37
66	Tanzania	rural (eight villages)	20.1	21.0			3705/4876	> 15	38
67	Togo	urban	22.0	23.0	17.4	9.8	2334/2109	adults†	39
68	Uruguay	urban (Montevideo)	24.1	24.5	3.4	3.7	274/271	20–50	1
69	Venezuela	national	24.3	24.3			1572/5131	20–40	1
70	Venezuela	national			5.3	6.5	1650/5392	20–50	1
71	Vietnam	province (Ha Tay)	19.4	19.4	30.9	32.8	6993/8142	20–50	1
72	Vietnam	10 states	19.3	19.3	28.5	30.5	4130/6892	18–60	40
73	Zimbabwe	district	20.7	22.0	15.0	12.0	477/806	> 18	17
74	Zimbabwe	district	20.3	21.7	17.0	10.0	291/546	33.4/34.2	30
75	Zimbabwe	rural	18.8	20.1			177/323	adults	1

* Mean age of sample.
† Age group not precisely indicated.
‡ Mean age for, respectively, men and women in sample.
§ n.a. = not available.

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Sources of datasets (last column)

1. FAO Nutrition Country Profile, www.fao.org/es/ESN/nutrition/profiles_en.stm, Argentina (dated 27 October 1999), China (dated 19 April 1999), Fiji (dated 22 December 1999), Guinea (dated 4 February 1999), India (dated June 1998), Mali (dated 26 January 1999), Niger (dated 29 September 1998), Philippines (dated August 2001), Sri Lanka (dated 10 February 1999), Uruguay (dated 17 December 1999), Venezuela (dated 15 December 2000), Viet Nam (dated 2 March 1999), Zimbabwe (dated 3 July 2001).
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Zusammenfassung. *Hintergrund*: Informationen über die Prävalenz von Untergewicht bei Erwachsenen aus Entwicklungsländern beschränken sich hauptsächlich auf Daten von Frauen. Die Literatur über die Entrechtung von Frauen in Entwicklungsländern, insbesondere in Südasien, weist darauf hin, dass Unterschiede bei der Prävalenz der Unterernährung bei erwachsenen Männern und Frauen auftreten könnten. Es mangelt aber an systematischen Informationen zu diesem Thema.
Ziel: Die Studie vergleicht Prävalenzraten zur Unterernährung bei erwachsenen Männern und Frauen aus Entwicklungsländern. Unterernährung wurde anhand eines niedrigen Body Mass Index (BMI < 18.5) definiert. Regionale Vergleiche wurden zwischen den Hauptentwicklungsgebieten Subsahara Afrika, Süd-/Südostasien und Lateinamerika durchgeführt.
Material und Methoden: Die Studie verwendet Daten von 75 Stichproben aus 31 Ländern (verteilt über die drei Entwicklungsgebiete). Die anthropometrischen Daten wurden dabei bei erwachsenen Männern und Frauen derselben Gemeinde erhoben.
Ergebnisse: Die Ergebnisse zeigen, dass die Prävalenzrate für Unterernährung bei erwachsenen Männern und Frauen im Durchschnitt ziemlich ähnlich ist. Es gibt jedoch regionale Unterschiede. In den Gemeinden in Subsahara Afrika ist die Prävalenz niedriger BMI-Werte bei Männern im Durchschnitt einige Prozente höher als bei Frauen, in Süd-/Südostasien ist das Gegenteil der Fall. In einigen Gemeinden sind die Unterschiede zwischen Männern und Frauen bei der Prävalenz der Unterernährung außergewöhnlich groß.
Schlussfolgerungen: Es kann gefolgert werden, dass im allgemeinen die Informationen über die Prävalenz der Unterernährung bei Frauen eine Schätzung der Unterernährungsprävalenz bei allen Erwachsenen, Männern und in Frauen zusammen, zulassen. Jedoch zeigen die Befunde, dass in Süd-/Südostasien der Ernährungsstatus der Frauen relativ zu dem der Männer, im Vergleich mit Resultaten aus anderen Entwicklungsgebieten – insbesondere aus Subsahara Afrika – ungünstig ist. Dies bestätigt die Vermutung der Benachteiligung von Frauen in Süd-/Südostasien. In Gebieten mit großen Unterschieden bei der Prävalenz von niedrigen BMI-Werten zwischen Männern und Frauen, sollte eine geschlechtsspezifische Politik angestrebt werden, um die Unterernährung zu verringern.

Résumé. *Arrière-plan*: L'information disponible à propos de la sous nutrition des adultes dans les pays en développement, est essentiellement limitée à des données féminines. Les observations publiées sur les cas de sous alimentation des femmes dans les pays en développement, en particulier en Asie méridionale, suggèrent qu'il pourrait se produire des différences entre les prévalences de sous nutrition masculine et féminine, mais on manque d'information sur cette question.

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But: L'étude compare les taux de sous nutrition à partir de la prévalence d'indices de masse corporelle bas (IMC < 18,5) chez les hommes et les femmes adultes de pays en développement. Des comparaisons régionales sont effectuées entre les principales zones de sous développement: l'Afrique sub-saharienne, l'Asie du Sud et du Sud-est et l'Amérique latine.
Sujets et méthodes: L'étude utilise des observations provenant de 75 échantillons appartenant à 31 nations (réparties en fonction des trois zones de sous développement), pour lesquelles des informations anthropométriques ont été publiées sur les hommes et les femmes d'une même communauté.
Résultats: D'une manière générale, les taux de sous nutrition sont relativement semblables dans les deux sexes, mais il existe des différences régionales. La prévalence de faible IMC est légèrement plus forte de quelques pour cents chez les hommes que chez les femmes en Afrique sub-saharienne, alors que l'inverse est observé en Asie du Sud et du Sud-est. Dans quelques unes des communautés, les différences de prévalence entre hommes et femmes sont exceptionnellement élevées.
Conclusions: On peut considérer qu'en général, l'information disponible sur la sous nutrition féminine peut être utilisée comme une approximation de la prévalence de la sous nutrition chez l'ensemble des adultes. Cependant, le fait qu'en Asie du Sud et du Sud-est, contrairement à ce qui est observé dans d'autres zones en développement telle l'Afrique sub-saharienne, l'état nutritionnel des femmes soit inférieur à celui des hommes, évoque un concept de carence alimentaire féminine dans cette région. Là ou de grandes différences entre les prévalences masculines et féminines d'IMC faible se manifestent, on devrait prendre des mesures qui visent à réduire la sous nutrition liée au sexe.

Resumen. *Antecedentes*: La información sobre la prevalencia de desnutrición en adultos en los países en vías de desarrollo está restringida principalmente a datos sobre mujeres. La literatura que señala la existencia de carencias nutricionales en la población femenina de los países en vías de desarrollo, en particular en el sur de Asia, sugiere que podrían existir diferencias en la prevalencia de desnutrición entre mujeres y hombres adultos, aunque se carece de información sistemática sobre este hecho.
Objetivo: Este estudio compara las tasas de prevalencia de desnutrición, basadas en la prevalencia de bajos índices de masa corporal (BMI < 18,5), en hombres y mujeres adultos de países en vías de desarrollo. La comparación regional se realiza entre las principales regiones en vías de desarrollo del Africa subsahariana, del sudsudeste de Asia y de Latinoamérica.
Sujetos y métodos: El estudio utiliza datos de 75 muestras procedentes de 31 países (divididas según las 3 regiones en vías de desarrollo), en las que se ha recogido información antropométrica de hombres y mujeres adultos en el interior de la misma comunidad.
Resultados: Los resultados indican que, en general, las tasas de prevalencia de desnutrición son bastante similares en hombres y mujeres adultos. Sin embargo, existen diferencias regionales. En las comunidades del Africa subsahariana, la prevalencia de bajos índices de masa corporal es, en media, porcentualmente algo mayor en los hombres que en las mujeres, mientras que en el sudsudeste de Asia se da la situación contraria. En algunas comunidades las diferencias en la prevalencia de desnutrición entre hombres y mujeres son excepcionalmente altas.
Conclusiones: Puede concluirse que, en general, la información sobre la prevalencia de desnutrición en mujeres puede ser considerada como una predicción de la prevalencia de desnutrición en el conjunto de los adultos, hombres y mujeres. Incluso el hecho de que el estado nutricional de las mujeres del sudsudeste de Asia, comparado con el estado nutricional de los hombres, muestre una relación inversa respecto a los resultados de otras regiones en vías de desarrollo, en particular el Africa subsahariana, proporciona un cierto apoyo al concepto de carencia alimentaria femenina en el sudsudeste de Asia. En aquellos lugares donde se producen las mayores diferencias en la prevalencia de un BMI bajo entre hombres y mujeres deberían considerarse políticas específicas para cada género, dirigidas a reducir la desnutrición.

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