Predicting under- and overnutrition among women of reproductive age: a population-based study in central Java, Indonesia

Anna Winkvist[1,*], Detty Siti Nurdiati[1,2], Hans Stenlund[1] and Mohammad Hakimi[2,3]
[1]Department of Public Health and Clinical Medicine, Epidemiology, Umeå University, S-90185 Umeå, Sweden: [2]Department of Obstetrics and Gynaecology, Faculty of Medicine, Gadjah Mada University, Yogyakarta, Indonesia: [3]Community Health and Nutrition Research Laboratory, Faculty of Medicine, Gadjah Mada University, Yogyakarta, Indonesia

Submitted 17 June 1999: Accepted 20 October 1999

Abstract

Objectives: To evaluate changes over 1 year in weight and body mass index (BMI) among a population-based sample of non-pregnant women in Indonesia and to identify risk factors for developing under- and overnutrition.
Design: Cross-sectional studies in 1996 and 1997 in the same population.
Setting: Purworejo District, central Java, Indonesia.
Subjects: Non-pregnant women ($n=4132$) aged 15–49 years of age who participated in both 1996 and 1997. Based on BMI, women were classified as having chronic energy deficiency (CED), and as being either of normal weight or obese.
Results: The mean height of the women was below the fifth percentile of international standards. In 1996, 16.2% had CED, 72.2% were normal and 11.6% were obese. In 1997, the corresponding figures were 14.4%, 71.2% and 14.3%, respectively, revealing a significant mean increase in weight and BMI. Among women classified as normal in 1996, 3.0% developed CED in 1997. Significant risk factors for developing CED were experiences of child deaths and non-use of contraceptives. Among women classified as normal in 1996, 5.3% developed obesity in 1997. Here, significant risk factors included most indicators of wealth as well as occupation.
Conclusions: The results should be important for future efforts to prevent CED and obesity in the general population; conditions which are both associated with health risks.

Keywords
Nutritional status
Indonesia
Women
Chronic energy deficiency
Obesity

Women in Third World countries have long been included in studies where the focus has been on child health and family planning rather than on the health of the women for their own sake. During the 1990s, calls were made for research that focused on the women themselves, whether they be mothers or not[1–3]. Broader definitions of women's health have therefore been suggested, for example '. . . a way of total well-being, which is not only determined by biological factors and reproduction, but also by effects of work load, nutritional stress, war and migration, among others'[4]. Important health concerns of women through their life cycle, related to diet, include CED and nutritional anaemia as well as obesity, osteoporosis, cardiovascular diseases and women's cancers[5].

Many developing countries today face the dual burden of diseases of poverty as well as diseases of affluence. Reasons for this global change in disease distribution include successful infectious disease control, longer life expectancy, urbanization and adaptations of westernized lifestyle[6–9]. In 1990, non-communicable diseases accounted for about 40% of the total loss of healthy life worldwide. Predictions are that by 2020, this proportion will have reached 60%, largely due to increases in low-income countries[7]. Cardiovascular diseases currently account for almost 10% of the total burden of diseases globally and this will be almost 15% by 2020. In industrialized countries, heart disease and stroke are the most common causes of death not only among men but also among women[5]. In Third World countries, infectious and parasitic diseases are still the leading causes of death. Even so, in absolute numbers cardiovascular diseases and cancers are greater in Third World countries than in industrialized countries[10]. Thus, research on women's health in the developing world must address the burden of diseases at both ends of the wealth spectrum.

We here report on changes in nutritional status between 1996 and 1997 among a population-based sample of women of reproductive age in Purworejo District, central Java, Indonesia. To obtain baseline information for a cohort of women who later became pregnant, measurements were taken on a representative sample of non-pregnant women of reproductive age in both 1996 and

*All data were collected before the onset of the economic crisis in the region.

**Corresponding author:* Email anna.winkvist@epiph.umu.se

https://doi.org/10.1017/S1368980000000227 Published online by Cambridge University Press

1997*. Nutritional status among the women in 1996 has been described elsewhere[11]. The aim of the substudy reported here was to evaluate changes in the prevalence of CED and obesity over a 1-year period among the women measured on both occasions. Risk factors for developing the two conditions, among women classified as having a normal BMI in 1996, were also investigated.

Methods

Study setting

Data were collected in Purworejo District, central Java, Indonesia. The total district population in 1996 was 744 881 and the population density was 720 persons km^{-2}. People reside in 494 villages that are organized into 16 subdistricts. The district, 65 km to the west of Yogyakarta, includes coastal, lowland, highland and mountainous areas. Most people are Muslim and the major occupation is farming. Rice is the primary staple food, while cassava and sweet potato are consumed as snacks. Vegetables are eaten regularly and fruits are available during all seasons. Egg and fish are added to the diet if affordable, whereas meat is a luxury item not regularly consumed.

Since 1994, the district has undergone continuous surveillance through an initiative by the Community Health and Nutrition Research Laboratory (CHN-RL), Gadjah Mada University, Yogyakarta, Indonesia, in collaboration with the Ministry of Health, Indonesia and supported by the World Bank. During 1994–97, a subsample of approximately 10% of all households in the districts were visited every third month and data on demographics, vital statistics and health were collected. A two-stage cluster sampling method with probability proportional to the estimated size of cluster was used for the selection of households[12]. All family members in these households were included.

Study population

Women of reproductive age, currently not pregnant or sterilized (i.e. likely to become pregnant), were selected for a longitudinal study on nutritional status among women starting before pregnancy. A CHN-RL survey performed in August–October 1995 identified 13 094 women aged 15–49 years in the surveillance sample (Fig. 1). Among these, 4940 had outmigrated, were pregnant or unmarried (hence culturally unsuitable for a study on women 'likely to become pregnant'). The

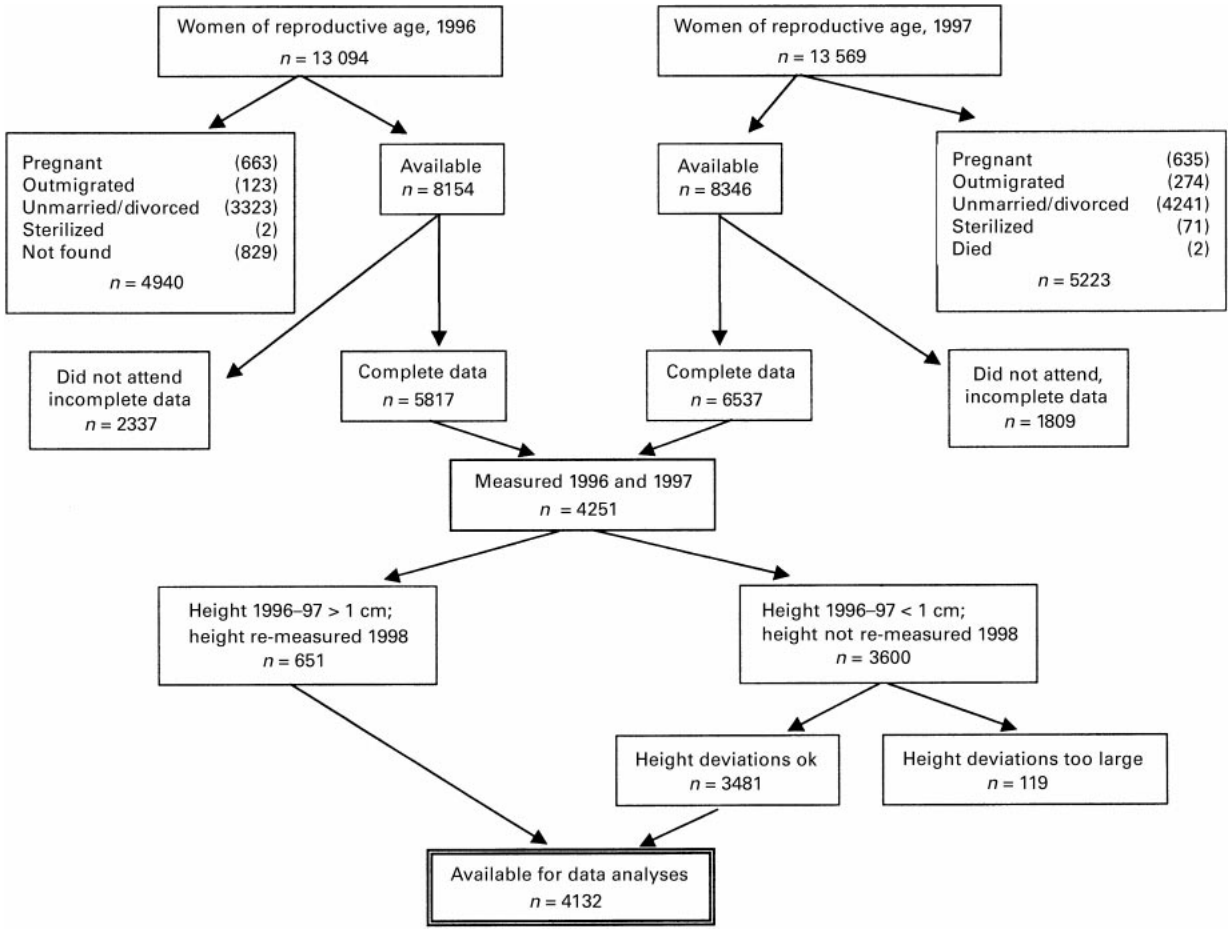

Fig. 1 Sample selection for analyses

https://doi.org/10.1017/S1368980000000227 Published online by Cambridge University Press

remaining 8154 women were invited to attend anthropometric measuring sessions between January and March 1996. In total, 5880 women attended the measuring sessions (72% coverage) and complete data existed for 5817 of these (see ref. 11 for further details).

Anthropometric measurements on non-pregnant women of reproductive age were again carried out between May and July 1997. A CHN-RL survey performed January–March 1997 identified 13 569 women aged 15–49 years. Among these, 8346 were married and non-pregnant and measurements were obtained on 6537 (78%) of these. Finally, a data file was created with information on women who had attended both the measurement sessions. Among the 5817 women with complete data from 1996, 408 were not identified in the 1997 survey, 182 were no longer likely to become pregnant (114 pregnant, 67 outmigrated, 1 dead), 357 were not at home, 19 were sick, 2 refused and 598 were not reached for unknown reasons. Hence, 4251 women had their height measured a second time. Due to discrepancies of $\geqslant 1$ cm between height measurements taken in 1996 and 1997, indicating measurement errors, 651 women were re-measured in 1998. Among the remaining 3600 women, deviations between the 1996 height and the 1997 height were still large enough for 119 women to be classified into categories of CED (see below). These women were removed from analyses. A new height variable was created using data from 1998 if available, and otherwise using data from 1997. Thus, the final data file contained information on nutritional status in 1996 and 1997 (and height in 1998 for 651 women) as well as demographic and socioeconomic data from the 1995 survey for 4132 women.

We believe that the results from our analyses generally are representative for women of childbearing age in Purworejo District. For cultural reasons, only married women likely to become pregnant were included. Still, the majority of women in Purworejo District are Muslim, with a strong tradition of marrying before bearing children. We have also previously[11] compared the women attending measurement sessions in 1996 with the women not attending the measurement sessions as well as the women classified as not likely to become pregnant. Women not likely to become pregnant were significantly younger, more likely to live in the urban area, and more educated yet still unemployed, than the other groups. Among eligible women, those not attending measurement sessions also were significantly more educated, and more likely to live in the urban area as well as to work in the non-agricultural sector. Measurements of mid-upper arm circumference were available for all three groups and these did not differ significantly. Hence, our results should be representative for the majority (86%) of women in Purworejo District who live in the rural areas but extrapolation to younger, more educated women in the urban area should be made with caution.

Unfortunately, height had to be re-measured in 1998 on a sample of 651 women and an additional 119 women had to be excluded from analyses because of minor deviations in height between 1996 and 1997 which were still large enough to affect the classification on BMI. However, these 119 women did not differ significantly on any of the demographic or socioeconomic variables from the 4132 women included in the analyses (*t*-test and chi-square test, *P*-values 0.26–0.99). We believe that weight was measured more accurately because this measurement took place in front of the fieldworker recording the data; hence two people observed the results on the electronic scale. In contrast, height readings from the stadiometer were reported from one fieldworker to the one recording the data.

Measurements

Anthropometric measurements were taken by 10 trained fieldworkers in the integrated health posts in each village. Training and standardization procedures were carried out regularly. Measurements included body weight (measured within 0.1 kg with calibrated electronic scales) and height (using stadiometers with an accuracy of 0.1 cm).

BMI for 1996 and 1997 were calculated using the new height variable based on data from 1997 ($n=3481$) and 1998 ($n=651$). Women were classified into categories of CED based on BMI as follows[13]: CED III, $<16.0\,kg\,m^{-2}$; CED II, 16.0–16.9; CED I, 17.0–18.4; normal, 18.5–24.9; obesity I, 25.0–29.9; obesity II, 30.0–39.9, and obesity III, $\geqslant 40\,kg\,m^{-2}$. Height was compared to Canadian standards for women[14].

The demographic and socioeconomic data were collected by trained CHN-RL fieldworkers during home visits using precoded questionnaires. Information used for the current analyses include age, parity, family size, child deaths, use of contraceptives, ownership of radio, television, refrigerator, bicycle, motorcycle or car, expenditures on food, non-food items and medicines, as well as education, occupation, area of residence, altitude and housing condition. The latter five were categorized based on the Indonesian Demographic and Health Survey categorization scheme[15].

Statistical analysis

Data were entered using the Household Registration System (HRS version 2, 1995) and dSurvey (1989). Data cleaning and statistical analyses were performed using SPSS (version 8.0, 1998). Comparisons of nutritional status in 1996 and 1997 were performed using mean changes in weight and BMI with the 95% confidence interval (CI) of mean changes. In addition, the chi-square test was applied to the proportion of women in each category of nutritional status during 1996 versus 1997. Using multivariate logistic regression analysis, the 2734 women classified as normal during both 1996 and 1997 were compared with the 90 women classified as normal in 1996 who developed CED in 1997, as well as with the 159 women classified as normal

Table 1 Anthropometric measurements among Indonesian women during 1996 and 1997 ($n=4132$)*

Variable	1996 (mean ± SD)	1997 (mean ± SD)	Change 1996–97	
			Mean	95%CI
Weight (kg)	47.9 ± 7.9	48.7 ± 8.2 (48.5 ± 8.1)†	+0.7 (+0.6)†	+0.6, +0.8 (+0.5, +0.7)†
Body mass index (kg m^{-2})	21.3 ± 3.1	21.6 ± 3.3	+0.3 (+0.3)†	+0.3, +0.4

*Number of days between measurements: mean 435 (SD ± 35); minimum 327, maximum 580.
†In parentheses: adjusted for number of days between measurements and expressed for 365 days' difference.

in 1996 who developed obesity in 1997. Potential risk factors that were evaluated for association with development of CED and/or obesity included the demographic and socioeconomic variables described above. Risk factors that were significant or that exhibited an important trend in univariate analysis were included in multivariate models, where maternal age was adjusted for as a potential confounding variable.

Population attributable proportion was calculated for significant risk factors as $p*(RR-1)/[1+p*(RR-1)]$. Here, RR (relative risk) was approximated by the OR (odds ratio) from the logistic regression analyses and p was the proportion of exposed in the population (calculated among the 13 569 women of reproductive age in 1997). Ethical approval was obtained from Ethical Committees at the Medical Faculty of Umeå University as well as Gadjah Mada University.

Results

Description of Indonesian women

For the sample of 4132 women, the mean height was 149.8 (SD ± 5.0) cm, which is below the fifth percentile of international standards. Women were significantly heavier in 1997 than in 1996, as indicated by both weight and BMI (Table 1). In 1995, the mean age of the women was 34.8 (SD ± 7.0) years; 2.5% were nulliparous, 13.3% were uniparous and 84.2% were multiparous. Further, 6.8% had no education, 71.3% had 1–6 years of education and 21.8% had over 6 years education. About half of the women worked in agriculture. Finally, about half of the women lived in the coastal area and about a quarter each lived in lowland or hilly areas, respectively, leaving only a few percentages in the mountain areas. Only 6.5% resided in urban areas and 93.5% in rural areas.

Between 1996 and 1997, in most age groups about half of the women gained more than 0.5 kg in weight (Table 2). Similarly, in most age groups about 25% of the women lost more than 0.5 kg and about 25% experienced a weight change of less than 0.5 kg.

The proportion of women classified with any degree of CED was 16.2% (669) in 1996 and 14.4% (597) in 1997 (Table 3). In 1996, 72.2% (2983) were classified as normal and in 1997 this proportion was 71.2% (2943). Obesity of any degree existed among 11.6% (480) in 1996 and among 14.3% (592) in 1997. Among the 2983 women classified as normal in 1996, 90 (3.0%) developed CED during 1997 and 159 (5.3%) became obese during the same period. Among the 2943 women classified as normal in 1997, 163 (5.5%) had recovered from CED and 46 (1.6%) had been obese in the previous year. The proportions of women classified as having CED, or being normal or obese during 1996 and 1997 differed significantly, with a smaller proportion classified as having CED and a larger proportion as being obese in 1997 (chi-square test of marginal distributions, $P=0.0003$).

Risk of developing CED or obesity during 1996–97 among women classified as normal in 1996

Only a few significant risk factors for developing CED between 1996 and 1997 were found (Table 4). Women who had ever experienced a child death were of significantly increased risk of developing CED, compared to women who had never experienced a child death (adjusted for maternal age). The child deaths were mainly neonatal and infant deaths that had occurred during the

Table 2 Association between age and change in weight in 1996–97 among Indonesian women ($n=4132$)

Age (years)	*n*	Weight change (kg) (mean ± SD)	Weight change (% within age groups)		
			> −0.5 kg	−0.5 to +0.5 kg	> +0.5 kg
15–19	42	1.2 ± 3.1	28.6	2.4	69.0
20–24	282	1.2 ± 2.8	25.2	20.9	53.9
25–29	653	0.7 ± 3.1	31.1	17.8	51.1
30–34	980	0.7 ± 3.0	28.6	20.2	51.2
35–39	1027	0.7 ± 2.7	28.5	22.5	49.0
40–44	763	0.7 ± 2.3	25.6	23.1	51.4
45–49	385	0.5 ± 3.4	33.0	23.9	43.1

https://doi.org/10.1017/S1368980000000227 Published online by Cambridge University Press

Table 3 Proportion of Indonesian women classified with chronic energy deficiency (CED)*, and classified as either normal or obese in 1996 and 1997 ($n=4132$)

Classification in 1996	Classification in 1997			
	CED (grades I–III)	Normal	Obesity (grades I–III)	Total
CED (grades I–III)	504	163	2	669 (16.2%)
Normal	90	2734	159	2983 (72.2%)
Obesity (grades I–III)	3	46	431	480 (11.6%)
Total	597 (14.4%)	2943 (71.2%)	592 (14.3%)	4132 (100%)

*Based on body mass index, as described by James *et al.*[13].

previous 10 years. Women with no children constituted a small group (2.5%). There was no significant association between parity or age and risk of developing CED although women with 2–4 children tended to have a lower risk than women with 0–1 or ⩾5 children. When parity was adjusted for in the multivariate analyses, experience of a child death was still a significant risk factor for developing CED.

Women not using any contraceptives had a significantly increased risk of developing CED compared to women using contraceptives. Both the experience of a child death and non-use of contraceptives were prevalent conditions in the population, leading to large population attributable proportions. If causal relationships were assumed, the experience of child death would account for 14% and the non-use of contraceptives for 39% of the development of CED in this population. No indicators of wealth were found to have significant relationships with the risk of developing CED.

Several factors were significantly associated with the development of obesity between 1996 and 1997 (Table 5). Women working in agriculture were significantly protected from developing obesity compared to other women. The proportion of obesity explained by women being unemployed or housewives, compared to working in agriculture, was 30% (assuming causal relationship). On the univariate level, area of residence and altitude were also significantly associated with the risk of developing obesity, with urban women and women in the coastal area having the highest risks. Most indicators of socioeconomic status showed significant relationships with the development of obesity. In Table 5, ownership of bicycle, floor type and latrine type have been included as examples. Finally, food expenditures were not significantly associated with the risk of developing obesity. There was no association between parity or age with risk of developing obesity, although older women tended to have an elevated risk.

Discussion

These results constitute one of the first reports on longitudinal changes in nutritional status among a population-based sample of women of reproductive age in Indonesia. Even though the follow-up period was short (1 year), emerging patterns can be identified that can be further studied in larger, more costly studies. The overall trend during 1996–97 among our sample of women was of significantly higher body weight and BMI, probably reflecting a shift to a more westernized diet[9]. The proportion of women classified with CED decreased significantly, whereas the proportion of obese women increased significantly. The latter trend deserves attention: in women obesity is associated with increased risk for several diseases, for example non-insulin-dependent

Table 4 Risk factors for developing chronic energy deficiency (CED) between 1996 and 1997 among Indonesian women of normal BMI in 1996 ($n=2824$)

Risk factor	Level	Univariate analyses		Multivariate analyses*	
		OR	95%CI	OR	95%CI
Any child deaths	No deaths	1.00		1.00	
	Deaths	1.99	1.24, 3.20	2.18	1.32, 3.62
	No children	2.59	0.91, 7.37	1.14	0.33, 3.90
Contraceptive use	Yes	1.00		1.00	
	No	2.20	1.44, 3.36	2.04	1.30, 3.19
Food expenditures	121–475	1.00		1.00	
(1000 Rupiah month^{-1}, quintiles)	99–120	1.41	0.63, 3.14	1.41	0.61, 3.25
	84–98	2.03	0.96, 4.31	1.88	0.84, 4.19
	70–83	1.47	0.66, 3.23	1.47	0.64, 3.38
	1–69	2.18	1.03, 4.60	1.81	0.80, 4.08
Car ownership	Yes	1.00		1.00	
	No	1.59	0.73, 3.46	1.37	0.58, 3.22

*All four variables included in multivariate model and maternal age adjusted for.

https://doi.org/10.1017/S1368980000000227 Published online by Cambridge University Press

Table 5 Risk factors for developing obesity between 1996 and 1997 among Indonesian women of normal BMI in 1996 ($n=2892$)

		Univariate analyses		Multivariate analyses*	
Risk factor	Level	OR	95%CI	OR	95%CI
Occupation	Unemployed/housewife	1.00		1.00	
	Agricultural	0.39	0.27, 0.56	0.46	0.30, 0.79
	Non-agricultural	0.80	0.52, 1.21	0.75	0.48, 1.16
Residence	Rural	1.00		1.00	
	Urban	2.36	1.41, 3.97	1.34	0.75, 2.40
Altitude	Coastal	1.00		1.00	
	Lowland	0.94	0.64, 1.40	0.95	0.61, 1.47
	Hills or highland	0.50	0.33, 0.76	1.15	0.68, 1.95
Bicycle ownership	No	1.00		1.00	
	Yes	0.36	0.22, 0.59	0.48	0.26, 0.86
Floor type	Ceramic or tiles	1.00		1.00	
	Wood	1.10	0.14, 8.60	1.42	0.17, 11.50
	Soil	0.38	0.26, 0.54	0.59	0.39, 0.92
Latrine type	Private septic tank	1.00		1.00	
	Private, no septic tank	0.67	0.37, 1.22	0.89	0.48, 1.65
	Shared or public toilet	0.49	0.23, 1.05	0.63	0.29, 1.37
	River, pond or yard	0.44	0.31, 0.62	0.78	0.52, 1.19
Non-food expenditure	80–808	1.00		1.00	
(1000 Rupiah month^{-1}, quintiles)	59–79	0.52	0.32, 0.84	0.73	0.44, 1.20
	46–58	0.74	0.48, 1.15	1.14	0.71, 1.84
	35–45	0.41	0.24, 0.68	0.71	0.40, 1.26
	1–34	0.42	0.25, 0.71	0.81	0.46, 1.46

*All seven variables included in multivariate model and maternal age adjusted for.

diabetes mellitus, coronary heart disease, stroke, hypertension, gallbladder disease, menstrual irregularities and certain cancers[5]. However, weight change patterns were not homogeneous for the whole sample; therefore the analysis of risk factors for developing either CED or obesity was important.

A shift in disease distribution has been observed in many developing countries, leading to increases in diet-related chronic diseases[10]. In Indonesia, a transition in morbidity pattern has occurred in Java and Bali islands during the last decade[16]. Here, the main cause of mortality has changed from infectious diseases to chronic degenerative diseases. This transition has happened in parallel with a change in the age distribution of the population towards a larger proportion of older people. However, infectious diseases are still the main problem in other islands and also in rural areas and among young people in Java and Bali islands. Hence, Indonesia, like many other developing countries, experiences a double disease burden where prevention of both aspects of nutrition are needed[17]. To this end, knowledge of risk factors for under- as well as overnutrition is important.

As expected, most indicators of socioeconomic status as well as occupation were significantly associated with risk of developing obesity. Probably because of the colinearity among residence, occupation and altitude (all significant in univariate analysis), only occupation remained significant in multivariate analyses. Unexpectedly, none of the socioeconomic indicators significantly predicted risk of developing CED.

Surprisingly, there was no significant association between parity or maternal age with either risk of CED or risk of obesity, although older women tended to have a higher risk of developing obesity. Inasmuch as several other risk factors were associated with maternal age, the latter was adjusted for in the multivariate analyses. Higher education was (non-significantly) associated with lower risk of CED and higher risk of obesity.

Non-use of contraceptives and having experienced at least one child death were found to be significant risk factors for CED, even when other indicators of socioeconomic status were adjusted for. It may be that families that have experienced previous child deaths have less access to health services and support – characteristics not captured by the indicators of socioeconomic status included in our study. Maternal and child health may also be poorer. Similarly, non-use of contraceptives may indicate less access to health services and/or closer birth spacing. In sum, even if not causally linked to the development of CED, these factors may indicate circumstances of reproductive stress and inadequate access to health services. At the least, the results underscore the importance of proper health and nutrition and access to health care for women during reproduction.

The findings presented on risk factors for developing CED and obesity between 1996 and 1997 are consistent with our previous findings on risk factors among these same women for being CED or obese versus being normal in 1996[11]. Further, comparisons of women classified as having CED in both 1996 and 1997 with women classified

https://doi.org/10.1017/S1368980000000227 Published online by Cambridge University Press

as normal in both 1996 and 1997 identified similar sets of risk factors for CED (data not shown). Likewise, comparisons of women classified as obese in both 1996 and 1997 with women classified as normal in both 1996 and 1997 identified similar sets of risk factors as those described above. Finally, comparisons of women shifting from CED in 1996 to normal in 1997, with women classified as CED in both 1996 and 1997, yielded similar results to those shown in Table 5 although no significant associations were found in the multivariate analyses.

Studies in other countries also have investigated risk factors among women for being CED or obese. For example, predictors of BMI among mothers have been explored within the Nutrition Collaborative Research Support Program (CRSP) in Egypt, Mexico and Kenya[18]. In all three countries, BMI was unrelated to socioeconomic status, the value of the family's house, their education level as well as parity of the mother. In Egypt, age was positively associated with BMI. In contrast, in Bangladesh[19], higher education was associated with higher weight among non-pregnant women. Here, age and parity were negatively correlated with weight. Among women in the East Java Pregnancy Study in Indonesia, prevalence of CED before pregnancy was higher among women of lower parity[20]. However, no relationship with age was found once parity was adjusted for. In Congo, prevalence of CED among women increased with age in rural areas but decreased with age in urban areas[21]. Prevalence of CED was higher among poor women than among rich women in both urban and rural areas for all age groups. Finally, among women in Cuba, obesity was more prevalent in the urban areas and among those working in offices compared with those working in agriculture or who were housewives[22]. The results indicate complex relationships between nutritional status and sociodemographic variables; these relationships are probably modified by several other factors. One important effect modifier is, perhaps, level of nutrition of the women because among the studies cited, prevalence of CED and obesity varied greatly. Also, none of these studies evaluated risk factors for the development of CED or obesity.

In sum, Indonesia, like many developing countries today, faces the dual burden of problems of under- as well as overnutrition. Risk factors for both conditions are equally important to identify and prevent. Our findings indicate that CED is not explained simply in terms of poor socioeconomic status. Further research on access to health care and reproductive stress among women of child-bearing age is needed. Resources to prevent obesity should be especially targeted towards those in the higher socioeconomic strata. Overall, further exploration of ways to address both conditions are needed.

Conclusions

Our sample of Indonesian women of reproductive age experienced a significant increase in both body weight and BMI between 1996 and 1997. Risk factors for developing CED did not include indicators of socio-economic status but probably reflected inadequate access to health care and reproductive stress. Risk factors for developing obesity were related to wealth. Both conditions should receive attention among nutritionists as well as professionals outside the nutrition field in preventive public health policy and programmes.

Acknowledgements

Sincere thanks are due to all the women in Purworejo District who participated in the study as well as to colleagues at CHN-RL who helped carry out the research. The research was funded by grants from SIDA/SAREC (Swedish International Development Authority/Swedish Agency for Research Cooperation in Developing Countries) and the Research Council (FRN), Sweden, and the World Bank through the Community Health and Nutrition Development Project of the Ministry of Health, Indonesia (IBRD Loan No. 3550-IND). Data analysis and preparation of this manuscript were facilitated by a 2-month visit for Anna Winkvist at CHN-RL, funded by STINT (The Swedish Foundation for International Cooperation in Research and Higher Education).

References

1 Leslie J. Women's nutrition: the key to improving family health in developing countries? *Health Pol. Plan* 1991; **6**(11): 1–19.
2 Koblinsky M, Timyan J, Gay J, eds. *The Health of Women: A Global Perspective*. Oxford: Westview Press, 1993.
3 Doyal L. *What Makes Women Sick–Gender and the Political Economy of Health*. London: Macmillian Press, 1995.
4 Van der Kwaak A, van den Engel M, Richters A, *et al*. Women and health. *Vena J.* 1991; **3**(1): 3–33.
5 Wolinsky I, Klimis-Tavantzis D, eds. *Nutritional Concerns of Women*. New York: CRC Press, 1996.
6 Paolisso M, Leslie J. Meeting the changing health needs of women in developing countries. *Soc. Sci. Med.* 1995; **40**(1): 55–65.
7 WHO. *Investing in Health Research and Development*. Report of the Ad Hoc Committee on Health Research Relating to Future Intervention Options, No. TDR/Gen/96.1. Geneva: World Health Organization, 1996.
8 Popkin BM. The nutrition transition in low-income countries: an emerging crisis. *Nutr. Rev.* 1994; **52**(9): 285–98.
9 Drewnowski A, Popkin BM. The nutrition transition: new trends in the global diet. *Nutr. Rev.* 1997; **55**(2): 31–43.
10 James P. The global nutrition challenge in the millennium: presentation of the draft commission report. In: *Challenges for the 21st Century: A Gender Perspective on Nutrition Through the Life Cycle*. ACC/SCN Symposium Report, Nutrition Policy Paper No. 17. Geneva: ACC/SCN, 1997; 25–44.
11 Nurdiati DS, Hakimi M, Wahab A, Winkvist A. Concurrent prevalence of chronic energy deficiency and obesity among women in Purworejo, central Java, Indonesia. *Food Nutr. Bull.* 1998; **19**(4): 321–33.
12 Wilopo SA and the CHN-RL team. *Key Issues on the Research Design, Data Collection and Management*. Report of the

Community Health and Nutrition Research Laboratory, No. 2. Yogyakarta, Indonesia: Community Health and Nutrition Research Laboratory, Faculty of Medicine, Gadjah Mada University, 1997.
13 James WPT, Ferro-Luzzi A, Waterlow JC. Definition of chronic energy deficiency in adults. Report of a Working Party of the International Dietary Energy Consultative Group. *Eur. J. Clin. Nutr.* 1988; **42**: 969–81.
14 Nutrition Canada. *Anthropometry Report: Height, Weight and Body Dimensions*. Ottawa: Bureau of Nutritional Sciences, Health Protection Branch, Health and Welfare, 1980.
15 Central Bureau of Statistics (CBS), Indonesia, State Ministry of Population/National Family Planning Co-ordinating Board (NFPCB), Ministry of Health (MOH), Macro International Inc. (MI). *Indonesian Demographic and Health Survey 1994*. Caverton, Maryland: CBS/MI, 1995.
16 Ministry of Health, Indonesia. *Indonesian Health Profile 1997*. Jakarta: Centre for Health Data, Ministry of Health, 1997.
17 Posner BM, Franz M, Quatromoni P and the INTERHEALTH Steering Committee. Nutrition and the global risk for chronic diseases: the INTERHEALTH nutrition initiative. *Nutr. Rev.* 1994; **52**(6): 201–7.
18 Allen LH, Lung'aho MS, Shaheen M, Harrison GG, Neumann C, Kirksay A. Maternal body mass index and pregnancy outcome in the Nutrition Collaborative Research Support Program. *Eur. J. Clin. Nutr.* 1994; **48** (Suppl. 3): S68–77.
19 Huffman SL, Wolff M, Lowell S. Nutrition and fertility in Bangladesh: nutritional status of nonpregnant women. *Am. J. Clin. Nutr.* 1985; **42**: 725–38.
20 Kusin JA, Kardjati S, Renqvist UH. Maternal body mass index: the functional significance during reproduction. *Eur. J. Clin. Nutr.* 1994; **48** (Suppl. 3): S56–67.
21 Delpeuch F, Cornu A, Massambe J-P, Traissac P, Maire B. Is body mass index sensitively related to socio-economic status and to economic adjustment? A case study from the Congo. *Eur. J. Clin. Nutr.* 1994; **48** (Suppl. 3): S141–7.
22 Berdasco A. Body mass index values in the Cuban adult population. *Eur. J. Clin. Nutr.* 1994; **48** (Suppl. 3): S155–64.