Bmi category table

Chapter 6 Health and BMI Low BMI, pregnancy and lactation Maternal undernutrition during pregnancy impairs foetal growth. The Dutch famine during the Second World War provides an excellent example of the effects of maternal nutritional status on foetal outcome (Stein et al., 1975). A study in South India attempted to relate maternal anthropometry with birth weight in 1,642 live births (Kapur et al., 1971) and found that the mean heights of the mothers appeared to be similar in all socio-economic groups while body weights were nearly 10 kg less in mothers who belonged to the group with the lowest socioeconomic status. The birth weights followed the same trend, the mothers of the poorer socioeconomic strata had infants with the lowest birth weights. The birth weights appeared to be linearly correlated with both maternal body weights and heights. Using previous anthropometric studies on maternal nutrition, summarized by Kapur and colleagues (1971), the BMIs can be computed from mean heights and weights, all of which show maternal BMIs < 20 and in some studies, mean maternal BMIs of < 18.5. In Vietnam, these results were confirmed. The birthweight was always lower with low BMI (< 18.5) whatever the weight gain of the mother was during pregnancy (Giay & Khoi, 1992). Analysis of data from the National Nutrition Monitoring Bureau (NNMB) suggests that states in India that have women with better nutritional status, i.e. a higher value of BMI (> 18.5) also have better histories of maternal and infant nutrition (Naidu et al., 1991). Maternal BMI was related to the birth weight of the infant with the mean birth weight (in kg) improving as the BMI value moved from grade 3 CED (> 16.0 BMI) to normal BMI ranges between 18.5-20 and 20-25 (See Table 6.1). Even among the mothers with grade 3 CED, the mean birth weight at 2.51 kg was just above the cut-off point of 2.5 kg birth weight for diagnosing newborns as being small for gestational age. Nevertheless, the proportions of low birth weight children increased among those mothers whose BMIs were low. In Table 6.1 the proportions of mothers in each BMI category and the proportions of children classified as having low birth weight in each category are presented. Similar inferences can be made from a study of Glasgow mothers from poor socio-economic groups where low pre-pregnant body weights were associated with a higher incidence of low birth weights. A study from East Java (Kardjati et al., 1988) also shows that pre-pregnant weight is a determinant of birth weight. The cut-off of 40 kg for pre-pregnant weight appeared to be the risk level of low birth weight in the East Javan community (Kardjati, 1985). This cut-off point for pre-pregnant body weight for a woman of less than 1.5 metre in height works out approximately to a BMI < 18.0. The East Javan study reinforced the fact that birth weight is determined by the pre-pregnant BMI TABLE 6.1 Maternal anthropometry, BMI and pregnancy outcome in India Maternal BMI range Category < 16 16.0- 17.0- 18.5- 20.0- 25.0- 17.0 18.5 20.0 25.0 30.0 Birth weight (g) 2,510 2,573 2,653 2,771 2,812 2,972 Percent low birth wt 53.1 41.4 35.9 27.7 26.4 14.7 Risk ratio 2.02 1.58 1.37 1.05 1.00 0.56 Mothers' age 24.0 23.8 23.6 23.8 24.6 26.2 Mothers' ht (m) 1.519 1.514 1.512 1.512 1.510 1.515 Mothers' wt (kg) 35.4 38.1 40.9 44.1 49.6 60.6 Gravida 2.6 2.6 2.4 2.5 2.6 2.7 Haemoglobin (g/100 ml) 10.3 10.5 10.8 10.9 10.9 11.3 Number 81 133 460 553 717 68 Source: Naidu et at., 1991. Of the mother. In this study, the incidence of low birth weight fell from 21 percent to 5 percent when the maternal pre-pregnant BMI rose from 18.5 (Kusin et al., 1992). A low BMI status, indicative of CED, is a particularly important aspect of the nutritional risk of women in a community during the reproductive years. This risk can be exacerbated by early marriage. Statistics from the World Fertility Survey have shown that early marriage is common in some countries. For instance, 25 percent of 14-year old girls in Bangladesh and 34 percent of 15-year old girls in Nepal are married (WHO/UNFPA/UNICEF, 1989). The social pressure to conceive early and thus gain status through fecundity further aggravates the problem. If a pregnancy occurs before the requirements for growth have been adequately met, an additional demand on the body is created and could lead to extra problems. The onset of puberty in girls is earlier than in boys but menarche may be at 12-13 years with the growth spurt still in progress at the age of 14 years and linear growth continuing until the age of 18 years. Peak bone mass is not achieved until about the age of 25 years. The development of the pelvic birth canal is slower than that of the early teenage spurt of long bones. The birth canal does not reach its mature size until several years after growth in height has ceased by the age of 18 years (Moerman, 1982). The competing nutritional needs of pregnancy and growth in an adolescent mother will affect the growth of the foetus and hence the birth weight of the child. Thus, the incidence of low birth weight, which is an indicator of intra-uterine malnutrition, is higher among adolescent mothers. Since the incidence of low birth weight is higher among all mothers with a low BMI status (Naidu et al., 1991) the combination of a low BMI and adolescence is likely to increase the chances of having a low birth weight infant. Young adolescent mothers who are not fully grown will naturally have a lower BMI than they would have when mature since the usual pattern in children is for BMIs to increase markedly during adolescence as pubertal changes occur. Whether the BMI cutoffs for adults are also applicable to young, adolescents is uncertain. Frisancho and colleagues (1983) have shown quite conclusively that adolescent mothers of low body weight and hence low BMI are likely to be at a greater risk of having babies with low birth weight. They surmised that among rapidly growing adolescents, the nutritional requirements of pregnancy may be greater than those of older, mature mothers; the increased maternal intake of energy has to compete with the needs for tissue deposition in pregnancy, e.g. in the uterus and placenta and with the needs of the foetus. A study by Sibert and colleagues (1978) in South India has shown that maternal nutritional status, in particular energy stores reflected in skinfold thicknesses, were positively correlated with low birth weight, decreased length and deficient fat folds in infants. The detrimental impact of low BMIs on foetal outcome of teenage and adolescent mothers is true in both developed and developing countries. Lactation is considered to be a physiological process that is robust and hence preserved well in spite of the poor nutritional status of the mother. However, there is some evidence to show that poor maternal status exemplified by a low BMI is associated with poor lactational performance and poorer growth in infants (Kusin et al., 1992). Low maternal BMIs are associated with poorer post-partum outcomes such as lower breast milk output and underweight children (Anderson, 1989). Lactational requirements will impose further demands on mothers with CED and this may be an even greater imposition in the young adolescent mother whose pubertal development of fat stores is incomplete. In an environment where the risks of low energy intakes and of increased demands on physical activity are high, pregnancies, particularly when frequent, may not allow sufficient time for the mother to recuperate. This further stresses the mother's nutritional status and reduces her body energy stores (Merchant et al., 1992). These reductions in body energy stores will in turn affect subsequent pregnancy and lactational performance. With enhanced nutrient needs in early life the infant is particularly vulnerable to any impediment in a mother's ability to nurse the child and provide an ample supply of milk of an appropriate nutrient composition. Without this normal supply the small baby will be at risk of a long-term handicap which may be only physically manifested as a retardation in the growth in length. Thus, it is important to consider events which are likely to increase the probability of prematurity and a child having additional needs. Low birth weight also has considerable societal costs in the form of increased neonatal mortality and susceptibility to infections due to diminished immunocompetence. It also starts the child's "life fight" with subnormal stores of nutrients (Jelliffe & Jelliffe, 1989). These events will also increase the probability of stunting. On these grounds alone, the use of the BMI index seems justified as a means of alerting community workers to the vulnerability of mothers. Selective food supplements may benefit mothers with a low BMI whereas mothers with normal weights usually show little benefit. The cut-off point of 18.5 with further lower grades at 17 and 16 thus seem to be justified on the basis of the data presented in Table 6.1. Morbidity and mortality and the BMI of adults The relationship between morbidity from chronic disease and mortality and high BMI has been recognized and analysed in developed countries for a number of years (Kushner, 1993) primarily for the purpose of determining life insurance risk. There is now an increased interest in using BMI as an index for those chronic diseases which are common in affluent, industrialized countries and which are now appearing in the urban industrialized regions of developing nations. Thus, the prevalence of coronary heart disease (7.3 percent) in urban India is over six times that seen in the surrounding rural environments and the victims are from the affluent, upper socioeconomic classes (Gopalan, 1988). The prevalence of obesity in Brazil has increased enormously. These findings have emphasized the relationships between BMI and morbidity or mortality at the upper end of the range of optimum BMIs, while similar relationships at the lower end of the acceptable BMI range are only now emerging. BMI has been used to determine the prevalence of diabetes mellitus in 2,500 government employees in urban Hyderabad. High BMIs were associated with a higher prevalence of diabetes mellitus and glycosuria (Satyanarayana, 1976). The BMI was also found to be greater among the employees who had a higher educational or socio-economic status as well as among those who were older (Rag, 1977). A large study involving 3,314 individuals in urban south India showed that obesity was more common in women than men (27 percent vs 5 percent) and that high BMIs and high incomes were significantly correlated with the presence of diabetes mellitus. The use of BMI as an index to determine the prevalence of obesity in developing countries is a more recent phenomenon. In urban India, Sood and others (1984) using a cut-off BMI of >27 have reported that among those in the age group of 30-39 years, 20.9 percent of men and 14.3 percent of women were obese; while among those between the ages of 40-49 years, obesity was found among 15.6 percent of men and 34.3 percent of women. In their sample of 836 adults, in the age range of 20-65 years, the prevalence of obesity was 8.4 percent and 20.9 percent among men and women, respectively using a BMI cut-off of >27.0. BMI has also been used to evaluate the prevalence of diabetes mellitus among undernourished rural adults (Jaya Rao et al., 1972). The rate of diabetes of 2.4 percent in the rural, undernourished population was not very different from those of 1.5-2.5 percent reported in urban surveys. Yet comparisons between rural and urban areas and ethnic groups made in a biracial (Melanesian and Indian) population in Fiji in 1980 (Zimmet et al., 1983) showed a sixfold difference between rural and urban male Melanesians. Such differences were not apparent among Indians. The diabetes associated with early malnutrition is not readily seen when assessing the link between BMI and the prevalence of diabetes mellitus in adult life. These data on morbidity and disease do show, however, the emerging general usefulness of BMI measures in adults in the developing world. Low BMI and sickness events There is a considerable volume of data on morbidity and events of illness in malnourished children. However, rarely have similar associations been made between adults with low BMIs and episodes of illness. The National Food Consumption and Household Budget Survey carried out in rural adults in Rwanda has provided some data in this area (François, 1990). When the data on total time spent lying down by adults was calculated and expressed as the number of equivalent days per year spent in bed, (i.e. where 16 hours extra sickness was equivalent to 1 day in bed), there was a disproportionately large amount of time spent in bed among those people with BMIs below 17.6 (see Figure 6.1). Evidence from Bangladesh (Pryor, 1990) also supports this observation, with an association between the percentage of fathers who were not working due to illness and the percentage of fathers with low BMIs (see Figure 6.2). Figure 6.1 - BMI and "Equivalent days. of illness among Rwandese women, 1982 Source: François, P., FAO, 1990, unpublished data. Figure 6.2 - BMI and loss of labour days due to illness in Bangladesh Source: adapted from Pryer, J., 1990. The same phenomenon occured in Brazil which represents a more developed country. In the 1989 National Health and Nutrition Survey, information was collected regarding the number of days ill (identified as days in bed) over a two week period prior to the interview. In addition to the length of the illness, information was sought regarding the disease or cause itself. If the different BMI categories, ranging from the underweight to the obese, are displayed against the percent of individuals in each category spending more than one day in bed, the result is the pattern shown in Figure 6.3. This follows the U-shape curve similar to that of BMI and the mortality rate. In both situations, the thin as well as the obese have a higher probability of spending time in bed due to illness than those in the normal weight range and this increases with the degree of thinness or obesity. The costs resulting from episodes of illness may be very high. If low BMIs imply proneness to illness with, for example, a compromised immune system, this has serious implications. It could place enormous additional economic and social burdens on a community because adults have a low BMI. The data are preliminary by necessity because no systematic long-term studies in developing countries have been undertaken to determine whether thin adults who are initially free of infection and infestation are more prone to illness and specific diseases than heavier adults. Although the evidence is now clear in underweight children, data on adults are so limited that we can only state that the condition of low weight is associated with excess illness and an inability to work. Figure 6.3 - BMI and the probability of illness among Brazilian women (PNSN Survey, 1989) Source: de Vasconcellos, 1992, based on date presented at a meeting "Functional Significance of Low Body Mass Index (BMI). Rome", 4-6 November, 1992. Low adult body weights may not only reflect the effects of recurrent infection, but a combination of problems of food availability and increased energy demand due to increased physical activity resulting in seasonal changes in body weight in many communities. It would be foolish, therefore, to regard low adult weights as simply reflecting disease. It is a remediable nutritional condition which could, when treated, possibly enhance resistance to infection and improve human welfare. It must be remembered that McKeown in his analysis of health trends over the past 200 years in Britain and Europe noted that nutrition and hygiene were major factors in reducing the incidence of infectious disease long before immunization or antibiotics were available. With a huge array of studies now demonstrating the remarkable importance of nutrition for developing and maintaining immunocompetence (Chandra, 1983), it would be best to assume, from a policy point of view, that a low BMI is an indicator of impaired immunocompetence and an enhanced susceptibility to infection. A low BMI is also associated with alterations in several important cellular functions which may include drug metabolism and pharmacokinetics. This, in turn, may affect the therapeutic responses, the doses required, the length and success of drug treatments, but these issues have been poorly studied. Low BMI, mortality and the limits of survival With interest in low BMI as an indicator of CED in adults, new data are emerging which relate low BMIs to mortality rates. In the rural area surrounding Hyderabad, India, data show an inverse relationship between BMI and mortality rates as shown in Table 6.2. Since more details are not available it is difficult to state categorically whether the low BMI was the result of the disease process leading to death or whether the low BMI state preceded and increased the men's proneness to illness and subsequent death. In a recent communication, Henry (1990) has undertaken a detailed review of the available data on the lower range of BMI and the limits of human survival obtained from a wide range of sources. The BMIs of persons, most of whom were from developed countries, who died of starvation are remarkably consistent: in males, a BMI of around 13 appeared to be fatal whereas women survived to reach a BMI of around 11.0. A mean BMI of around 13.0 was seen in groups of young women with anorexia nervosa: similar values were observed in a group of free-living south Indian females. It was claimed that they were physically active and carrying out their normal daily chores. TABLE 6.2 Mortality rates for men according to BMI categories (Hyderabad) BMI range Mortality rate (deaths/ 1000/year) < 16.0 32.5 16.0-16.9 18.9 17.0-18.4 13.2 > 18.5 12.1 Source: Satyanarayana et al., 1 99 1. This indicates that very low BMIs in women are compatible with survival. Henry (1990) graphically represented the data to show that a BMI around 13.0 sharply divides the male survivors from the non-survivors while there is a much larger variability in the BMIs of surviving and dying women for whom the cut-off point in BMI for survival was not clear. These sex differences in the BMI value for survival may prove to be important and may relate to the greater body reserves of energy at any BMI value of the women. It is clear, however, from the preceding chapters that such low BMIs are very unsatisfactory from a functional and morbidity point of view. It seems clear therefore that BMI is a useful index in urban areas in developing countries where the risk of the chronic diseases of affluence exists. Yet data on those with a low body weight is limited. To obtain comparable data on the risks of general ill health and specific diseases among those with low BMI will require systematic study. This will be one step towards developing evidence of the functional and medical significance of low body weights. Until these are available we will be forced to use long-term studies linking low body weight to mortality.