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MARGINAL MALNUTRITION AND WORKING CAPACITY

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In addressing the question of how nutrition influences working capacity, whether mild malnutrition has a negative impact on the health and general well-being of the individual and, in the case of the family's main provider, the well-being of those with whom he or she has interdependence, it is necessary to discuss the concepts and the meaning of the various parameters used to evaluate work.

The first and most difficult concept to define is that of marginal subclinical and mild malnutrition as it relates to the working force. Accepting the definition of marginal malnutrition given by Dr. Behar (1981) for this symposium as that in which non-specific signs and specific or non-specific laboratory indices are present, we are forced to review the basis upon which such diagnosis can be attempted in the adult male and non-pregnant female. At the outset we must clarify that the more severe forms of malnutrition will not be considered nor will specific vitamin and mineral deficiencies for which impaired work capacity and performance have been documented previously (Foltz et al. 1944; Keys et al. 1945; Keys et al. 1950; Viteri, Torún 1974; Dam 1978).

The signs of marginal energy-protein malnutrition (MM) in the productive segment of the population must take into account the fact that work is a complex function which depends on biological factors, the work setting (which

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includes types and conditions of work), and behavioral components. It is because of the different demands that various occupations impose on the individual that past and present nutrition may be more or less important for the specific chore to be performed. The question is whether an individual is adequately nourished for performing his/her type of work in the usual condition where it is done or whether MM is affecting his/her performance? For example: Short stature and low relative body weight can be negative factors in chores demanding force and/or mechanical leverage (Morrison, Blake 1974; Spurr et al. 1977; Immink et al. 1981), while the same conditions may even be assets in work situations which demand primarily body translation and again may be irrelevant in factory, sedentary or minimal (miniature) work situations. Similarly, MM from the excess side of the spectrum (relatively high body weight) can be desirable or a hindrance in terms of work and general well-being.

Short stature on the basis of standards for genetically defined populations is generally a reflection of past malnutrition. On the other hand, low body weight relative to stature may indicate present energy deficit as the opposite, high relative body weight, may indicate MM in terms of energy excess. In judging relative weight and stature a critical issue is that of standards for genetically-defined populations; in theory, however, an adult man with 7-8% body fat, that is almost devoid of adipose tissue, compared to the reference man with 14% body fat (Brozek et al. 1963) would have a 10% body weight deficit. A subject or a population with these characteristics can not be labelled MM. Furthermore, relative body weight in the working force lacks both specificity and sensitivity as a sign of MM, since populations living under restricted energy intake decrease their energy expenditure and thus preserve their body weight, in part at the expense of physical activity (Viteri, Torún 1975; Durnin 1979). The opposite is also true: when energy intake is higher in free living, active populations, energy expenditure is concomitantly elevated (Apfelbaum 1978; Viteri, Torún 1975) and weight can remain stationary. Moreover an increase in body weight may reflect a gain in adiposity with a loss in lean body mass and can be correlated negatively with work capacity and viceversa (Viteri 1971; Torún 1965). Body composition studies help define the meaning of relative body weight but still MM may not be defined on the basis of body composition alone.

Functional estimates may be useful biological signs of MM and can complement body composition. These signs of MM must be sought within the interrelations of the biological and the other two components of the work functions: the setting and the behavioral aspects. The biological expression within this complex is work

capacity and is intimately related to static and dynamic parameters determined by body characteristics, health and nutrition and physical fitness. Each of these determinants have different implications. For example, the absolute amount of lean body mass and more precisely that of cell residue (protein) determine maximal aerobic power or VO_2 max.(Astrand, Rodahl 1977; Viteri 1971). This is highly dependent on stature and on muscular development, which are important components of work capacity in the performance of heavy, forceful work. Fitness measures the dynamic component of work capacity as in the determinations of cardio respiratory and metabolic responses to different work loads (VO_2 - heart rate relations, Harvard Step Test, excess lactate, etc.) (Astrand, Rodahl 1977). Fitness is essential in the performance of tasks requiring endurance and sustained moderate work. VO_2 max. and fitness, important in defining work capacity,do not necessarily vary together: A weight lifter with very high VO_2 max. can not compete in cross country and mountain climbing which requires overall fitness; yet the total force delivered by the lifter at a moment is greater.

The setting and the type of work modulate the expressivity of the capacity to work and translate it into work performance which again is also affected by the behavioral components. Among the biological demands in work performance are the type and amount of physical activity (short spurts of heavy work; sustained, moderate work, etc.), total physical activity and energy expenditure along time, and together with this, the work efficiency component in which work done per unit time becomes the parameter. An extension of work efficiency in longer periods of time determines activity-rest period ratios during work and work-leisure relations along extended units (days, weeks, etc.). All of these components can be explored searching for functional biological and behavioral signs of MM, but carefully considered within a work setting and a life-style.

Work capacity may or may not be related to work performance and to work efficiency. For example, biologically similar populations may not perform work with similar efficiency because of external, environmental and psychological conditions (Immink 1978). In terms of nutrition, subjects may be limited in their efficiency in everyday conditions of work along time if their energy intake is marginal; still these subjects can be fit, and can have excellent working capacity (Viteri 1971; Viteri 1976). But also, energy sufficient populations under different social settings may perform work differently. In a study in the Guatemalan highlands (Viteri 1971; Viteri et al. 1971; Viteri, Torún 1975), agricultural workers were in energy equilibirum ingesting and expending 3550 Kcal/day on the average. Of these, near 1900 Kcal were spent in activity at 8 hours

work. Workers with similar body characteristics and work capacity, engaged in sugar cane harvesting and receiving for two years an energy supplement to bring their total energy intake to 3500 Kcal/day, but in a different work setting, after an initial increase in efficiency settled back to spending on the average no more than 1,000 to 1,200 Kcal in activity at work. Moreover, a similar group of workers receiving an energy poor supplement worked with the same efficiency as those supplemented with the energy-rich preparation, also after a smaller initial rise in this parameter (Hawthorn effect). Body weight in both groups remained constant. The dominant factors in this situation were the social, managerial and behavioral components of work (Immink, Viteri 1981).

These workers had a very strong group identity and work was set within a social structure with its demands, expectations, motivation and general social role. Still the workers receiving the energy-rich supplement spent more energy than the other group. The different energy expenditure between these groups appeared to take place during out of work activities and leisure where a greater freedom from group-identity was also apparent.

It is obvious that as additional components beyond purely biological characteristics are added in the exploration of nutrition - work interrelations a greater contribution of behavioral considerations becomes more evident. These also assume greater importance as confounding variables in purely biological experiments.

Finally, the not yet well understood interrelations between energy intakes and expenditures must be considered with the context of MM. An essential general principle holds that unless disrupted by extraneous influences, adult populations maintain energy equilibrium along time. Consequently efficient feed-back mechanism by which energy expenditure is influenced by intake and viceversa, energy intake is influenced by expenditure, must exist. Under conditions of limited intake, energy expenditure along time is reduced to reach equilibrium (Viteri, Torún 1975; Durnin 1979). Since under free-living conditions without restrictions in energy intake energy expenditure depends primarily on the setting and on the behavioral components of work, and the laborer somehow determines his/her optimal work conditions within the setting, these conditions must also influence energy intake. For example, an agricultural laborer whose income depends on his productivity and on his work efficiency in energy-demanding tasks, naturally along time finds the most suitable conditions for his work. Obesity among these workers is essentially non existent even in situations of unlimited food supply: physiologically they can not afford to become obese, on the contrary,

they must remain lean. Therefore, they limit their intake very probably to maintain optimal work conditions (Immink et al. 1981a).

We are back at the first dilemma: How can Marginal Protein-Energy Malnutrition be defined in the adult worker? We can not rely on body weight or on body composition; we can not rely on energy intake or expenditure alone; we can not even rely on changes in weight or in energy expenditure by changes in intake. We must rely on the above complemented by functional measurements which can be work capacity, work performance and work output but as they apply to the work type and setting within a cultural behavioral pattern. Therefore we fall into a circular situation in which what we are trying to define, that is, the effects of MM on work capacity uses work capacity and its ulterior expressions to define MM.

Good nutrition in terms of work must allow the fulfillment of the individual's biological and social roles and should be an integral part of the promotion of development at the population level. In trying to determine what negative impacts MM has on the health and general well-being of the individual and of those with whom he/she has interdependence, the effects of MM on work must be measured and evaluated in terms of whether nutritional inadequacies impair the achievement of these goals. In this context, the nutrition-work interrelationship is only part of the overall nutrition-health-well being of the individual and his/her society. It may very well be the case that increased food availability for the working force can result in significant and desirable changes in out-of-work behavior, sometimes more meaningful in terms of development and well-being than simply greater work output. Limitations in intake need to be carefully evaluated also in development projects with active involvement of the labor force. If the whole community structure is set to maintain an equilibrium according to established work-leisure patterns the extra demand for energy expenditure, beyond that well-defined work expenditure, requires the availability of extra intake at least equal to the expected increase in expenditure. We believe that many projects have failed because of this limitation in spite of excellent degrees of community motivation. The basic concept of food-for-work is therefore an alternative within certain cultures.

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