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Dietary reference values

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In 1991 the Department of Health of the United Kingdom published a new set of guidance values for the consumption of energy and nutrients by the British population (Department of Health, 1991). These replace the Department of Health and Social Security's *Recommended Daily Amounts of Food Energy and Nutrients for Groups of People in the United Kingdom* (Department of Health and Social Security, 1979). The new dietary reference values (DRV) cover many more nutrients, as well as a wider range of vitamins and minerals; the report (Department of Health, 1991) also provides guidance on dietary components such as the fats, carbohydrates, sugars and 'dietary fibre'. Although usually contained in separate publications the Panel decided that it was becoming confusing to try to differentiate between 'recommended dietary amounts (RDA)' and 'dietary guidelines for health' (Whitehead, 1989). To the man in the street phrases such as these have identical meanings!

'RECOMMENDED' AND 'REFERENCE'

Why did we decide to drop the term 'recommended' and replace it with 'reference'? Both RDA and the new DRV are statistical concepts relating to physiological requirements for health and well-being among population groups. They are intended as a guide or reference for health professionals, food planners and the food industry: they are not unconditional recommendations. Often social customs and taste preferences dictate that people consume larger amounts of particular nutrients than they need to on physiological grounds alone and, within the limits discussed in the report (Department of Health, 1991), there is no reason why they should not follow their inclinations and continue to do so. Protein and vitamin C would be good examples of this, and it would be absurd to 'recommend' otherwise. On a somewhat different tack, the new report (Department of Health, 1991) contains DRV for *trans*-fatty acids. Here the purpose is to advise health workers and the public that average *trans*-fatty acid intake should not rise above 2% of food energy. Again the 2% is a reference value, people are not being recommended to consume this amount. If they are eating less than 2% it is of no significance. The practical interpretation of DRV will vary according to the use to which they are being put. To have continued with the general term 'recommended' would have been illogical.

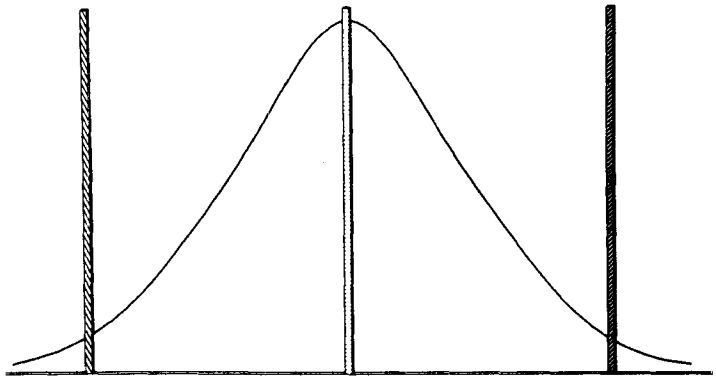

Fig. 1. Reference nutrient intakes (▨), estimated average requirements (▩) and lower reference nutrient intakes (▨) in relation to the distribution of individual requirements within a community. From Department of Health (1991).

WHY THREE DATA VALUES FOR EACH SET OF DRV?

The reason why three data values are provided for each age and sex 'set' of nutrient DRV is to describe more completely the distribution range of individual requirements within the population (Fig. 1). The mean physiological need of each group is termed the estimated average requirement (EAR). The upper limit of the range of physiological needs, nominally the average plus two standard deviations, is now called the reference nutrient intake (RNI). The latter value is, however, exactly the same in statistical concept as the traditional nutrient RDA, in other words a value equating with someone who has relatively high requirements. Thus, the American RDA is directly comparable with the new British DRV.

The statistical complexities of RDA have rarely been as clearly understood by potential users as they should be! One problem has been that in contrast to the nutrient RDA, the RDA for energy was defined quite differently. It is set at the mean requirement, not at the mean plus two standard deviations. In the new set of DRV the primary values for energy continue to be set at the average requirement, but to end the confusion they are now given a different and more meaningful name, the EAR. RNI values are confined to protein and the micronutrients. In the case of the dietary constituents that provide this energy the values are given as population average values.

The lower end of the range of physiological needs is defined by the lower reference nutrient intake (LRNI). Precisely which of the three descriptors is the more appropriate to use in a given situation depends on the purpose to which it is being put.

SCIENTIFIC DERIVATION OF DRV

A given set of DRV is, thus, a statistical description of the estimated range of nutrient needs as they relate to population groups. It is an unfortunate fact, however, that there is rarely sufficient experimental data for the scientist to define variables such as the EAR, the LRNI and the RNI to his complete scientific satisfaction. In the new report (Department of Health, 1991), every effort has been made to describe as clearly as

possible, how the values have been derived, as well as the shortcomings of these estimates.

Our 'gold standard' was to try to define each DRV on a functional basis using a physiological process dependent on that nutrient and vital for health and well-being. For example, with energy requirements, this functional variable was energy expenditure and for vitamin C it was the maintenance of plasma levels compatible with accepted chemical pathology norms; with calcium the basis was nutrient balance. Ideally, such functional variable studies should have been used to measure the range of needs for that nutrient within each and every sector of the community. In all too many instances, however, it has been necessary for the different working groups of the Panel to adopt less complete and, therefore, more subjective approaches.

ENERGY AND ENERGY-RELATED DIETARY SUBSTANCES

The part of the new report that fulfils most completely the above ideal is that which deals with energy requirements. There are a number of differences in philosophy between the Department of Health and Social Security (1979) report and the Department of Health (1991) one. In 1979 the Panel based their energy recommendations for adults on occupational categories only. In other words, it was assumed that the major variable in energy expenditure was the type of work a person did. Quite clearly, current lifestyles are nothing like as simple as this, and thus, the 1991 DRV Panel decided to take into account both occupational and non-occupational activities. Calculating requirements in this way it is perfectly possible to identify groups with moderately active occupations, but who live a sedentary existence at home, having the same energy requirements as office workers who are actively involved in sport. Advice and information are provided so that these complexities can be taken into account in making appropriate calculations for any sector of the adult population.

In the 'main table' of the report (Department of Health, 1991), in which the energy values are summarized, the only values given are the EAR for population groups with both light occupations and low non-occupational activities. This description fits more British adults than any other combination, but it does mean that with groups of people who are more active, either at work or during their leisure, it is important to carry out the correct calculations in the manner advised. The critical biological measurement is the basal metabolic rate (BMR), and formulas are provided for this to be estimated for groups containing individuals of differing weight: all other physical activity levels (PAL) are expressed as a ratio of this BMR and advice has also been made available on which PAL values to adopt in different circumstances.

Similar advice is given for the calculation of energy requirements in older children and adolescents, but for children of less than 10 years of age, the primary data source had to be published information on energy intake. The overall validity of this data was checked, however, via a specially commissioned study, using doubly-labelled water. For infants, the primary data sources were estimates of energy expenditure as calculated from doubly-labelled-water measurements, although information on food intake was also taken into account.

In the case of the dietary components supplying this energy, the fats, carbohydrates and the sugars, the principal DRV are expressed as a percentage of the total energy intake, which assumes that moderate amounts of alcohol are consumed, and additionally

for just food energy alone. The values given are population averages. These are based closely on advice contained in the Committee on Medical Aspects of Food Policy (COMA) report *Diet and Cardiovascular Disease* (Department of Health and Social Security, 1984), and on the Department of Health (1989) report *Dietary Sugars and Human Disease*. It is important to remember that the fat values in the Department of Health and Social Security (1984) report were not population average values, but upper limit recommendations. When this is taken into account, and due notice is taken of the fact that in Department of Health (1991) report the *trans*-fatty acids are not consolidated within the saturated fatty acid values, the 'new' 11% value given for the percentage food energy for this component equates very closely with that of 15% in the earlier document (Department of Health and Social Security, 1984). The guideline value for the percentage of polyunsaturated fatty acids is slightly higher than that in the Department of Health and Social Security (1984) report.

The Department of Health (1989) report did not give quantitative advice, but recommended that the intake of non-milk extrinsic sugars, or free sugars, should be reduced below the current level of intake, which was about 13%, and replaced with foods such as fruit. The population average DRV adopted by the Panel was, therefore, 11% of food energy, or 10% of total energy intake in people who were moderate alcohol drinkers.

When the DRV for fats, sugars and other carbohydrates are compared with recent international population nutrient goals (World Health Organization, 1990) the British data are generally less extreme. With dietary fibre, however, the DRV is in the middle of the World Health Organization (1990) range, as is the DRV for the *cis*-polyunsaturated fatty acids.

PROTEIN

The DRV for protein are based closely on the Food and Agriculture Organization/World Health Organization/United Nations University (World Health Organization, 1985) recommendations. Although more recent data relating to protein and amino acid requirements were extensively evaluated, the Panel's opinion was that at the present time there was insufficient indication to warrant any change.

VITAMINS

The number of micronutrients covered in the new set of DRV is far greater than that in the Department of Health and Social Security (1979) report. In the latter report, quantitative values for only thiamin, riboflavin, nicotinic acid, ascorbic acid, vitamin A and vitamin D were provided. It had been reasoned that only those nutrients in which some possibility of deficiency existed, within the context of the United Kingdom, needed to be dealt with in such detail. This selection effectively imposed a limit on those nutrients for which labelling claims could be made. With the much greater interest in the micronutrients now being exhibited by the food industry, health workers and the general public alike, such an approach had become outmoded, and this time thirteen vitamins have been listed. Thus, the British DRV are now as all encompassing as the RDA produced by the American Food and Nutrition Board of the National Academy of Sciences–National Research Council (National Research Council, 1989).

In the past it has been the case that American RDA were set at somewhat higher levels than the corresponding British ones, and the same is the case this time as well, although

the differences are not major. Basically, when there is an inconsistency, the British RNI (the mean plus two standard deviation values) tend to be closer to the relevant World Health Organization (1990) RDA values than to National Research Council (1989) values.

It is not possible to highlight all the data, but the following changes are of importance. The National Research Council (1989) RDA values for folate exhibited a major fall compared with the National Research Council (1980) ones, and now both the British RNI and the American RDA for adults are set at the same value, 200 μg/d. In spite of considerable discussion of the American Committee concerning the advisability of reducing the adult vitamin C RDA to 40 mg/d, this did not occur. The Department of Health (1991) did, however, increase its RNI recommendation to 40 mg/d. Significant differences still remain for vitamin A; the corresponding adult male values being 700 μg/d for Britain and 1000 μg/d in the United States. National Research Council (1989) continued to provide a vitamin D RDA for all age-groups, whilst the British have given RNI only for children up to the age of 3 years, for pregnant and lactating women, and for people over the age of 65 years. It was reasoned that after this age there will be an increasingly large number of people who do not venture out of doors with sufficient regularity to synthesize adequate amounts of their own vitamin.

For some of the vitamins, pantothenic acid, biotin, vitamin E and vitamin K, the Department of Health (1991) Panel felt there was insufficient information to provide a complete data set of recommendations, and they have had to fall back on single 'safe intake' recommendations. In the case of vitamin E, the problem was that requirements depend to a large extent on associated polyunsaturated fatty acid intakes which vary widely. After examining recent survey data on the intake of British people, and also their serum tocopherol:cholesterol ratios it was reasoned that intakes above 4 mg α-tocopherol equivalents/d for men and 3 mg/d for women were adequate, although the report (Department of Health, 1991) did point out that potential hazards could not be ruled out if intakes close to the minimum value were maintained for extended periods of time. The corresponding American RDA for males and females are 10 and 8 mg respectively, but it must be remembered that these are based on the upper end of the distribution curve not the lower one. Essentially there is little or no discrepancy between the two sets of recommendations.

MINERALS

As was the case with the vitamins, the range of minerals covered in Department of Health (1991) is substantially greater than that in Department of Health and Social Security (1979). In the latter report, only two minerals, Ca and iron, were listed, whilst in the new Department of Health (1991) report, there are fourteen minerals. With the minerals, especially the divalent ones, Ca, magnesium, zinc, copper and Fe, one of the major problems in setting DRV is nutrient availability. This value is affected, not only by the overall composition of the diet (for example, constituents such as phytate bind divalent ions, and vitamin C can convert the less easily absorbed Fe^{3+} ion to Fe^{2+} ion) it is also influenced by the physiological status of the individual. For example, under conditions in which dietary Fe has been chronically in short supply, or alternatively the person has high metabolic Fe needs, the proportion of Fe entering the body from the intestine can increase substantially. This makes the setting of fixed ranges for requirements difficult. In the Department of Health (1991) report, this problem is discussed

fully and the assumptions made in setting the full DRV range for each divalent mineral is spelled out.

Of the two 'traditional' mineral RDA, perhaps the changes to the Ca values are of the most interest. In Department of Health and Social Security (1979) the RDA value for both adult men and women was set at 500 mg/d, whilst the new Department of Health (1991) RNI value is 700 mg/d which brings it close to the American National Research Council (1989) value of 800 mg/d. There is a difference, however, between the American Committee's and the British Panel's philosophy on how to deal with pregnancy and lactation. The Americans have added an extra 400 mg/d to their RDA for both these physiological processes. The British Panel, however, assumed that during pregnancy an enhanced efficiency of absorption, plus a limited amount of bone resorption, would be able to accommodate the needs imposed by the developing fetus and, thus, the RNI remained at 700 mg/d. For lactation the Department of Health (1991) reasoned that an enhanced absorption efficiency would not be able to cope, nor would it be wise to rely on mobilization of bone Ca over extended periods of lactation. We, thus, recommended an increase in Ca intake of 550 mg/d bringing the total to 1250 mg. The corresponding National Research Council (1989) RDA value for lactation was 1200 mg/d.

CONCLUSIONS

It is not easy to summarize a report in excess of 200 pages and 80–100 000 words, covering over forty nutrients and other dietary constituents, in a short review article. I would like to emphasize one point, however. With this DRV report (Department of Health, 1991) even more so than with previous RDA publications from the Department of Health (1989), it is essential that the body of the text is studied thoroughly. The main tables summarizing the DRV have only been included as a guide, as an *aide-mémoire*. They are not intended to be used as 'free standing' tracts of information.

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