Keeping the young-elderly healthy: is it too late to improve our health through nutrition?1–4

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ABSTRACT
Healthy older individuals can take several measures to preserve and improve their health. Even if past nutritional and lifestyle practices were not optimal, much can be done to reduce the risk of chronic disease and disability in future years. The first challenge is to recognize and address the profound changes in body composition that occur with aging. Older persons tend to accumulate relatively more body fat and less lean body mass, ie, muscle and bone. With a gain in body weight, which usually occurs, these changes are exaggerated. Because muscle tissue has a much higher metabolic rate than does fat tissue, older individuals generally develop lower metabolic rates. To avoid excess weight gain, older individuals must make major restrictions in caloric intake and increases in energy expenditure. Women experience changes in body composition similar to those in men, with changes becoming more prominent at menopause. Exercise improves body composition among healthy elderly, both by reducing fat mass and by increasing bone and muscle mass, thereby helping to restore higher metabolic rates. In men and women aged ≥65 y and taking calcium and vitamin D supplements for 3 y, the rate of bone loss slowed and the incidence of nonvertebral fractures was reduced. Several population studies of older persons show that following nutritional and lifestyle guidelines for cancer prevention reduces risk by one-third. Improving serum lipid concentrations in adults over 65 y of age with coronary artery disease decreases the risk of future cardiac events by as much as 45%. Furthermore, the greatest benefit from control of hypertension is in older individuals. Am J Clin Nutr 2007;86(suppl):1572S–6S.

KEY WORDS Elderly, cancer prevention, osteoporosis, diet, nutrition, cardiovascular disease, body composition, BMI

INTRODUCTION
With the increasing emphasis on health and the progressive lengthening of the average life span among adult men and women, both the scientific community and the general public have been examining ways to improve well-being and to prevent disease at every stage of life. It is fair to say that the earlier in life one starts healthy nutritional and lifestyle measures, the more likely these measures are to be effective in the long run. This article marshals the evidence that even when measures are begun in one’s 60s and 70s, definite benefits occur in many categories of chronic disease. There are many ways in which nutrition can prevent major categories of chronic disease and thereby promote health and vigor when initiated at a later age.

In approaching a consideration of nutritional matters, it is essential to keep in one’s mind a clear distinction between diet and nutrition. Although many treat these 2 words as synonyms, their real meanings are distinct. The word diet has ancient origins in both Latin and Greek (1) and is defined as “a manner of living,” that is to say, a way of life.

This original definition of diet serves as a reminder that the word conveys a sense of purpose, of seeking long-term goals. It is not a quick fix or a term that denotes crisis management. Therefore, “to go on a diet” should really convey making fundamental changes and a steadfast commitment.

In popular usage, diet has come to mean the foods that are consumed for a specific purpose, most commonly to try to lose weight. By contrast, nutrition has a much broader meaning. Nutrition is the science of how nutrients act, how they are utilized by the body, and which factors regulate their utilization. Nutrition involves both energy intake and energy expenditure, or exercise. Nutrition encompasses metabolism, biochemistry, and physiology. The science of nutrition has longer conveys simply “feed and weigh” but extends all the way from the basic sciences, such as molecular biology and molecular genetics, to clinical intervention. The newest fields of nutrition investigate nutrigenomics, proteomics, and metabolomics (2). Nutrition underlies both prevention, which in reality is risk reduction, and treatment of disease.

The interaction of genetics and nutrition remains relevant in the elderly. As we age, we become more heterogeneous, not less so. It is no longer adequate to group all elderly as ≥65 y. Rather, we have come to appreciate the differences between the young-old and the old-old and to view each older person’s health status and disease risk as distinctive. In giving recommendations to the elderly for health promotion, one size does not fit all.

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AGE-RELATED CHANGES IN BODY COMPOSITION

In coming to grips with the challenges of growing older, we must be knowledgeable first and foremost about the fundamental changes in body composition that evolve naturally with aging. We tend to lose lean body mass, primarily muscle and bone, and become relatively and usually absolutely fatter as we age.

An example of the changes that occur with aging is shown clearly in the review by Munro (3), as presented in Table 1. A group of adult males in 4 decades of life, their 20s, 40s, 60s, and 70s, who all had comparable weights underwent analysis of body composition. Men in the youngest age group had muscle mass that was >50% greater than that of fat mass. In men in their 40s, muscle mass was virtually identical to fat mass. By contrast, men in their 60s had much higher fat mass and lower muscle mass than did either of the 2 younger groups. Men in their 70s, there was no further increase in body fat mass, but muscle mass underwent an additional loss. The values for body fat and body muscle mass in men in their 70s are virtually the opposite of the values of men in their 20s.

It needs to be emphasized that this was a cross-sectional and not a longitudinal investigation. The men were examined at only one point in time and were not followed serially as in the Framingham and other long-term population studies (4–6). One cannot conclude that the individuals who weighed the most in their 20s were the same ones who were heaviest in their 70s. In fact, it is highly likely that they were not, because long-term obesity reduces the life span (7).

In women, similar changes in body composition occur, particularly at the time of menopause. As shown in Table 2, body weight, total body fat, percentage body fat, and body mass index (BMI) increase, with a concurrent decrease in fat-free mass, largely in muscle and bone (8). As expressed whimsically by Gypsy Rose Lee, a well-known interpretive dancer, “I have everything now I had twenty years ago—except now it’s all lower” (9).

These changes in body composition have profound consequences for the health of the elderly. Among the most important effects is that with the loss of bone come loss of height, deterioration of posture, and fractures (10). Restriction and distortion of the chest cage reduces pulmonary vital capacity and maximal breathing capacity (11). Mobility is impaired, which limits basic daily movements and the opportunities for increased energy expenditure. It is not sufficiently appreciated that a significant proportion of patients, perhaps as high as one-quarter, who sustain a hip fracture never fully recover (12).

The loss of muscle as well as the loss of bone has important implications for health. With reduced body strength, fractures are more likely to occur. Patients are more likely to fall and to sustain serious injury on falling (13). As noted above, muscle tissue has a much higher metabolic rate than does fat tissue (14). As a consequence, if there is a progressive loss of muscle and an increase in fat tissue, caloric requirements for weight maintenance will decrease progressively with aging. The undesirable consequences of excess weight gain will occur if the older individual maintains the same level of caloric intake as that consumed at a younger age and does not maintain or increase the level of energy expenditure.

This problem of undesirable weight gain is particularly relevant for former athletes, such as football players, who may retain the training table mentality of massive calorie intake long after there is a need for it. Some evidence, in fact, does show that the incidence of cardiovascular disease may be greater in those individuals who have a history of extensive exercise and have stopped than in their sedentary peer group who never habitually exercised vigorously (15).

The decrease in metabolic rate with aging is largely attributable to these changes in body composition (16), namely, reduced muscle and bone mass with a relative and absolute increase in body fat (17). With increased weight gain, the changes become even more impressive. Thyroid function also falls with aging (18). Serum concentrations of thyroid stimulating hormone and of free triiodothyronine tend to be reduced in elderly persons, even healthy elderly (17). This decline could theoretically contribute to the reduction in metabolic rate with aging, but the magnitude of the decrease in serum hormone concentrations is probably too small to have a major effect on metabolic rate. Furthermore, decreasing serum hormone concentrations are observed largely in the very old rather than in the middle-aged or early elderly individuals (19). The decrease in resting metabolic rate (RMR) in elderly individuals may also be due in part to a drop in energy expenditure that occurs progressively throughout adult life from 20 to 100 y of age (20).

The important point to convey about the changes that occur in body composition is that they are not an invariable accompaniment of aging. Much can be done to ameliorate and even reverse these deleterious consequences of aging. Foremost is caloric restriction with meticulous attention to dietary selection. Protein of high quality should be conserved, saturated fat must continue to be limited, and whole grains with complex carbohydrates and high fiber content should replace simple sugars. Older individuals must watch their dietary intake especially carefully. If tempted by high-fat, high-calorie, so-called junk foods, the elderly must realize that there may be potential for excessive weight gain together with deficits of important minerals and vitamins.

No evidence suggests that older persons are more sensitive to the deleterious effects of junk foods; in fact, such foods may be helpful in older persons with anorexia. Junk foods may stimulate

### Table 1

<table>
<thead>
<tr>
<th>Age group (y)</th>
<th>Body weight (kg)</th>
<th>Body fat (kg)</th>
<th>Muscle mass (kg)</th>
<th>Creatine output (mg·kg⁻¹·d⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–29</td>
<td>80</td>
<td>15</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>40–49</td>
<td>81</td>
<td>19</td>
<td>20</td>
<td>—</td>
</tr>
<tr>
<td>60–69</td>
<td>79</td>
<td>23</td>
<td>17</td>
<td>—</td>
</tr>
<tr>
<td>70–79</td>
<td>80</td>
<td>24</td>
<td>13</td>
<td>16</td>
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1. Data are from reference 3.

### Table 2

<table>
<thead>
<tr>
<th>Changes in body composition associated with menopause</th>
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<tbody>
<tr>
<td>Increases in</td>
</tr>
<tr>
<td>Body weight</td>
</tr>
<tr>
<td>Total body fat</td>
</tr>
<tr>
<td>BMI (wt/ht²)</td>
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</table>

1. From reference 8.
appetite and weight gain among very thin, frail elderly, a state that is also associated with increased mortality (21).

A body of evidence now clearly shows that either major weight gain or major weight loss reduces life expectancy for elderly individuals. Most studies have found that mortality rates as a function of BMI tend to exhibit a U-shaped relation (22). The lowest mortality rates are observed in persons with a BMI of \( \approx 25 \); increased mortality rates occur with either decreases below or increases above this level. Some investigators have reported that relatively small degrees of overweight with a BMI of 25–30 are not associated with increased mortality (22), but there is no universal agreement on this matter.

The important point is that obesity has a striking effect on the development and severity of several categories of disease in older adults. Obesity leads to resistance to insulin and greater likelihood of abnormally elevated serum glucose concentrations (23), elevated blood pressure, peripheral arteriolar disease, cardiovascular disease, and certain forms of cancer among adults with a mean age of 60 y (24). Persuasive data exist showing that mortality rates from some cancers are greatly elevated in relation to the degree of obesity of individuals at risk.

It has been concluded that treatment of obesity provides the greatest benefits for those older adults with a high risk of cardiovascular disease (25). Among the important causes of disability in older individuals, respiratory compromise and limitations caused by osteoarthritis have also been shown to improve with weight reduction (26). Thus, the accumulated evidence strongly suggests that being obese as an older adult greatly increases the risk of serious morbidity and mortality and that intentional weight loss by obese persons reduces the risk of morbidity and mortality.

On the other hand, it is increasingly appreciated that losing weight is not necessarily indicative of gaining good health. Elderly individuals may be losing weight because of progressive or preexisting disease. In fact, before death, many elderly persons tend to lose weight (27). Weight loss, if extensive, may be indicative of frailty rather than of health and greatly increases the risk of osteoporosis and fracture (27). Of the increased death rates that occur because of underweight, the majority, in fact, occur in individuals aged \( \geq 70 \) y (21).

EXERCISE

In addition to seeking wiser food choices, young–elderly must make regular exercise a part of their daily lifestyle. Numerous reports now document that much of the change in body composition that occurs with aging can be minimized by increasing energy expenditure (28, 29). A program of regular physical activity, as shown in Table 3, decreases body weight, total body fat, percentage body fat, and body mass index (BMI), while increasing muscle and bone mass.

The types of exercise particularly needed by older individuals are of 3 general kinds: 1) cardiovascular, with increases in heart rate; 2) weight-bearing, such as lifting small amounts of weight, which improves both muscle and bone; and 3) flexibility, such as stretching and bending. These exercises together improve movement ability and posture, thus helping to retain balance and easing the pain from arthritic joints (28, 29). Swimming is a good example of the third category of exercise because it enables individuals to undertake a full range of activities on land.

The vital importance of maintaining posture and balance cannot be overemphasized. With deteriorating posture, pulmonary vital capacity and maximal breathing capacity are impaired. It becomes more difficult to breathe, particularly with effort; to cough; and to move air effectively. Pulmonary infections may become life-threatening. Loss of balance can have many causes, including reduced age-related sensitivity of baroreceptors, side effects of drugs, and gradual onset of anemia, among others. Falling may be increased, raising the risk of fracture and other serious injuries (28, 29). The exercise program selected must be realistic, affordable, and likely to have long-term compliance. As with diet, exercise must become a way of life.

OSTEOPOROSIS

A major cause of disability among the elderly is osteoporosis. There are well-recognized risk factors, such as white ancestry, inactivity, family history, low calcium and vitamin D intakes, excessive alcohol intake, and so forth (30). Although many of these risk factors are ones over which we have no control, there is again much that we can do to ameliorate the effects of aging.

The main point again is that it is not too late to intervene to prevent further progression of osteoporosis. A study by Dawson-Hughes (31) showed that in free-living men and women aged \( \geq 65 \) y, consuming a supplement of 500 mg elemental calcium together with 700 IU vitamin D for a 3-y period reduced the rate of bone loss in the hip, spine, and total body. Slowing the rate of bone loss has been translated into an actual reduction in the cumulative incidence of a first nonvertebral fracture. As shown in Figure 1, the difference between the treatment and placebo groups was evident even after just 6 mo and became increasingly greater as the 3-y period progressed. These data further suggest that 2 to 3 y of supplementation with calcium and vitamin D virtually halted the further development of fractures, whereas in the placebo group, the incidence rate of fractures continued unabated.

CANCER PREVENTION

The evidence is increasing that diet and nutrition, as well as lifestyle, contribute to the development of about one-third of all cancers combined (32). For some cancers, such as those of the breast, prostate, colon, and endometrium, specific risk factors have been identified. For example, obesity, a high-fat diet, and weight gain all confer an adverse progression for women who have already been diagnosed with breast cancer (33).

Two independent studies showed that the rate of total cancer is reduced in older women who pursue healthy nutritional recommendations. In the first report, from the Iowa Women’s Health Cohort Study (34), the relative risk of all cancers was related to

### Table 3

<table>
<thead>
<tr>
<th>Decreases in</th>
<th>Increases in</th>
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<tr>
<td>Body weight</td>
<td>Fat-free mass (muscle and bone)</td>
</tr>
<tr>
<td>Total body fat</td>
<td>BMI (wt/ht²)</td>
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<tr>
<td>Percentage body fat</td>
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*From reference 8.*
the degree of compliance with 14 nutritional recommendations made by the American Institute for Cancer Research (AICR). This independent foundation, based in Washington, DC, has been at the forefront of funding research on nutrition and cancer prevention and translating advances in knowledge into practical measures for individuals who are at risk of having cancer or who have cancer already.

As shown in Table 4, those older individuals who followed 6 to 9 of the 14 AICR recommendations were defined as having a relative risk (RR) of 1.00. For those who followed none to only one of these recommendations, the relative risk of total cancer incidence was 1.35 and that of cancer mortality was even higher at 1.43 (34).

Similar results were obtained in another group of older women with mean age of 61 y who were followed for a median period of 9.5 y (35). Overall diet quality was evaluated in terms of adherence to a Recommended Foods Score. It is impressive that for all cancers, the RR of mortality was lowered to 0.74. For breast cancer patients in particular, the RR of mortality was 0.75. The RR of mortality was reduced even more in patients with colon and rectal cancer (0.49) and in those with lung cancer (0.54), as shown in Table 5. In the most recent long-term study of postmenopausal women with breast cancer, the Women’s Intervention and Nutrition Study, reducing total dietary fat intake cut the rate of cancer recurrence by approximately one-third (36).

Studies of cancer prevention have appropriately emphasized early intervention. For example, studies of soy intake in relation to later development of breast cancer provide some indications that perhaps the greatest efficacy of soy may be in young girls before menarche (37, 38). Without minimizing the well-founded evidence of the value of early action, the accumulated evidence provides a strong rationale for convincing older adults that it is not too late to make changes in their diets and lifestyles for the specific purpose of cancer prevention.

### CARDIOVASCULAR DISEASE

As in the fields of osteoporosis and cancer prevention, specific steps can be taken by older persons to limit the future progress of coronary artery disease. There has been so much emphasis on cholesterol screening and prevention of disease in young adults that many older adults may be left with the mistaken impression that the damage has already been done and nothing further can be achieved at this late date.

In fact, for older persons, healthful changes may still be of great benefit. For example, control of hypertension in older persons may prevent 20% of coronary heart disease in men and 30% in women (39). These investigators found that with treatment of hypertension, the greatest reduction in manifestations of coronary heart disease was in the older persons. With respect to serum lipids, improving concentrations in adults older than 65 y who already have manifestations of coronary heart disease has been shown to decrease the risk of future events by up to 45% (40).

### SUMMARY AND CONCLUSIONS

It is a reasonable conclusion based on the results of recent reports, many of which are cited here, that older persons are in a position to take specific measures to preserve existing health status and to forestall much of the onset of disability and death. The changes in body composition with aging consisting of fat accumulation and concomitant loss of muscle and bone can be limited in severity by diet and exercise. Increasing energy expenditure in a manner that is appropriate should be the goal of every older person. Osteoporosis, cancer, and heart disease, which are leading causes of disability and death in older individuals, can be limited in severity by steps taken late in life. All signs

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**TABLE 4**

<table>
<thead>
<tr>
<th>RR</th>
<th>Cancer prevention by nutritional means in older women (^{1})</th>
</tr>
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<tbody>
<tr>
<td>1.35</td>
<td>Following 0–1 recommendations</td>
</tr>
<tr>
<td>1.43</td>
<td>Cancer incidence</td>
</tr>
<tr>
<td>1.00</td>
<td>Following 6–9 recommendations</td>
</tr>
</tbody>
</table>

point to a hopeful and optimistic approach to preserving health in older individuals, which we should all pursue.

REFERENCES