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Food intake and exercise study in older adults

A thesis presented in fulfilment of the requirements for the degree of Master of Science Degree in Nutritional Science at Massey University

Sarah Ley

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Abstract

This study aimed to explore the relationships between food intake, body composition and exercise levels of a group of people (8 men and 34 women) currently exercising with the Sport North Harbour programs. Food intake was estimated by three day records and a calcium food frequency questionnaire. Participants kept two week exercise diaries using the PEPSA scoring system to record levels of activity. In addition bioelectrical impedance analysis was carried out and data collected on supplement use, nutrition education, alcohol intake and gardening and housework undertaken in the last four weeks.

Mean exercise levels for the group were approximately one hour per day with walking the most popular form of exercise. Fat free mass (FFM) for women was found to decline with age despite this level of exercise. The quality of food intake was similar to that obtained from the LINZ study participants 45 years and older. 35% of women and 12% of men under-reported energy intake according to the FAO/WHO/UNU criteria. No relationships were found between energy intake, energy expenditure or levels of FFM. Extremely good correlations ($r > 0.9$) were found between the PEPSA system and other validated methods of recording activity levels.

Despite these older adults exercising to provide health benefits they were not choosing a desirable food intake which would specifically provide health benefits; over 50% took dietary supplements. It is recommended that nutrition be included as an integral part of programs to promote exercise in older adults.

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List of Abbreviations

%	percent
Ω	ohms
BMI	body mass index
BMR	basal metabolic rate
kcal	calories
FFM	fat free mass
g	grams
kg	kilograms
m	metres
MJ	megajoules
n	number
NS	not significant
r	Pearson correlation coefficient

1 Introduction

The number of New Zealanders in the age group 50 years and above is expected to almost double in the next few decades. Projected figures published in 1995 estimate that this age group will comprise forty percent of the population in 2031, compared with recorded figures of twenty-five percent of the population in 1994.¹ Health care costs in this age group are traditionally high and the burden of their provision is expected to be onerous for future income earners. It is essential therefore, to explore ways to promote the maintenance of good health and delay the onset of chronic disease in older adults.

Some of the most important and modifiable factors which can positively effect the aging process are nutritional intake, nutritional status, body composition and physical activity. However the precise effects of nutrition and its related effects on the body are difficult to determine as information about dietary requirements of older adults is sparse and largely extrapolated from metabolic studies conducted in younger adults. The general consensus of opinion amongst those national committees setting standards for nutrient requirements has been that adults, as they age, require less energy intake in line with their reduced energy expenditure, whilst acknowledging that there are increased requirements for some nutrients. Inactive older people who consume small quantities of food may therefore place themselves at risk of nutritional deficiencies due to lower levels of intake whilst physically active older adults who require more energy for daily living, have an increased likelihood of meeting their body's nutrient requirements.

The levels of activity which are required to provide health benefits have been researched. Self-reported information from Australia, Canada and USA suggests that around 40% of adults obtain health benefits from leisure activities of light to moderate intensity. However despite our knowledge of the health benefits of exercise, a large proportion of older New Zealanders are known not to exercise at all or very little.² This lack of exercise increases the likelihood of older adults being disabled through loss of muscle strength, inability to perform the tasks of daily living and a upwardly spiraling level of care dependence.

Age-related changes in body composition (increased body fat and reduced muscle mass) are also strongly associated with increasing rates of morbidity and mortality from chronic disease of older people. Exercise is known to delay or improve these negative changes. Therefore an important part of assessing health related fitness is the estimation of proportions of body fat and muscle mass.

The relationships between body composition, exercise habits and nutrient intake of older adults who exercise is largely unknown for the New Zealand population. Sources of nutritional information and use of nutritional supplements most commonly used by older adults are not well documented. The findings of this research are expected to be helpful in furthering our understanding of the place of nutrition and exercise in positive aging. It is also expected that an understanding may be gained of ways to promote more healthy lifestyles and the impact of current programmes which are aimed at increasing physical activity.

2 Literature Review

2.1 Effects of aging on the human body

Changes in body composition are extremely important factors affecting the health of individuals as they age. The most significant changes include the loss of muscle mass³ and correspondingly increased levels of body fat.⁴ Predisposing factors for chronic disease have been found to be directly linked to these changes.^{5,6} This phenomenon of muscle loss has been referred to in the literature as "sarcopenia," from the Greek "sarcos" meaning flesh and "penia" meaning poverty.⁷ Loss of muscle mass also has very significant implications for the likelihood of older adults to suffer from disability for the following reasons - muscle mass is thought to be the major determinant of muscle strength of older adults⁸ and loss of muscle strength has been found to be the major cause of increased prevalence of disability among older populations.⁹

Age related changes in muscles are very similar to those found with disuse, that is an atrophy or reduction in size of fibres with loss of protein as the rate of turnover exceeds the rate of synthesis. This has led researchers to hypothesize that many age-related changes in muscle are more related to disuse than age per se. Approximately 65% of the body's total protein is found in skeletal muscle, the largest reservoir of protein in the body. The other major constituent of skeletal muscle is water which is also known to reduce in volume as a result of aging.¹⁰

A number of risk factors for cardiovascular disease have also been found to increase as a result of aging. Hypertension, insulin resistance and lipid

abnormalities comprise three of the four modifiable risk factors recently identified as major contributors to an individual's absolute risk,¹¹ and all are thought to increase as part of "normal" aging.¹² There is also known to be a redistribution of body fat with aging with more appearing intra-abdominally.¹³ This tendency has been associated with increased risk for coronary heart disease in both men¹⁴ and women.¹⁵

Another important age-related change in the human body is a reduction in bone mineral density in men¹⁶ but more particularly in women after the menopause.¹⁷ Age-associated loss of bone mineral density is the major cause of osteoporosis, a frequent and disabling disease of older adults. Although there are a number of genetic and lifestyle factors which are known to affect the rate and amount of bone loss associated with aging, body composition changes per se appear to play an important role. Bone mineral density in men has been found to be significantly positively related to lean body mass (body muscle and water) measured by dual energy x-ray absorptiometry,¹⁶ whilst in women total body fat was found to be the most significant predictor of bone mineral density.¹⁷ However in a subsequent study of the relative contributions of lean and fat tissue to bone mineral density in adult eumenorrheic females, the authors concluded that bone density was only associated with fat mass in sedentary women and associated with lean mass in vigorous exercisers.¹⁸

The actual mechanism for the decline in aerobic power or maximal oxygen uptake which is directly attributable to age alone, is relatively unknown. In a review of longitudinal and cross-sectional data by Hagberg, he suggested an approximate decline of 10% per decade for sedentary adults compared with an approximate decline of 5% for athletes who maintained their activity levels as they aged.¹⁹ Evans and Campbell considered that the age-related decline is likely to result from reduced

physical activity, with age being of secondary importance.⁷ This conclusion was based on their study comparing the maximal oxygen uptake of young and middle-aged men where time spent training was found to be the most important factor in achieving high maximal oxygen uptake.²⁰ Also in the same study, when initially sedentary young and older men and women (60-70 years) undertook aerobic exercise for 3 months, similar gains in aerobic capacity were achieved. However another long-term study of older athletes over a 20 year period showed a decline of 8-15% despite continued vigorous endurance exercise.²¹ These data suggest that, whilst acknowledging the decline in aerobic power with age, there is still much to be learned about the aerobic responses to exercise of older adults.

In view of these profound changes to the human body associated with aging, there has been much speculation as to the changing nutrient requirements of older people. Most researchers agree that there are some nutrients for which an increased need has been defined. However specific amounts and ages at which this increased need becomes manifest have been more difficult to define due to the tremendous heterogeneity found within the older population. In a review by Blumberg, vitamins B₆, B₁₂ and D were specifically identified as being required in larger amounts in older adults than for younger adults.²² His justification for these increased needs resulted from the number of studies of older populations where low to very low serum levels of these vitamins and their related biochemical compounds were found. In addition a reduction in efficiency of the older body to utilise nutrients as effectively as younger adults and the ability to normalise or considerably improve status when amounts above the recommended levels of these vitamins were ingested, confirmed his opinion of the age-associated increased needs. In contrast to Blumberg's recommendations, the current Australian Recommended Dietary

Intakes (adopted by New Zealand) specify a reduced need for thiamin, riboflavin, niacin and vitamin B₆ for older adults.²³ Further evidence of the contradictory nature of the present limited research data is found in a paper examining the protein requirements of older adults where it is suggested that protein needs may be higher than current recommendations for younger adults.²⁴ Table 2.1 provides a comparison of the United States, Australian and British recommendations for older adults and illustrates the discrepancies between not only the recommendations for vitamins and minerals, but also the age classifications employed.

Table 2.1 A comparison of the recommended levels for energy and some of the major nutrients for older adults in Australia, the United States of America and the United Kingdom. (New Zealand has adopted the revised Australian Dietary Intakes 1990.)

	Australia ^a		USA ^b		UK ^c	
	males	females	males	females	males	females
Age range (years)	64+	54+	51+	51+	50+	50+
Nutrient						
Energy (MJ/day)	8.8	6.4	9.6	8.0	8.7-10.6*	7.6-8.0*
Protein (g/day)	55	45	63	50	53.3	46.5
Calcium (mg/day)	800	1000	800	800	700	700
Iron (mg/day)	7	5-7	10	10	8.7	8.7
Zinc (mg/day)	12	12	15	12	9.5	7.0
Vitamin A (µg/day)	750	750	1000	800	700	600
Thiamin (mg/day)	0.9	0.7	1.2	1.0	0.9	0.8
Vitamin B ₆ (mg/day)	1.0-1.5	0.8-1.1	2.0	1.6	1.4	1.2
Vitamin C (mg/day)	40	30	60	60	40	40

^a National Health and Research Council. Recommended dietary intakes for use in Australia. Canberra: Australian Government Publishing Service, 1990.

^b National Research Council. Recommended dietary allowances. Report of the Food and Nutrition Board. 10th revised ed. Washington DC: National Academy Press, 1995.

^c HMSO. Dietary reference values. Manual of Nutrition 10th Ed, Ministry of Agriculture, Fisheries and Food. Reference book 342, 1995.

* Estimated average requirements (EARs).

2.2 Effects of exercise on the human body

There is a growing body of evidence which suggests that exercise and physical activity has very positive influences on the health and survival of older adults. Table 2.2 lists some of the major longitudinal studies documenting these relationships. Recreational and non-recreational physical activity were reported in a large representative American sample (National Health and Nutrition Examination Survey 1971-1975, or NHANES 1) aged 45 to 74 years. This sample was traced for subsequent mortality in the NHANES 1 Epidemiological Follow-up Study (NHEFS 1982-1984). Men who were physically inactive were more likely to die sooner than those who were very physically active, whilst for women the relative hazard was far less clear. Of a number of health related behaviours studied, non-recreational activity only in the age group 65-74 years was associated with shorter survival time in women.²⁵ The relative lack of recreational activity (40%) in both men and women in this study was thought to explain this lack of association.

When all-cause mortality was examined in the Alameda County Health Study, relative risk for participants aged 50 years and above with low physical activity status at entry, ranged from 1.27 to 1.38 compared to those with high physical activity status.²⁶ The Honolulu Heart Program has followed a cohort of middle-aged and older men for 12 years documenting rates of definite coronary heart disease. Rates of heart disease were 30% lower among those middle-aged men who led active lifestyles and almost 60% lower among older active men.²⁷

Table 2.2 Longitudinal studies documenting health or mortality risk by physical activity of middle aged and older adults.

Study	Age at entry (years)	Activity measured	Risk measured	Change in relative risk	
				Least active	Most active
British civil servants ²⁸	45-64	Vigorous sportsplay	CHD	1.00	0.36
British civil servants ²⁸	45-64	Non-vigorous sportsplay	CHD	1.00	1.26
Alameda County Health Study ²⁹	50-70+	General status at entry	all cause mortality	1.27-1.38	1.00
British Regional Heart Study ³⁰	40-59	physical activity index	CHD	1.00	0.80
British Regional Heart Study ³¹	45-59	physical activity index	stroke	1.00	0.20
Honolulu Heart Program ²⁷	45-69	physical activity index	CHD	1.00	0.43-0.69
Harvard Alumni ³²	45-84	walking, stair climbing, sportsplay	all cause mortality	1.00	0.41

Further evidence for the positive effects of exercise on the human body have been found in studies which examined fitness levels of older adults as fitness can be considered an indirect measure of activity. A large Texan study measured physical fitness of adults 20 years and over by a treadmill exercise test and mortality at follow-up for an average of more than eight years.³³ A more pronounced beneficial effect from higher fitness levels was exhibited with older men and women compared with younger subjects.

2.2.1 Strength training

Early studies of dynamic resistance training in older adults failed to show an increase in muscle strength but relatively low intensity of training was utilised. However when 69 year old long-term (12-17 years) strength trainers exercising at 70-90% of the 1RM* on average three times per week were compared with older male swimmers and runners, only the strength trainers were found to have similar muscle size and strength to that of younger exercising control subjects.³⁴ Another study of prolonged moderate to high intensity resistance training showed an average of 60% increase in muscle strength for older men and women after twelve months.³⁵ Furthermore once muscle strength was directly related to actual weight of muscle, both gender and age differences in muscle strength were found to be no longer evident.⁸

Additional positive effects of strength training were reported in a study of older men and women in which energy intake and expenditure were examined. In addition to a decrease in body fat mass and increase in fat free mass sustained by the participants, an increase in resting metabolic rate was found to contribute to that of the energy cost

* the amount of weight able to be lifted with one muscular contraction or one repetition maximum

approximately 15% increase in energy intake for body weight maintenance.³⁶ It would therefore appear that resistance training would make a significant contribution to programmes designed to reduce body fat in older adults.

2.2.2 Biochemical changes resulting from exercise

Nitrogen balance studies have suggested that the body's requirement for protein increases as a result of exercise but this increased requirement is dependent on many factors including exercise intensity, duration, type and frequency. It is thought however that athletes who play sports at recreational levels may well have sufficient intakes of protein provided by the population RDI levels.³⁷ In contrast one study found that elite endurance athletes appeared to require twice that of sedentary individuals.³⁸

Likewise, sweating and vasodilatory responses to exercise are an important part of the body's homeostasis mechanism and are thought to be progressively impaired with age. A study comparing these factors in groups of younger and older men found the diminished response to exercise was removed in highly active individuals with high for age maximal oxygen uptake.³⁹

2.2.3 Effects on blood pressure

Hypertension is a major public health issue which has been documented to affect 40 to 50% of older people. An increased risk of cardiovascular problems such as ischaemic heart disease and stroke accompany a rise in blood pressure.^{40,41} However, epidemiological evidence suggests that those who are physically active have significantly lower resting blood pressure than their less active peers. A number of population-based cohort studies have reported an association between physical activity and risk of developing hypertension. A large study following the health of male University students found that those who played vigorous sports at

university had a 30% reduced risk of developing hypertension in later life.⁴² Similarly a study of women aged 55-69 years who participated in physical activity at moderate to high levels had 10-30% lower risk of developing hypertension than those who reported low levels.⁴³

Possible mechanisms involved in this inverse association between exercise and hypertension are the vasodilatory effect of exercise and the reduction in resting heart rate following exercise. However, there is limited information available on the specific exercise effects on blood pressure for older adults. Seals and Hagberg carried out an extensive review of studies of exercise effects on hypertensives in 1984.⁴⁴ Twelve studies were finally included in their review which reported on adults aged between 26 and 55 years who were all using large muscle activities (that is walking, jogging, cycling). They concluded that a small improvement in cardiovascular functional capacity was evident in most of the studies with a trend for larger reductions in diastolic blood pressure in subjects with borderline or high normotensive blood pressure. However, the reviewers cautioned about the interpretation of results due to flaws found in the study designs such as the absence of a non-exercising control group. Also a very marked variation in exercise frequency, intensity, duration and length of training period amongst the reviewed studies made it difficult to quantify overall training stimulus or draw comparisons. The authors found that the use of animal models such as the spontaneous hypertensive rat, did not clarify the situation any further as to whether exercise training had a significant effect on blood pressure either at rest or during exercise.

Where exercise has been included as part of a combined lifestyle intervention to investigate blood pressure reduction, positive effects have been noted in a group of 60-85 year olds.⁴⁵ Subjects were mild hypertensives and the six month study was

randomised. The intervention group was given advice on dietary modification for weight loss and sodium restriction together with increased physical activity levels to 120 minutes per week whereas the control group was simply monitored. The intervention group experienced significantly greater reductions in both systolic and diastolic blood pressure than the control group after two months and these reductions were sustained throughout the remainder of the study. However the design of this study did not allow for the determination of exercise effects without dietary modifications.

To investigate more closely the overall effects of blood pressure changes resulting from exercise would have on body organs, which suffer damage as a result of hypertension, a study was carried out which monitored ambulatory blood pressure over 24-hour periods.⁴⁶ Participants were men and women aged 50-74 years with mild hypertension. An exercise group performed regular low-intensity aerobic exercise for a six and 12 month period and were compared with a non-exercising control group. The study demonstrated that regularly-performed low-intensity aerobic exercise lowered arterial blood pressure at rest in this age group to a similar or larger degree than that found in younger individuals.

2.2.4 Effects on body weight

Apart from the age-related changes in body composition already referred to in this review, an incremental increase in body weight associated with the aging process has frequently been reported in the literature. The mean body weight of a large sample of New Zealanders surveyed in 1991 showed an increase of 7.2kg for males and 5.2kg for females between the age ranges of 19-24 years to 45-64 years. The mean body weight of New Zealanders 65 years and over however showed a marked decrease for both men and women.⁴⁷ Although physical activity of older

adults frequently declines with aging, a corresponding decline in energy intake appears to be insufficient to avoid this weight gain in many individuals at least up to 65 years of age. There is also well-documented evidence of a decline in resting metabolic rate associated with aging⁴⁸ which potentially compounds the difficulty of maintaining energy equilibrium for older adults.

Exercise has frequently been cited as a beneficial component of any weight reduction programme although the precise physiological mechanisms which result from this changed behaviour are not clearly understood. The actual energy cost of participating in exercise is an obvious contribution to the overall energy expenditure of an individual, but there has also been reported an increase in metabolic rate which continues after the exercise episode.⁴⁹ Clearly exercise has the potential to be a very useful component of any programme aimed at weight control and avoidance of obesity as well as increasing lean body mass for older adults.

2.2.5 Effects on frail elderly

Very few studies have examined the effects of exercise on frail older adults who would derive enormous benefit from an increase in muscle strength. Researchers have shown that an increasing prevalence of disability occurred as a result of decreased muscle strength.⁹ It does appear however, that there is no age-related decline in ability to gain muscle. A group of researchers found that increases in muscle strength of 180% occurred after just eight weeks of vigorous cycling and weight training programmes in a group of institutionalised older adults aged 87 - 96 years.⁵⁰ An increase in muscle strength and balance resulting from exercise in frail elderly has also been shown to reduce the risk of falling and subsequent hip fracture⁵¹ and to dramatically increase spontaneous physical activity.⁵²

There are a number of other important benefits which frail older adults can gain from exercise. Included amongst these is the improved functional status shown for arthritis sufferers,⁵³ and improved serum vitamin D levels of older institutionalised women in New Zealand resulting from spending more time engaged in outdoor activity,⁵⁴ and thus the reduced likelihood of suffering osteoporosis.

2.2.6 Effects of exercise on nutrient intake

As the nutrient intake of older adults may be below desirable levels for optimal health, it is important to consider the likely effects that exercise itself exerts on the food intake habits of individuals. Research in this area is difficult as collection of reliable food intake data is an ongoing problem for researchers and the introduction of new levels of exercise may create a compensatory reduction in activity outside the exercise periods. Also if exercise is commenced to aid a weight loss regime, food intake and expenditure values will be confounded by this goal. In a review of the relationship between exercise and food intake, a number of cross-sectional studies reported an increased energy intake amongst active individuals when compared with sedentary controls.⁵⁵ In those longitudinal studies reviewed where exercise levels of participants were well-documented or manipulated, an increase in energy intake with increased exercise was more likely to have occurred in lean individuals and no significant changes in intake observed amongst obese individuals. Food selection and thus nutrient composition appeared to have remained unchanged.^{55,56} When cardio-respiratory fitness as well as physical activity were related to dietary quality in 20-40 year old women, no significant correlations were found.⁵⁷ However the majority of studies examining the effect that exercise has on nutrient intake have been carried out in groups of young or middle-aged adults, and competitive athletes.

In summary, aging is known to adversely effect the functional status of the human body in a progressive manner. Possibly the most significant change is that of muscle loss and its replacement with body fat, and an associated increase in risk factors for cardiovascular and other chronic diseases. However it would follow that if older adults either maintain or increase their physical activity levels as they age, much of these adverse changes can be postponed or significantly slowed. Frail elderly and very old adults can equally obtain these benefits from exercise.

2.3 Exercise description and methods of estimation

Determination of energy expenditure in daily physical activity is an important feature in many research projects studying the health of populations. The most accurate methods of quantifying energy expenditure are either direct measurement of heat output or indirect measurement by gaseous exchange. The use of recording devices to monitor heart rate or body movement and doubly-labelled water techniques to calculate carbon dioxide production by the body have also been used to study small groups. However these methods of determining energy expenditure are limited by their requirement for expensive equipment or materials, considerable completion time, limitations on the types of exercise suited to the measuring devices and intrusiveness of the measurement on the daily lives of individuals.

In contrast, epidemiological or field methods of measuring energy expenditure from exercise have traditionally used either of the following three methods - employment classifications (sedentary, active and very active), questionnaires or surveys, and activity diaries. These methods, whilst much less accurate as a measurement device, are easily applied in the research setting and less likely to affect an individual's normal activity patterns to the same degree. However, employment classifications are unsuited to older adults as they are frequently no longer employed. Questionnaires or surveys of habitual activity whilst providing information on long-term activity patterns rely heavily on short term memory which may be impaired in older people. Seasonal influences on exercise have also been considered a possible confounding factor in older women in the Netherlands.⁵⁸ The disadvantages of diary recordings are that they require a high level of subject

compliance and time for completion and only reflect short-term activity patterns. However all of these field methods are affected by the absence of a “gold standard” with which to compare them.

Exercise estimation methods which have been used specifically for groups of older adults include questionnaires completed by interview and recorded activity diaries. A questionnaire designed for independently living healthy older adults living in the Netherlands⁵⁹ was modified from that of a validated physical activity which collected information regarding habitual physical activity at work and during sport and leisure in young Dutch adults via a self-administered questionnaire.⁶⁰ The main emphasis of the questionnaire related to household activities including questions on flights of stairs and numbers of floors in the residence. Sporting and leisure time activity were estimated by recalled time and frequency of participation. Another epidemiological survey used in the USA for working men relied on participants to recall sport and leisure activities over the previous week as well as recording information on stair climbing and average number of city blocks walked.⁶¹

Any exercise measurement tool should preferably be validated in the country of use and with a similar subset of the population. In New Zealand there is limited information on exercise in older adults. The PEPSA (Physical Exercise Programme for Sedentary Individuals) diary is a concept which was developed in New Zealand by Drs. Bevan Grant and Noela Wilson to encourage inactive individuals to increase the amount of physical activity in their daily lives.⁶² The diary contains a points system in table form to allow individuals to calculate their own activity levels. There has also been a large scale New Zealand survey in 1991 (Life in New Zealand) which incorporated questions on physical activity participation over the preceding four weeks and reasons for participation.⁶³

2.4 Body composition estimation

Reliable estimations of body composition changes in older adults and their relationships with physiological health and longevity are an important goal towards our understanding of ways to counteract the adverse effects of aging. The most accurate methods of estimating body composition include underwater weighing, dual energy x-ray absorptiometry and total body electrical conductivity by neutron scanning but all of these methods are expensive, require considerable subject compliance and must be used in a clinical setting. In contrast, bioelectrical impedance analysis (BIA) is fast, portable and non-invasive which makes it a method ideally suited to field studies.

Bioelectrical impedance measurement is based on the resistance or impedance of the human body to a small constant electric current (usually 50kHz) flowing between electrodes placed on the hand and foot of a supine subject. As the water and electrolyte components of the body are good conductors of electricity whilst the fat component is not, this difference allows for an estimation to be made as to the proportional volumes of each portion. However cell membranes represent a partial block to the penetration of the electric current (capacitance) and thus the measurement of intracellular water. The following equation is used to calculate total body impedance -

$$Z = V/I = R+jX$$

(where Z = complex impedance, I = complex current, V = complex voltage, R = resistive component of Z , X = reactive component and $j = \sqrt{-1}$ which indicates X is

orthogonal to R). Prediction equations which include height, weight, age and sex of individuals are then employed which provide an estimation of fat and fat free tissue.

Since body water comprises approximately 73% of the measured fat free mass, BIA measurements are profoundly affected by the relative state of hydration of individuals. Accordingly it is important to make sure subjects are normally hydrated and that there are no clinical disorders where extracellular fluid is abnormally represented.⁶⁴ Hydration variations and effects from recent exercise, consumption of food and beverages and time of last micturition should therefore be controlled for as closely as possible in the research methodology. However some researchers have found that eating and drinking did not significantly effect body composition estimations.⁶⁵

The relevance of this method of body composition for older adults is important to consider. In a review by Baumgartner it was recommended that multicompartment models be used in BIA measurement as fat free mass may vary more markedly in older adults from the approximated 73% than it does for younger subjects due to age-related changes in extracellular fluid.⁶⁶ Other researchers have found that older adults had a higher water content of fat free mass than younger adults and that errors of up to 10% fat may occur when a constant hydration level of fat free mass is assumed.⁶⁷

2.5 Food intake estimation methods

When attempts are made to measure dietary intake it is important to obtain results that are indicative of usual intake of a group of individuals. Much research has been conducted using different dietary assessment methodologies, but validation of the results can only be ascertained to a limited degree by correlating results with an alternative method which itself may not be truly indicative of usual intake. Every method will have inherent advantages and disadvantages. To complicate the matter further, intra-subject variations in nutrient intake can be larger than inter-subject variations.⁶⁸ This effect is most marked with nutrients present in high concentrations in a few foods, but less likely to be encountered in macronutrients widely distributed in foods such as protein and carbohydrate. It is also important to consider whether individual intakes or group means are more of interest to the researchers.

The most frequently used methods for measuring food intake are food diaries, food frequency questionnaires, diet histories and food recall. Diet history can be particularly labour intensive, especially if there is any hearing impairment of participants and therefore less suited to older populations. Similarly food recall methods (e.g. 24 hour) rely heavily on short term memory and have been found to be unreliable in older adults.⁷⁰ In contrast, food intake diaries have been used successfully in older adults in New Zealand,⁶⁹ but the actual process of recording intake has been found to affect the food choices of an individual and thus misrepresent usual intake. Food frequency questionnaires are a quick method of determining how often specific foods are eaten and are convenient for ranking the

intake of individuals and identifying individuals at extremes of intake. However they are limited for estimating true average intake and portion sizes may not be applicable to the group under study. These limitations, together with study size, cost effectiveness and likely subject compliance must be carefully considered when an estimation method is chosen for the population in question.

A review of the nutrient intake estimation methods used for older populations revealed two large epidemiological surveys. These concluded that recording of food intake at the time it is eaten was one of the most suitable methods for older people due to the possibility of declining short-term memory of participants. The Survey in Europe on Nutrition and the Elderly, a Concerted Action (SENECA) used a three day estimated record together with a frequency checklist for food intake assessments which showed good agreement with other evaluation criteria.⁷⁰ The feasibility study for the British National Diet and Nutrition Survey of people aged 65 years or over (NDNS) recommended the use of four consecutive days of weighed records reporting that the completion rates were better and there were no significant differences in the major nutrients tested compared to seven days of recording.⁷¹ Weighed food records requiring high respondent burden in time, motivation and care in accurate recording could arguably be the best possible method of estimation of average intakes of older individuals. Other researchers have also suggested that weighed food records were the most appropriate method of estimating intake in older populations.⁷²

Day of the week effects have been found to be an important factor for intake of some nutrients such as fibre which was shown to be lower at weekends in a Dutch adult population,⁷³ whereas in micronutrients such as cholesterol, sodium and

vitamin A, known to exhibit large inter- and intra-subject variability, this effect was not found to be present.⁷⁴

Calcium is an important nutrient for older people as the chronic disease of osteoporosis is linked to advancing age. Information on intake levels of this nutrient from the latest Life In New Zealand Survey found mean intakes for women in the age ranges 45-64years and 65+ years assessed by 24 hour recall to be approximately half that of estimated requirements. Mean intakes for men were approximately three-quarters that of estimated requirements.⁴⁷ It has also been noted in an Australian study that some subjects had recently changed their eating habits to include less frequent consumption of milk and other dairy products.⁷⁵ A calcium food frequency questionnaire for New Zealanders has recently been successfully validated against seven day estimated records amongst NZ European women aged 25-49 years. The mean difference in intake by the two methods did not differ significantly from zero.⁷⁶

3 Aims

The aims of this research project were to collect data about the following lifestyle habits of a group of exercising older adults aged 50 years and over:-

1. food intake using a three day food diary.
2. calcium intake using a calcium food frequency questionnaire
3. levels of exercise over 14 days using the PEPSA scoring system
4. usual levels of other activities commonly undertaken by older adults - gardening and housework

A further aim was to explore relationships between activity and exercise, body composition and nutrient intake in this group of older adults.

4 Methods

4.1 Participant selection

The intended research was approved by Massey University Human Ethics Committee.

Prior to commencement of the research project, a general article about the intended research was published in a quarterly newsletter mailed to all current participants of Sport North Harbour's Kiwisenior and Roll start exercise programmes for older adults in Rodney district and North Shore city (Appendix A). To obtain a random sample of prospective subjects from this database of approximately 900 names, Sport North Harbour performed a computer-generated allocation of numbers from one to three for all entries in their database. All those allocated one of these numbers were then printed out (a total of 298) in October 1996 which comprised approximately 33% of the complete database. These individuals, or in a few cases couples, were all mailed out project information which briefly explained the intended research (Appendix B), a consent form (Appendix C) and freepost envelope to send back their signed consents if they wished to enter the project.

Fifty seven positive consent forms were returned during late October and throughout the month of November. Consenting individuals were contacted by telephone and subsequently eight were eliminated as they were under 50 years of age, two decided to withdraw consent citing lack of time to complete the three day food diary and two were unavailable due to holidays at the time the research was undertaken. The researcher arranged to meet the remaining 45 individuals either at

their homes or before they commenced an exercise session. A follow-up letter to confirm this arrangement was subsequently posted out which also reminded participants to avoid eating or drinking for less than two hours beforehand and avoid exercising that day before the meeting was to take place (Appendix D).

4.2 Exercise estimation

The literature search revealed no suitable tool, to the author's knowledge, which had been used by researchers for quantifying exercise levels over time in healthy older adults in New Zealand. Neither the Baeke⁶⁰ or Paffenburger⁶¹ questionnaires for activity recordings were considered appropriate for New Zealand conditions as these included questions related to flights of stairs climbed and city blocks walked. (Most of the participants in this study were presumed to reside in single storey dwellings and a significant proportion were from rural areas). Also neither of these questionnaires would have provided sufficient information regarding regular participation in sporting activities of participants.

A 14 day exercise diary was therefore devised which requested information on the type and length of the exercise periods and which used the PEPSA points system and table described previously⁶² (Appendix E). Although a minimum time frame of four weeks is considered preferable for recording habitual levels of exercise,⁷⁷ a shorter time frame of two weeks, was chosen by the researcher to encourage full and accurate participation in all of the study objectives. Participants also completed questions in the general questionnaire about their exercising with the Sport North Harbour programmes (Appendix F). At the time that the scales and food

record booklets were collected, a freepost envelope was left with participants to return the exercise diary after 14 days of recordings.

A PEPSA score derived from exercise length and intensity for the 14 day period was calculated by participants and checked for accuracy of calculation by the researcher. Playing golf was scored as badminton or table tennis, that is six PEPSA points per hour, and playing outdoor bowls as four points per hour. All other exercise activities undertaken by participants were covered by the PEPSA points table. It was the intention of the researcher to validate the scoring system in this age group. An indication of the frequency and length of time participants had spent gardening and doing household chores in the last four weeks was also obtained from the exercise diary (see page 9 of Appendix E). Participants were then given a combined score based on the time and frequency for these separate activities (range of scores 0-60 for gardening, 0-30 for housework).

4.3 Body composition estimation

Each participant's height was measured with a portable stadiometer and weight was measured with a Healthometer spring balance medical scales. These weights were checked against electronic weighing scales in approximately one third of subjects. Participants had refrained from exercising that day and had not eaten or drunk anything two hours prior to the measurements being taken.

Bioelectric impedance data was measured using a Seac BIM4 bioimpedance hand held pre-programmed single frequency meter (manufacturer - UniQuest at The University of Queensland) operating at 50 kHz and 200 microamps. The participant laid supine with limbs not touching the body and electrodes were placed at the

midpoint between the distal ulna/radius dorsal on the right wrist, the third metacarpal head dorsum on the right hand, the midpoint between distal tibia/fibula dorsal of the right ankle and the second metatarsal head dorsum on the right foot. Their height, weight, age and sex were entered into the meter with the normal rather than obese option used in all cases. The meter was read directly after the participant's characteristics were completely entered.

4.4 Food and nutrient intake estimations

Weighed food and drink records were considered an appropriate method for the intended small study group. Random allocation of days of the week for recording was chosen to obtain information for both weekdays and weekend days with relation to macronutrients and certain selected micronutrients. In this way any weekend effects which may exist could be investigated. Three random days of intake were also considered appropriate for the intended participants in the study as any longer than this may be an inappropriate burden and thus reduce compliance with the study design.

The selection of days of the week were performed by the researcher using a random selection of seven counters each allocated a different day of the week. The weekend to week days ratio was checked and found to be proportionally representative with weekend days comprising approximately two seventh of the total days for recording over the entire group.

During the first meeting with participants which lasted approximately one hour, the researcher explained and demonstrated the use of weighing scales for accurate recording of food and fluid intake. A comprehensive list of written instructions was

included in the recording booklet with 14 lined pages for recording (Appendix G). No sample diet, recording examples or suggested meals were given to influence subject's choice of food or meals.

As calcium has been identified as a nutrient appearing to be required in higher amounts in older adults than younger adults⁷⁸ and intake levels are thought to be an important modifiable factor in osteoporosis, this micronutrient was also of interest to the researcher. A four page previously validated calcium food frequency questionnaire⁷⁶ was briefly explained and left with each participant to fill in before commencing the three days of food and drink recording (Appendix H). Questions on dietary supplement use, income and alcohol consumption taken from the Life in New Zealand 1991 survey⁴⁷ were also included with permission in the general questionnaire (Appendix F). The researcher returned to collect the scales, the food frequency questionnaire and the food record booklet from each participant approximately seven days later.

4.5 Data collection

Thirty eight participants completed the recordings during November and early December. Data collection was halted at this point due to the proximity of Christmas. A further four subjects were studied during February and March 1997. Two volunteers failed to complete the food and exercise diaries and FFQ and elected to pull out of the project after the initial general questionnaire and body measurements were completed citing lack of time to fill in a three day food diary. One volunteer suffered illness which prevented completion of the food and exercise diaries and was subsequently eliminated from the study. Two volunteers completed all parts of the

study except the exercise diary due to injuries and they were retained in the study. Participants were informed by letter of their individual and the grouped results (Appendix I) and a second general article explaining the results of the research project was published in Healthier Lifestyles July 1997 magazine (Appendix J).

4.6 Statistical analyses

Data collected was entered by the researcher on to a spreadsheet and all analyses were performed using Microsoft Excel 5.2 software package. Mean values and standard deviations for the general participant characteristics of male and females were calculated separately. The New Zealand Diet 1 version 3 software package was used to estimate nutrient intake from the food and drink diaries. The 50th centiles for total energy, carbohydrate, protein, fat, saturated fat, calcium and zinc consumed per day, and the mean percentage of total energy obtained from protein, fat, saturated fat, carbohydrate, and alcohol were recorded for each individual. An estimated calcium intake from the calcium food frequency questionnaire was obtained by analysis using an Apple MacIntosh Hypercard application software package obtained from Otago University which had been used and validated in a previous study with younger adults.⁷⁶

Simple correlations were performed using body composition data, PEPSA scores, gardening and housework scores, nutrient intake data and energy expenditure information of male and female participants separately. Where a significant correlation was found between variables (p value $<5\%$ and $<1\%$), scatter plots of the data were obtained with trend lines, equations and R^2 .

An estimation of the daily energy expenditure for participants (see Table 4.1) was obtained from the New Zealand Diet 1 software calculations which uses Schofield's equations for calculating the basal metabolic rate for individuals⁷⁹ multiplied by a factor for an assumed physical activity level (PAL). Energy requirements as multiples of BMR have been described by Warwick as varying between 1.4 x BMR for minimal activity to 2.0 x BMR for very active individuals.⁸⁰ As the participants were known to be exercising at very varied levels the researcher elected to describe PAL for all participants as light to moderate. Therefore to calculate daily energy expenditure, the BMR was multiplied by 1.7 for males and 1.6 for females (see Table 4.1).

Table 4.1 Method of calculating energy expenditure (MJ/day) for participants as described by Warwick.⁸⁰

Sex	Age (years)	Equation
males	50 - 60	$[(0.048 \times \text{weight}) + 3.653] \times 1.7$
	61 +	$[(0.049 \times \text{weight}) + 2.459] \times 1.7$
females	50 - 60	$[(0.034 \times \text{weight}) + 3.538] \times 1.6$
	61 +	$[(0.038 \times \text{weight}) + 2.755] \times 1.6$

As diary recordings of two weeks of exercise using the PEPSA points system had been obtained from 40 of the 42 participants, the researcher attempted to validate this easy and simple scoring system with that of a more complex method designed by Warwick to measure daily energy expenditure and activity. This method requires the recording of activity times in minutes over a 24 hour period and allocates energy costs to various activities (such as sleeping, sitting, standing, walking and exercising) as a multiple of an individual's BMR.⁸⁰ These energy costs were followed

as closely as possible when determining the additional energy expenditure of the recorded exercises of participants from their 14 day diaries (see Table 4.2).

Table 4.2 Energy costs of exercises undertaken by the study group as multiples of BMR (using Warwick's examples where possible).

Activity category	Energy cost factor
Outdoor bowls	2
Slow walking	2.5
Golf, other activity - active but not puffing	3
Brisk walking, Kiwisenior exercise classes, aerobic stretch classes, badminton, table tennis, line dancing, aquarobics, slow cycling	4
Other activity - active, puffing a bit	5
Running, fast swimming, other activity - very active, puffing	7

Warwick's method of calculating energy expenditure in MJ/day from the recorded number of minutes of each exercise bout was then adapted for the 14 day diary records of the study participants and an individual additional daily energy cost of exercise (ADECE) estimated (see example in Table 4.3 where participant's BMR = 5.22).

Table 4.3 Example of adapted method of calculating additional energy expenditure of exercise (ADECE).

Exercise	Recorded minutes 2 weeks	Calculation	(MJ/day)
Brisk walking	60 + 60 + 60 = 180	*4*5.22 = 3758.4 / 14 / 1440	0.19
Badminton	40 + 40 = 80	*4*5.22 = 1670.4 / 14 / 1440	0.08
Slow walking	120 + 120 + 120 = 360	*2.5*5.22 = 4698 / 14 / 1440	0.23
		Total ADECE	0.50

A further method of testing the validation of the PEPSA scoring system was sought which utilised an American table compiled from a large number of exercise studies to provide estimations of the daily cost of exercise for participants. Energy costs of participation (ECP) (expressed in kcalories) are calculated from the number of minutes spent in a particular exercise multiplied by a factor dependent on the body weight of participants and in some cases, the sex of participants also.⁸¹ These values were converted to MJ by the researcher using the following factors - [*4.186/1000]. Both of the above methods of calculating the additional energy costs of exercise were compared with the PEPSA scoring system using simple correlation and scatter plots with trend lines, equations and R².

In order to compare daily energy intake from food records with estimated energy expenditure incorporating data from the 14 day activity records, the PEPSA scores of participants (expressed in units/day) were required to be converted to MJ/day. This was done by comparing the means of the PEPSA scores with the mean ADECE values (expressed as MJ/day) for men and women separately to find an equivalent energy expenditure value for the PEPSA scores in MJ/day. The PEPSA scores for each participant were then incorporated into the following

equations to obtain an estimated daily energy (PAL = light) plus activity expenditure value:

$$\text{Males - } 1.5 \cdot \text{BMR} + (\text{PEPSA} / 139)$$

$$\text{Females - } 1.5 \cdot \text{BMR} + (\text{PEPSA} / 169)$$

Energy expenditure plus activity were also calculated using the ADECE and ECP values obtained for each individual ($1.5 \cdot \text{BMR} + \text{ADECE}$, $1.5 \cdot \text{BMR} + \text{ECP}$). Separate correlations were performed to compare all three methods of estimating energy expenditure plus activity with energy intake. A further set of correlations were performed using a PAL of 1.4 (sedentary) instead of 1.5.

Finally linear regressions were performed to attempt to explain the relationship found between fat free mass of females and age, and also the relationship found between the activity records using the PEPSA scoring system and ADECE. Kg of fat free mass and PEPSA points were used as the response variables in these regressions, and age and ADECE as explanatory variables.

5 Results

5.1 Participant characteristics

The response rate was 19% (57 of 298) to the randomly generated letter for research participation. Table 5.1 shows the general male and female participant characteristics of those 42 individuals who took part in the study. The age range was 50 to 82 years and 62% of participants were between 60 - 70 years of age. Of the 34 women participants, 47% were aged 50-64 years and 53% were 65 years and over. In comparison most of the men were 65 years and over (n=7) and one was in the age group 50-64 years.

The range of BMI values was 19 - 40kg/m² with 45% (n=19) of participants over 25kg/m² and 19% (n=8) over 29kg/m², the desirable upper limit for BMI of adults over 65 years.⁸² The mean BMI values for the study group are similar to those from the nationwide survey⁴⁷ which are 26.0kg/m² and 25.7kg/m² for men and women respectively 65 years and over, and 26.9kg/m² and 26.4kg/m² for men and women respectively of 45-64 years. Five female participants had a BMI > 30kg/m².

Table 5.1. Participant characteristics.

	Males (n=8) mean ± SD	Females (n=34) mean ± SD
Age (years)	69.5 ± 5.2	64.8 ± 6.8
Height (m)	1.68 ± 6.7	1.59 ± 5.6
Weight (kg)	73.8 ± 6.6	66.6 ± 11.5
BMI (kg/m ²)	26.0 ± 3.7	26.1 ± 4.6

Twenty four percent (n=10) of the study sample lived alone whilst the remainder lived with a spouse. The approximate household income level most commonly cited for those living alone was \$20,000 (range \$10,000 - \$30,000) and \$30,000 for those living with a spouse (range \$13,000 - \$60,000 +). 56% of women participants had a household income ranging between \$15-35,000 and 23% had an income \$35-55,000. When participants were grouped by age as in the LINZ data (i.e. 50-64 and 65+),⁴⁷ it was found that fewer women aged 65 years and over in the study group were in the lowest income bracket of <\$15,000 per household (17% compared with 40%) and more were in the next level of income \$15,000-\$35,000 (67% compared with 48%). Percentages similar to the LINZ data for income groups were seen in the women aged 50-64 years and for men.

5.2 Exercise characteristics

The most popular Sport North Harbour exercise groups which participants belonged to at the commencement of the study were Kiwisenior exercise classes (n=20) and walking groups (n=16). Five participants stated they had not previously been exercisers before starting with the Sport North Harbour groups and four had ceased attending. When offered four possible reasons for starting exercise with the Sport North Harbour groups (health, social, dieting, other - Appendix F) 88% cited health reasons and 50% of the group cited social reasons. In contrast, dieting and "other" were cited only occasionally. These results are similar to the reasons given by adults aged 65+ years for participation in physical activity during the last nationwide survey where 87% of men and 82% of women cited health and 46% of men and 50% of women cited social reasons.⁴⁷ However in the age bracket 45-64 years, health and social reasons for exercise were cited less frequently in the nationwide survey.

Many participants listed two or more forms of exercise over the 14 day record keeping period. Two participants were unable to provide information about exercise habits as they had suffered recent injuries. The most popular form of exercise undertaken was walking (88%, n=37) which is similar to the LINZ sample groups incorporating adults 45+ years where 80 - 88% participated at least once in four weeks.⁴⁷ The next most popular activity undertaken was Kiwisenior exercise classes or exercises at home (48%, n=20). This frequency was far more than that recorded for the general older population over a 4 week period (1-31%).⁴⁷ When the frequency of participation in walking was calculated from the 14 day diaries, it was found that

those that walked averaged five times per week which is far more than the nationwide survey of 1.9-2.4 times per week for the age groups 45 years and over.⁴⁷ Averaged daily length of time for exercising was higher for males than females (see Table 5.2).

Recorded exercise times, gardening and housework scores and the other methods of describing additional energy expenditure of exercise (PEPSA points, ADECE and ECP) for males and females separately are shown in Table 5.2. Males recorded higher energy costs of exercise as determined by PEPSA points, ADECE and ECP and gardening scores than women but lower housework scores (Table 5.2). A large variation was observed between individuals with regard to the length of time spent exercising, gardening and doing housework. Energy scores obtained from the table published in the USA (ECP)⁸¹ were much higher than those calculated from the paper published in Australia.⁸⁰

Table 5.2 Recorded exercise levels and energy costs of exercise.

	Males (n=7) mean ± SD	Females (n=33) mean ± SD
Exercise time from 14 day diaries (mins)	905 ± 421	717 ± 315
Average daily exercise time (mins)	65	51
Gardening score	19 ± 16	14 ± 14
Housework score	5 ± 2	10 ± 7
PEPSA points score	147 ± 53	115 ± 42
ADECE (MJ)*	1.06 ± 0.42	0.68 ± 0.28
ECP (MJ) [#]	1.69 ± 0.87	1.15 ± 0.50

* see Table 4.3 for calculations.

[#] see method for calculations.

The mean daily energy expenditure for participants using the light to moderate PAL and the comparison with the mean daily energy intake from three day diaries is shown in Table 5.3. Although the energy intake is less than the energy expenditure for both sexes, the difference between energy intake and expenditure is far less in the male participants than the females. This difference between the sexes was still apparent when energy was related to body weight (see Table 5.3). Of the five participants with BMI > 30, three reported an energy intake less than the energy required to sustain BMR. It was also found that 35% of women (n=12) and 12% of men (n=1) appeared to under-report energy intake according to the FAO/WHO/UNU minimum estimate for survival of 1.27*BMR. The female under-reporters had a mean BMI of 28.5kg/m².

Table 5.3 Energy expenditure and energy intake of participants.

	Males (n=7) mean ± SD	Females (n=33) mean ± SD
Energy expenditure (MJ)	10.33 ± 0.55	8.69 ± 0.82
Energy expenditure (MJ/kg body weight)	0.14	0.13
Energy intake (MJ)	9.72 ± 1.30	7.40 ± 1.44
Energy intake (MJ/kg body weight)	0.13	0.11

5.3 Body composition characteristics

Body composition estimations measured by bioelectrical impedance indicated male participants had a variation in body fat levels between 9.6 and 25.5kg and female participants ranged between 10.5 and 41.0kg of body fat. Further body composition characteristics are shown in Table 5.4.

Table 5.4 Body composition characteristics measured by bioelectrical impedance.

	Males (n=8) mean \pm SD	Females (n=34) mean \pm SD
Impedance (h^2 /resistance)	470.2 \pm 48.1	566.2 \pm 59.2
Resistance (Ω)	465.8 \pm 48.1	561.8 \pm 59.1
Reactance (Ω)	64.2 \pm 6.3	70.0 \pm 7.8
Fat free mass (kg)	56.6 \pm 3.2	44.0 \pm 5.1
Fat free mass (%)	77.1 \pm 5.8	66.7 \pm 5.8

5.4 Food and Nutrient Intake Estimations

5.4.1 Three day food records

The mean daily food intake estimates from the three day food records can be seen in Table 5.5. The percentages of energy consumed as carbohydrate, protein, fat and alcohol were similar in both men and women and the percentage of fat intake consumed as saturated fat was also similar (see Table 5.5). The male participants consumed on average 31% more energy than women. Calcium and zinc intake was higher for men than women.

Table 5.5 Daily food intake characteristics of study group.

	Males (n=8) mean ± SD	Females (n=34) mean ± SD
Energy intake (MJ)	9.72 ± 1.30	7.40 ± 1.44
Protein (g)	88.2 ± 5.7	71.1 ± 11.3
Protein (%age of total energy)	15.5 ± 1.3	16.7 ± 2.6
Fat (%age of total energy)	35.3 ± 4.6	34.7 ± 5.7
Carbohydrate (%age of total energy)	47.3 ± 6.6	46.7 ± 5.3
Alcohol (%age of total energy)	1.9 ± 2.2	2.1 ± 2.3
Saturated fat (%age of total fat)	44.5 ± 2.7	46.2 ± 5.9
Saturated fat (%age of total energy)	15.7 ± 2.8	16.0 ± 3.3
Calcium (mg)*	929 ± 262	780 ± 269
Calcium intake from FFQ (mg)*	841 ± 340	894 ± 408
Zinc (mg)*	12.3 ± 2.9	9.9 ± 2.2

* does not include intake from supplements

When compared to the 50th centile food intake data of the LINZ survey in 1989 of over 11,000 New Zealanders obtained by 24 hour recall,⁴⁷ the older

exercising male age group and both of the exercising female groups had higher intakes for energy, carbohydrate, protein, fat, saturated fat and the micronutrients calcium and zinc (see Table 5.6). Mean intakes for the macronutrients were similar for both studies but levels of alcohol intake were lower for the exercise groups.

Compared with the nutrient intake targets for adult New Zealanders⁸² protein intake was within the recommendation (not to exceed twice the RDI) for both males and females. Carbohydrate intake was slightly lower than the target of 50-55% of total energy and total fat intake was slightly above the target of 30-33% by the year 2000. The intake of saturated fat as a percentage of total energy was above the targeted level of 8-12% in both males and females. The mean unsupplemented zinc and calcium intakes for females were below the RDI levels.⁸² Only 18% (n=6) of women had calcium intakes over the recommended intake for age 54+ years (1000mg) compared to 88% (n=7) of men (800mg) estimated from 3 day food intake diaries. Similarly for zinc, only 24% (n=8) of women but 63% (n=5) of men had intakes over the recommended level of 12mg per day.

Table 5.6 Comparison of daily food intake characteristics of exercise study group with the LINZ survey.

Age (years)	Males				Females			
	Exercise study		LINZ study [#]		Exercise study		LINZ study [#]	
	45-64 (n=1)	65+ (n=7)	45-64	65+	45-64 (n=16)	65+ (n=18)	45-64	65+
50th Centiles of intake								
Energy intake (MJ)	8.1	10.2	9.3	7.8	7.5	7.0	6.4	6.0
Protein (g)	81	91	78	65	71	71	55	46
Fat (g)	72	95	89	77	69	73	62	53
Saturated fat (g)	31	38	37	30	26	28	25	22
Carbohydrate (g)	260	297	230	212	210	215	174	170
Calcium (mg)*	1010	1017	631	599	805	785	554	474
Zinc (mg)*	7	12	11	9	10	10	8	7
Mean intakes								
Protein (%age of total energy)	17	15	15	14	17	16	15	15
Fat (%age of total energy)	32	36	37	37	35	35	36	34
Carbohydrate (%age of total energy)	51	47	41	44	46	47	45	48
Alcohol (%age of total energy)	0	2	6	4	2	2	3	3

* does not include intake from supplements

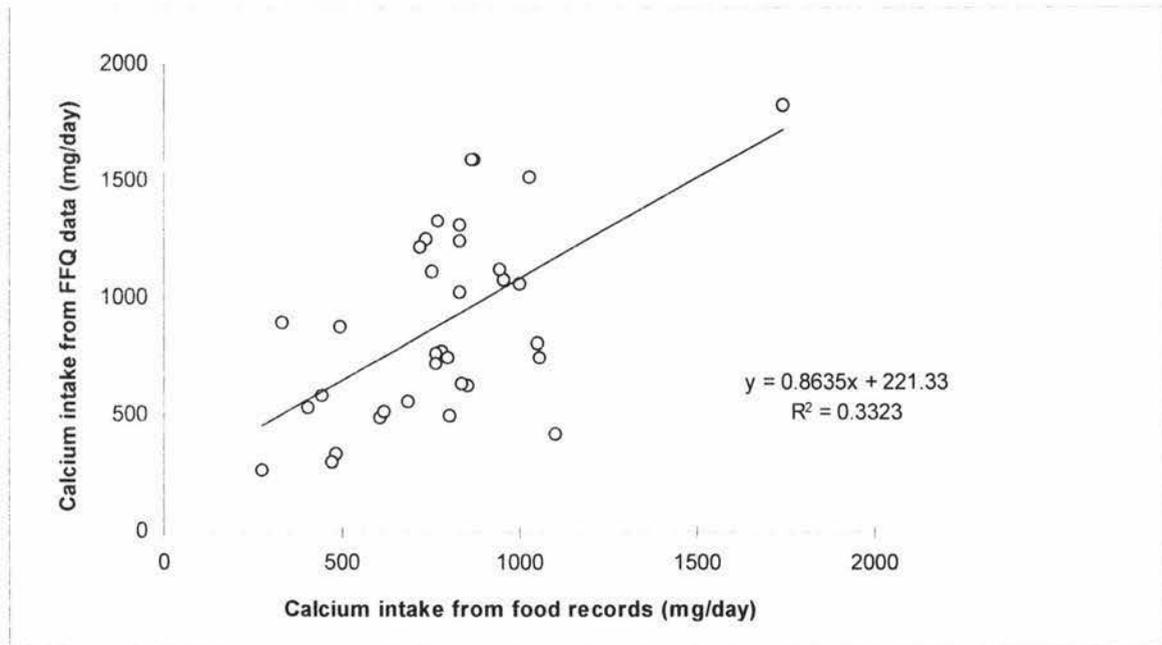
[#]Life in New Zealand survey 1989 obtained by 24 hour recall

5.4.2 Calcium food frequency questionnaire

Wilson's calcium food frequency questionnaire correctly placed 63% (n=5) of men and 59% (n=20) of women above or below recommended intake levels for this nutrient (800mg and 1000mg respectively) when intake was estimated from three day food records. The questionnaire classified women consuming less than recommended levels of intake per day (82% or n = 17) with 61% specificity. This compares with 78% specificity for intake below 800mg found in the younger women with which this FFQ was validated.⁷⁶ However when the figure of 800mg was used for the older women in the study, the questionnaire classified with 86% specificity. The mean difference in intake between the two methods was 88mg for men and 114mg for women. When women were grouped into quartiles of calcium intake from the three day food diaries, the food frequency questionnaire method correctly classified 41% (n=14). 74% of female participants fell into the same or within-one-quartile category compared with 81% for the younger female group.⁷⁶ When low recorded calcium intakes by three day food record were examined (less than 600mg), only three women were grossly misclassified into the top two quartiles of intake by FFQ.

A significant correlation was observed between estimations of calcium intake from food records and FFQs in females ($r = 0.576$) which was significant at the $p < 0.01$ level. A graphical representation of this relationship is seen in Figure 5.1 with details of the regression line. No significant correlation was found between these two variables in males. These relationships were not improved by log transforming the data.

Figure 5.1 Plot of relationship between food intake records of calcium intake and calcium estimated from the FFQ in females.



5.4.3 Supplementation

Over 50% (n=22) of the study group took vitamin and/or mineral supplements regularly and some of these participants also took supplements “now and again” (n=7). The most frequently used supplements were calcium (n=10), multivitamins or multiminerals (n=9), vitamin C (n=6), garlic (n=5) and vitamin E (n=4). Other supplements included vitamin B complex, cod liver oil, vitamin D, bee pollen and iron. Vitamin C was the most popular supplement taken “now and again”. Supplementation was much higher than the results from the nationwide survey using the same questions where 4% of men and 9% of women aged 65 years and over, and 4% of men and 14% of women aged 45-64 years took multivitamin and/or multimineral supplements regularly.⁴⁷

5.4.4 Nutrition advice

Sixty percent (n=25) stated they had not received nutrition advice from anyone. Of the other 40% (n=17), four had received advice from a doctor, four from a dietitian, three from a naturopath, two from a teacher and one from each of the following sources - district nurse, health food shop, chemist, health professional, weight watchers and Allergy Awareness Association. Two respondents cited two occupational groups. A diverse range of sources were cited as "other means of gaining nutrition advice", with reading (books, magazines, papers and pamphlets) being the most popular method.

5.4.5 Alcohol intake

Mean alcohol intake estimated by questionnaire was 3.8 glasses of beer, wine or spirits per week for males and 4.0 glasses for females. Assuming an estimated energy value of 0.42MJ per glass of alcohol, this equated to a daily energy intake from alcohol of 0.23MJ for men and 0.24MJ for women. By comparison energy consumed as alcohol estimated from the three day food diaries was lower at 0.18MJ for men and 0.15MJ for women. These results are similar to the nationwide survey for men (6 drinks/week for 45-64 year olds, 3 drinks/week aged 65+ years) but not for women (1 drink/week for 45-64 year olds, 0 drinks/week aged 65+ years).⁴⁷

5.5 Statistical relationships

5.5.1 Correlations

Table 5.7 shows the relationships found between the variables obtained from anthropometric and body composition measurements, nutrient and energy expenditure data when simple correlations were performed separately for men and women.

Table 5.7 Relationships observed between age, fat free mass, BMI, energy expenditure and nutrient intake variables.

Variables		r	
		Male	Female
Fat free mass (%age)	BMI	NS	-0.73**
Fat free mass (kg)	BMI	NS	0.72**
Fat free mass (kg)	Energy expenditure (MJ) ^a	NS	0.81**
Fat free mass (kg)	Age (years)	NS	-0.52**
Protein intake (% energy)	Fat intake (% energy)	NS	-0.62**
Protein intake (% energy)	Energy intake (MJ)	-0.89**	-0.51**
Zinc intake (mg)	Age (years)	0.85**	NS
Zinc intake (mg)	Energy intake (MJ)	0.74*	0.50**
Calcium intake from records (mg)	Energy intake (MJ)	NS	0.46**

^a see Table 3 for method of calculating energy

* significant at the p < 0.05 level

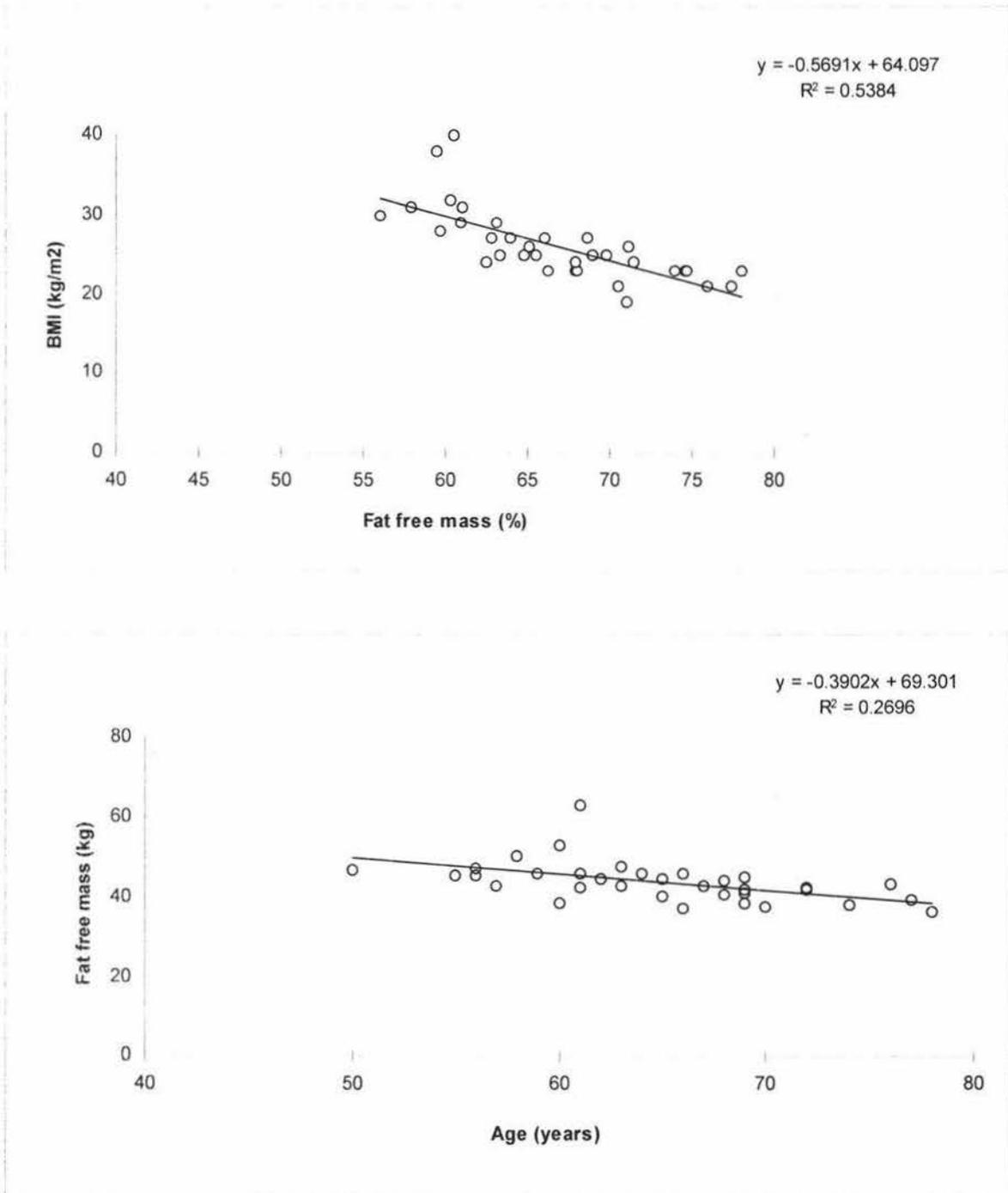
** significant at the p < 0.01 level

These relationships were further explained by the scatter plots shown below.

It can be seen in Figure 5.2 that there were two individuals with much higher BMI values than the remainder of the study group (38 and 40 kg/m²) whose fat free mass measurements were higher than that predicted from the values obtained for the remainder of the female participants. Similarly the fat free mass measurement as

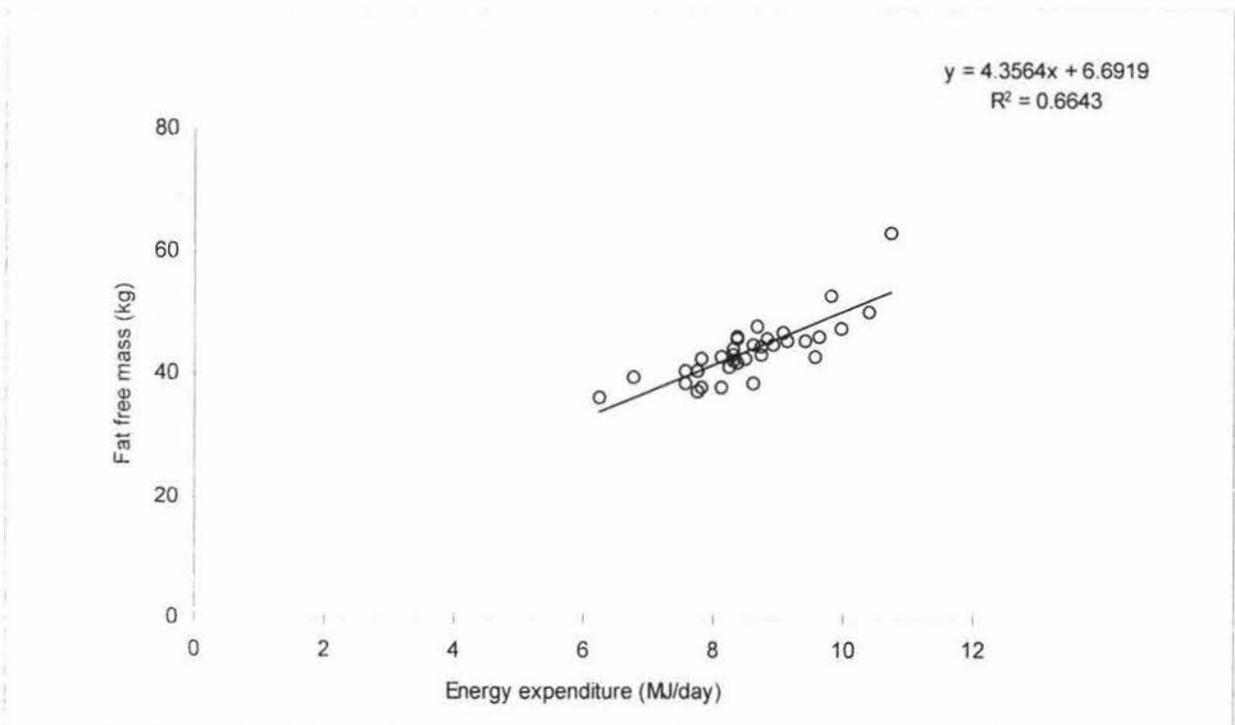
an absolute value in the participant with a BMI of 40 kg/m² was found to be considerably higher than that of the participants of a similar age.

Figure 5.2 Plots of relationships observed between fat free mass (%) and BMI, and fat free mass (kg) and age in females.



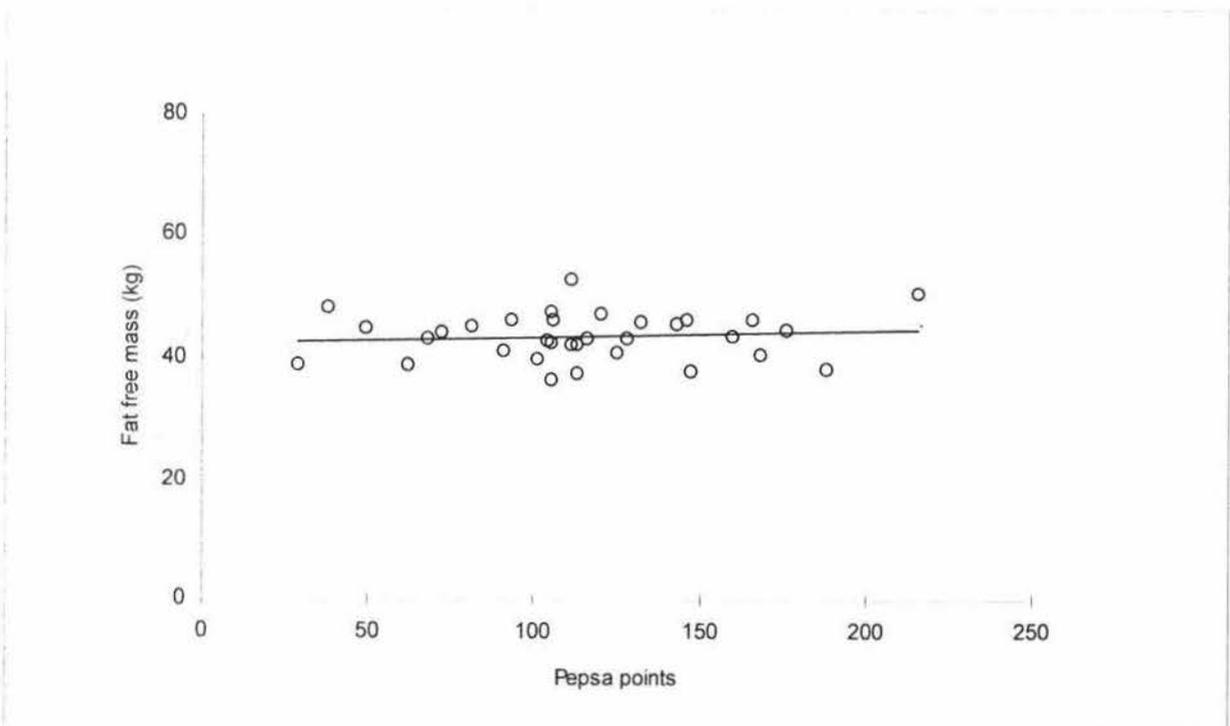
A positive relationship was observed between fat free mass of participants measured by bioelectrical impedance and energy expenditure calculated from anthropometric data with a standard PAL (Figure 5.3). Once again the participant with a BMI value of 40 kg/m² proved to have an outlier value for fat free mass above that of the study group.

Figure 5.3 Plot of relationship observed between fat free mass and expenditure with a standard PAL in females.



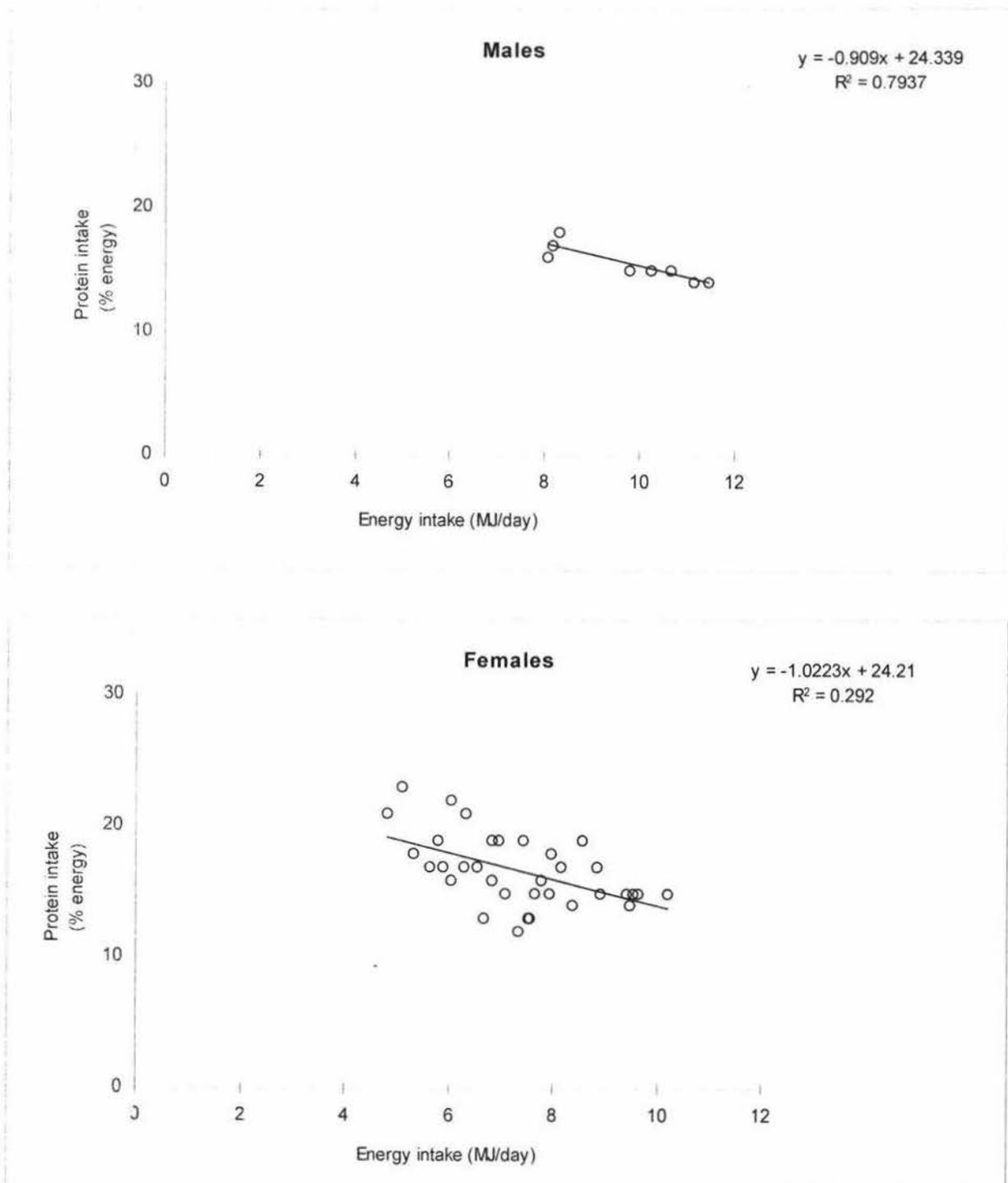
In contrast, no significant relationships were observed between measured fat free mass and nutrient intake data including energy intake or activity of participants (PEPSA, ADECE and ECP) calculated from the 14 day exercise diaries. An example of this lack of relationship observed between fat free mass and the PEPSA activity score can also be seen in Figure 5.4.

Figure 5.4 A comparative plot showing the lack of relationship found between fat free mass and PEPSA points.



Negative relationships were found in both men and women when protein intake was compared with energy intake from the 3 day food diaries (see Figure 5.5).

Figure 5.5 Plots of relationships between protein intake and energy intake for males and females.



The positive relationships observed between both calcium and zinc intakes and energy intake of female participants calculated from three day food diaries are shown in figures 5.6 and 5.7. One female participant reported a very large daily intake of dairy products (low fat milk, breakfast cereals with milk and hard cheese) which contributed to a much higher calcium intake in relation to energy intake than the study group in general and this outlier measurement can be seen in figure 5.6.

Figure 5.6 Plot of the relationship observed between energy intake and calcium intake for female participants.

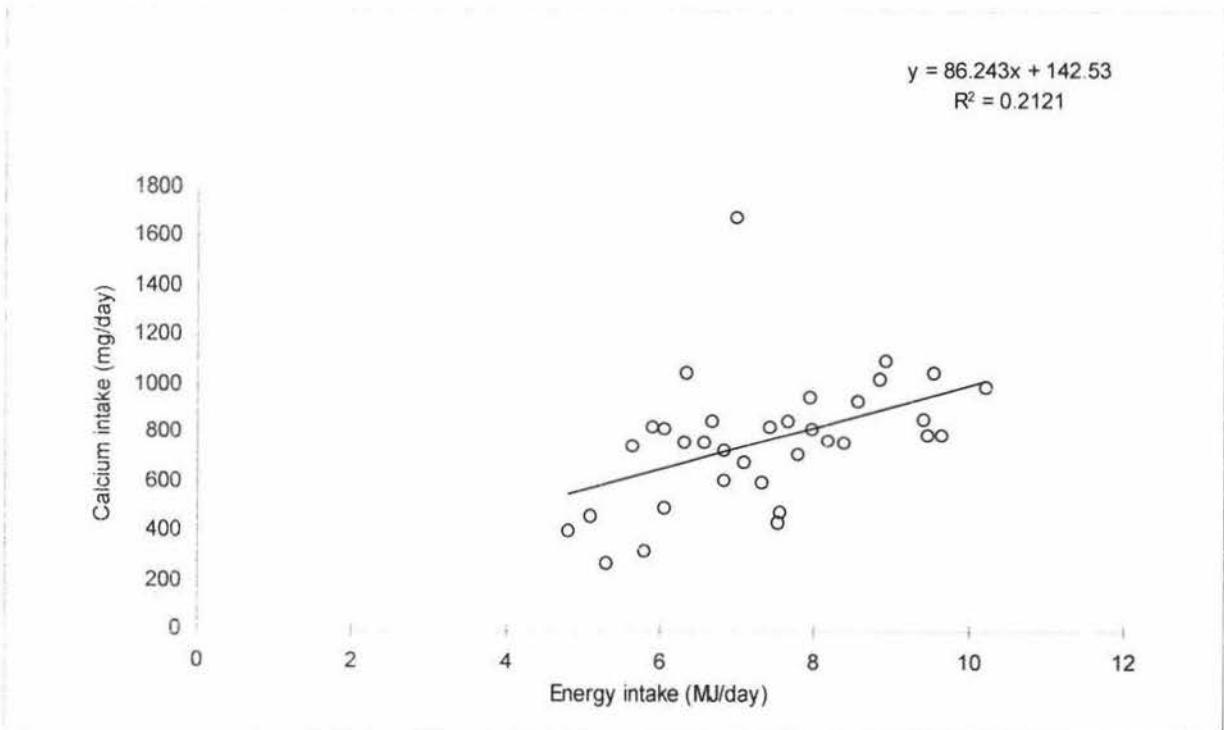
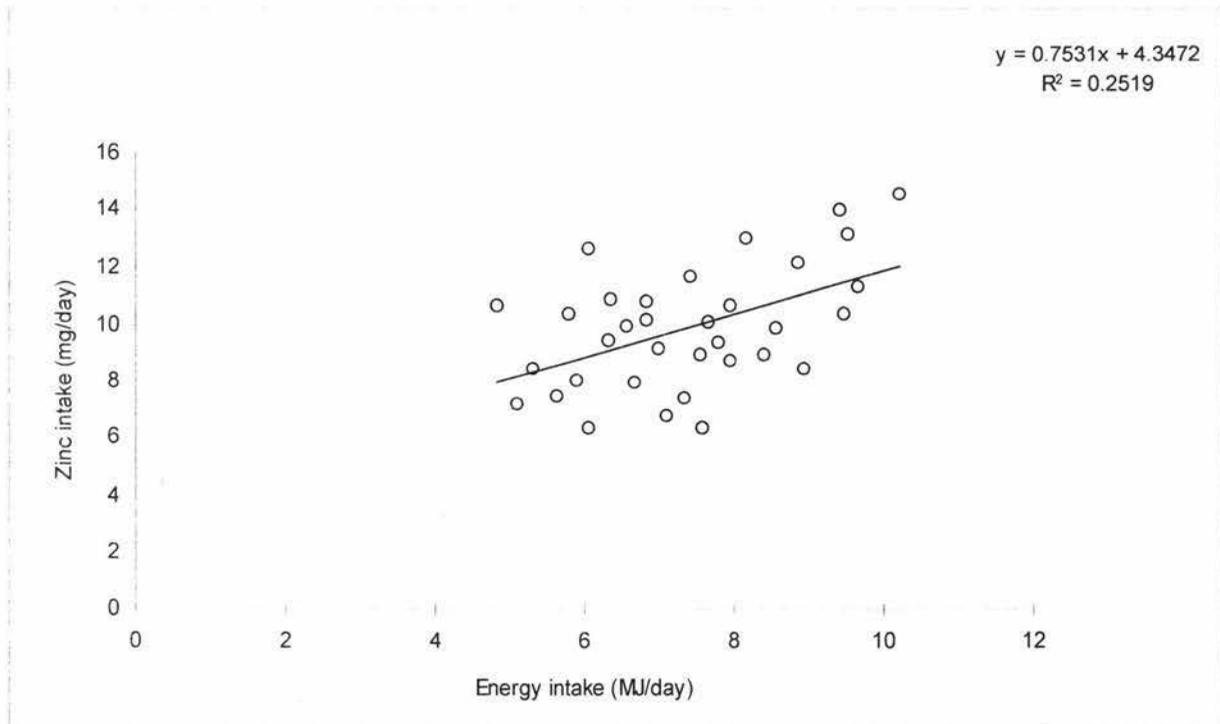
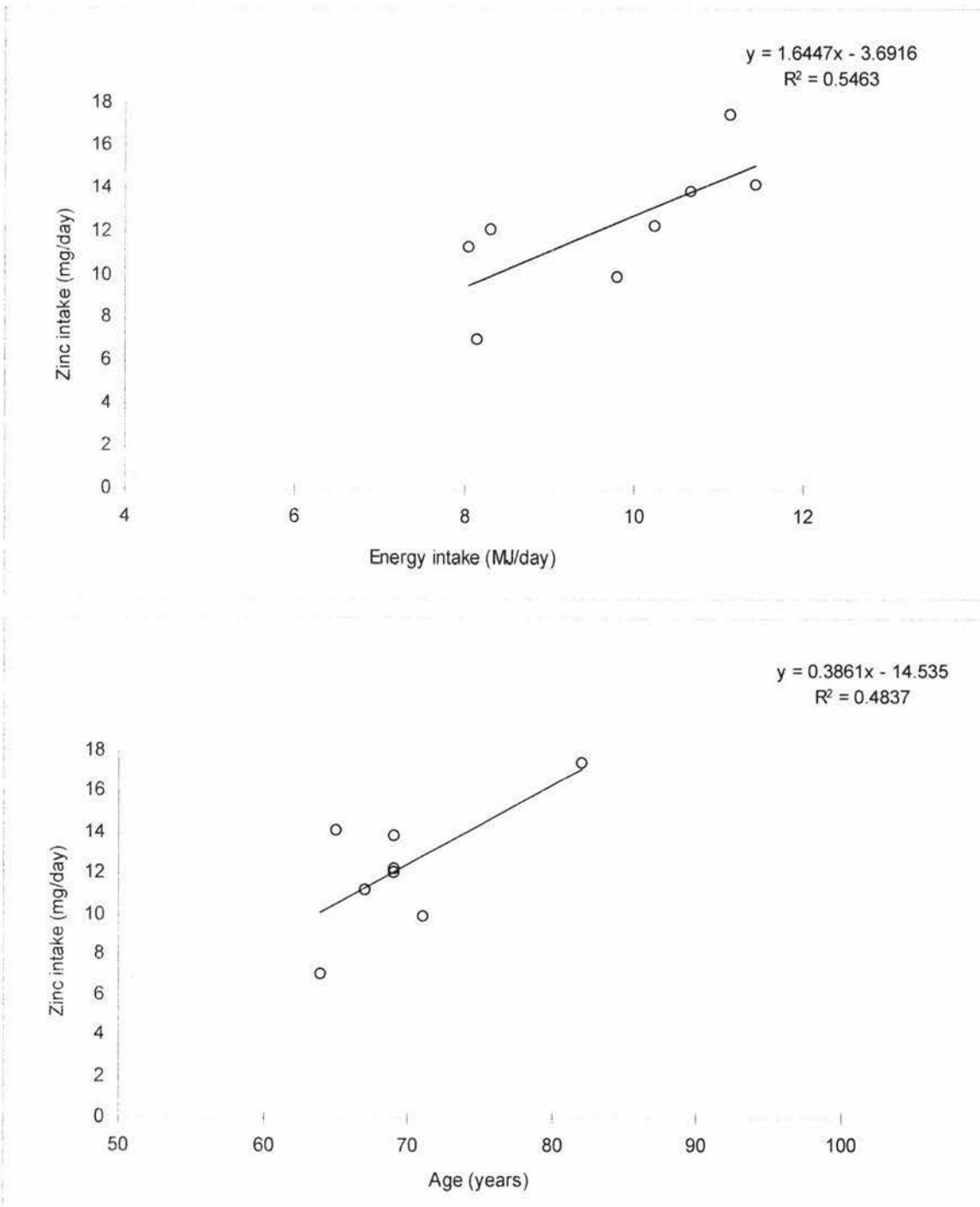


Figure 5.7 Plot of the relationship observed between energy intake and zinc intake for female participants.



Energy intake and age were both found to be correlated with zinc intake in the male study group (see Figure 5.8) but not in the female study group.

Figure 5.8 Plots of the relationships observed between zinc intake and the variables energy intake and age in males.



As the micronutrient density of the food intake appeared to be positively correlated with energy intake, a possible correlation was also sought between energy intake and energy expenditure of participants. No correlations were found between energy intake and the estimated energy expenditure using light-moderate PAL or when the PEPSA points, ADECE and ECP were added to a light or sedentary PAL. Also no correlations were found between energy intake and the activity measurements alone (PEPSA points, ADECE and ECP). When those participants who appeared to severely under-report energy intake ($<1.27 \times \text{BMR}$) were removed from the data set, the relationship observed between energy intake and energy expenditure plus activity measured by PEPSA points improved but did not reach statistical significance at the $p < 0.05$ level.

A validation of the PEPSA points system as an accurate and quick method of measuring the energy expenditure attributed to specific exercises undertaken by the participants was sought by comparison with the other available methods described previously and the results are given in Table 5.8. Extremely good correlations were found between the PEPSA system and both of the more complex methods of measuring energy expenditure from exercise (ADECE and ECP), despite the observed differences in energy values between these two methods (Table 5.2).

Table 5.8 Relationships observed between the different methods of calculating energy costs of exercise.

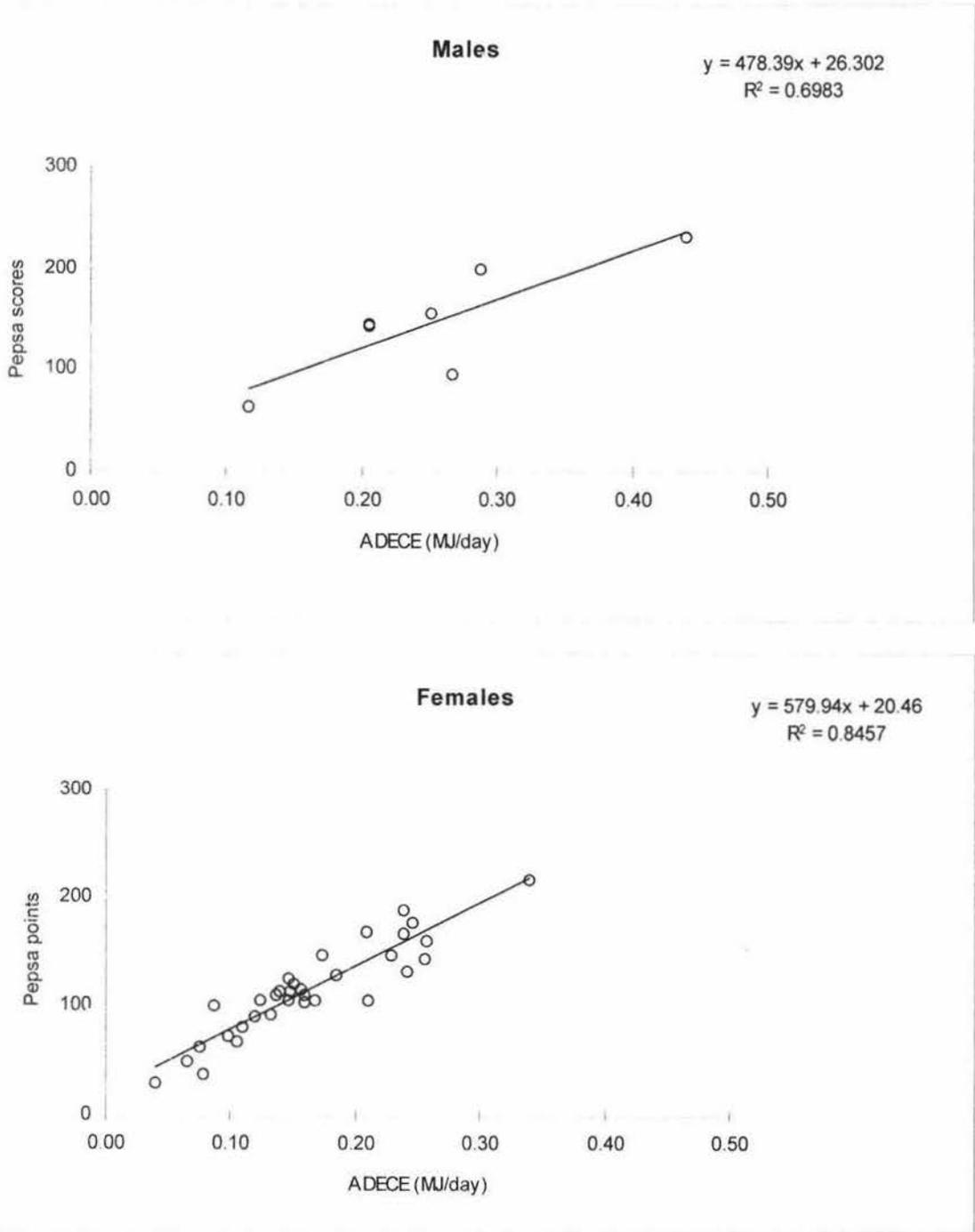
Variables		r	
		Male	Female
PEPSA points	ADECE (MJ)	0.916**	0.932**
PEPSA points	EDP (MJ)	0.824*	0.835**
ADECE (MJ)	EDP (MJ)	0.960**	0.950**

* significant at p < 0.05 level

** significant at p < 0.01 level

The relationships observed between the PEPSA points scoring system and ADECE scores for both men and women are further displayed by the scatter plots seen in Figure 5.9.

Figure 5.9 Plots of relationships between PEPSA points and ADECE (MJ) for males and females.



5.5.2 Regression

When the age of participants was regressed against fat free mass, it was found that age was highly predictive of fat free mass in females ($p = 0.002$) but not in males. It was also found that the PEPSA scores were strongly related to the ADECE calculations in both males and females ($p = 0$).

6 Discussion

The main aim of this research was to explore possible relationships between the food intake, exercise habits and body composition of a random sample of older individuals known to be currently participating, or recent participants in organised exercise groups. This choice of known exercisers was intended to provide a much more active study group than the general older population of New Zealand, and thus to provide information about older adults who exercise more than their peers. A validation of the simple PEPSA points scoring system for recording exercise levels was also attempted.

Only two volunteers (5%) decided not to proceed with the random three days of weighed food diaries after the first interview where body composition and general data was collected. This compares very favourably with other studies which have employed weighed dietary recordings. For instance a feasibility study for the national diet and nutrition survey of free-living older adults (65 years and over) in Britain reported 66% of the sample agreed to keep four continuous days of weighed diet records after the main interview.⁷¹ These data demonstrate that the participants, almost two thirds of whom were in their sixties, were particularly well motivated. The study group's mean income was \$20,000 to \$30,000 and proportionally fewer older women in the study group were in the lowest income bracket when compared with the nationwide survey. The group were more frequent vitamin and mineral supplementers, but had a similar range of body mass to the general older population living throughout New Zealand when surveyed in 1989. Less than 50% had received nutrition advice from anyone.

Although participants cited Kiwisenior exercise classes most often as the exercise group they were currently involved in, walking was by far the most frequent form of exercise undertaken. This was also the case for the LINZ sample 45 years and over, although the frequency of walking for the study group was more than double that recorded for the general older population 45 years and over. The study group also participated more in fitness classes and exercises at home.⁴⁷ Information about the actual time spent in exercising was not provided by the nationwide survey results and different methods were employed to collect exercise information. The present study utilised 14 day exercise diaries which may have provided motivation for participants to exercise more than usual throughout the collection time unlike the nationwide survey which was retrospective. Therefore, although it is likely that participants were more active than the general older population, the actual extent of increased activity is relatively unknown.

Similarly the methodology for collection of food intake data for the present study was different to the nationwide survey which was obtained by the 24 hour recall method.⁴⁷ Researchers have found that the 24 hour recall method tends to underestimate mean intakes in the elderly,⁸³ but the nationwide survey serves as the most recent and comprehensive database available for the nutritional intake of New Zealanders.⁴⁷ In general the food intake of male and female participants was higher in energy, macronutrients, calcium and zinc than the LINZ survey when the 50th centiles of intake were compared. Little difference was observed when mean intakes were compared except that recorded alcohol intake was slightly lower for those participating in the exercise study.⁴⁷ These data would suggest that the study group did have an increased likelihood of meeting the higher needs of older adults for some micronutrients which have been identified for older adults²² by simply eating

more than that recorded for older New Zealanders. Or these data may simply be a reflection of the different recording methods for food intake which have been employed. Females in the study group, despite eating more than that recorded in the LINZ study, appeared to find it difficult to reach recommended levels of calcium and zinc intake. Although the alcohol intake of study participants appeared lower than the nationwide survey, when questioned separately about the number of alcoholic drinks consumed per week, participants stated a larger number of drinks per day than the nationwide survey. The question also arises whether participants may have consciously or subconsciously consumed a healthier than usual diet on their recording days. Random selection of the three recording days of the week (which were mostly not consecutive) in the study design should have helped to eliminate this possible problem of incorrect reporting.

Apart from inaccurate reporting of usual intake, the lack of correlation found between estimated energy expenditure and energy intake in this study could be due to a number of factors associated with the individual variances in energy requirements of participants. For instance variances have been found which have been directly related to levels of fitness of older adults,⁸⁶ levels of exercise training,⁸⁴ energy balance,⁸⁵ and as a direct result of individual differences in BMR which have been found to be more likely in adults over 60 years of age.⁷⁹ The lack of correlation found between nutrient density of foods consumed and recorded exercise levels of participants is similar to other recorded studies.⁵⁵

Errors in reporting usual food energy levels resulting in lower values than that calculated to be sustainable, is a major cause for concern in interpreting the data collected in this study. Participants were well motivated to take part and all who were able, completed the food records and activity diaries. Despite this obvious

cooperation, a substantial difference between estimated energy expenditure and recorded energy intake of participants was observed. This difference was much greater in females (mean intake 15% less than expenditure) than in males (mean intake 6% less than expenditure). Discrepancies in energy expenditure of healthy older adults measured by doubly labelled water and energy intake estimated from three day food records have been found by Smith et al which also showed a greater under-reporting of females of the order of 31% compared with 12% in males.⁸⁶ This study with doubly labelled water found no significant association between under-reporting and body fatness. As the energy expenditure estimation for the present study was based on an approximation of activity levels as a multiple of BMR for all individuals alike, it is not possible to draw conclusions about the actual extent of under-reporting observed.

The finding that the mean BMI for the group of obvious under-reporters (n=13) in this study was higher (28.5kg/m²) than for the study group (26.1kg/m²) is an important factor. Evidence of under-reporting has been found by a number of studies using the doubly labelled water technique for energy expenditure measurement in obese and post-obese women and athletes.⁸⁸ There was evidence in the present study that the data may have been skewed in a similar way. Once under-reporters were removed from the analyses a positive relationship (which did not reach statistical significance) was observed between energy expenditure calculated from a standard light PAL, with added PEPSA scores expressed as MJ, and food intake energy amongst females. Other studies have found good agreement between reported energy intake and measured energy expenditure using doubly labelled water with volunteers of normal weight.⁸⁸ Therefore one could assume more positive correlations may have been possible between energy intake

and energy expenditure calculated using the methodology from this study, amongst a larger group of exercising participants who were of a more ideal weight.

Mean calcium intake of participants estimated by FFQ and measured against three day food records were significantly different for both men and women. However the FFQ as a tool for food intake estimation has most relevance when used to identify groups or at risk individuals with low levels of nutrient intake. In this respect, Wilson's calcium food frequency questionnaire (appendix H) was a successful tool for estimating whether calcium was consumed at levels less than recommended in 61% of participants. Whilst this specificity is less than that recorded by Wilson (78%),⁷⁶ this difference may be the direct contribution of the age difference between the present study group (aged 50 years and above) and that of the group for whom the measurement tool was developed (New Zealand women aged 25-49 years). Also it was observed that the higher recommended intake of calcium for the females in the study group (1000mg compared to 800mg) contributed to the lower specificity of the measurement tool. However more importantly, the misclassification of individuals at risk of very low calcium intake levels was much lower (9%). Therefore the calcium food frequency tool used in this study should be considered a useful method of identifying older women at high risk of very low intake. A further study with larger numbers of male participants would need to be carried out in order to validate this tool for use in older males.

The negative relationship found between percentage FFM and BMI in females and the positive relationship found between fat free mass (kg) and energy expenditure with a standard PAL in females were expected as both of the BMI and energy expenditure variables were calculated using equations which include weight and height measurements. These observed relationships using bioelectrical

impedance as a measurement tool serve to further validate this method of body composition estimation for field studies in older adults. The number of male participants was insufficient to provide data which reached significance but the trends were similar to the female participants.

The negative association found between FFM and age in females provided evidence that despite reported mean daily exercise periods of 51 minutes per day, this amount of exercise was insufficient for the study group to avoid some loss of FFM directly associated with aging. It is unknown to what extent this age associated loss of FFM may have been affected by the amounts of exercise being undertaken. There is limited data on bioelectrical impedance measurements in older New Zealanders for comparison. Information from a body composition dataset of 35 older Caucasian women (mean age 58 years), sampled through advertising and word of mouth referral, was available in Auckland. These women had similar BMI levels to the present study (mean 26.3kg/m^2) and a mean FFM of 42.0kg .⁸⁷ It can be seen that in general these younger women had lower FFM values than the older exercising women (44.0kg) of mean age 65 years. As the present study group have been identified as exercising more than the general older population, it could be assumed that their estimated levels of FFM are in fact higher than the general population and have undergone less of an age associated decline. However this assumption cannot be validated by the present data as no observed association was found between amounts of exercise recorded by individual participants and their FFM levels. This lack of association may be the result of the recording tool for activity being insufficient to characterise usual or more long-term activity patterns, or it may have resulted from factors which affected FFM measurement by BIA. The

number of male participants was insufficient to provide data which showed a significant trend between FFM and age.

Researchers are faced with a number of difficulties when attempting to accurately characterise energy expenditure in humans. Measurement of gaseous exchange, whilst being very accurate, obviously precludes participants from normal day to day activity. Doubly labeled water has recently become very popular which allows studies to be conducted in free-living conditions but the cost of material limits this method to relatively small populations. An extremely wide range of individual energy expenditure has also been found by research using the doubly labelled water technique⁸⁸ to the extent that individuals over 80 years have been found to have a PAL of 2.0. A further complication with any research into energy expenditure and requirements, alluded to by Warwick, is the considerable lack of recent published data for defining the energy costs of physical activity which would be pertinent for Australasia.⁸⁰ Much of the information currently being used has been derived from studies conducted many years ago on younger adults and in countries within Europe. There has also been an identified potential for overestimation and underestimation of energy costs of activities expressed as multiples of BMR if individuals are at either extreme of the body height and weight scale.⁸⁰

Extremely good correlations ($r = > 0.9$) were found between the PEPSA scoring system developed in New Zealand and used in this research for recording activity over two weeks, and both of the methods of calculating the energy costs of exercise described in other countries (ADECE and ECP). These results validate PEPSA as a practical and quick scoring system for determining exercise levels in older adults which can be easily calculated by individuals after a short explanation of

the principles. It would therefore be ideally suited for larger long-term exercise studies of older adults.

One of the main limitations to this piece of research is that the food intake and expenditure data was obtained over a relatively short time span which therefore only provided information about the current food intake and exercise habits of the study group. This short time frame did not provide information to make assumptions about likely health status which is the product of long-term exercise and eating habits.

Interpretation of diary recordings of exercise with respect to timing and description of activities, and the actual recording process itself have a potential to affect exercise habits over a study period. It is not known whether the actual diary recording of exercise by the participants accurately reflected the usual amount of exercise taken by the study population. As there was a considerable difference found between energy intake and expenditure, it is not known whether this discrepancy was due to underreporting of food intake or overreporting of energy expenditure.

BIA as a method used for estimating body composition, has its drawbacks. It cannot be considered comparable to the more precise measurement methods such as underwater weighing and dual energy x-ray absorptiometry and was designed for measurements of body water. Although the age of participants was entered into the model, exercise and fluid intake avoided prior to readings being taken, and readings taken directly after participants assumed the supine position, the relative hydration of individuals and any subclinical disorders affecting hydration would have altered BIA measurements. The medical records of participants were not available to the researcher to check for any likely problems which might have affected BIA recordings in this way. Altered body build or an increase in the amount of body water in obese

individuals leading to the overestimation of FFM have also been identified as a potential source of error for this method of body composition estimation.⁸⁹

There are also difficulties encountered when comparing food intake data obtained from different population subgroups. The food intake data for this research was compared with that obtained from a group of New Zealanders in 1989, approximately seven years earlier. Food intake habits of New Zealanders are known to be changing rapidly, but possibly more slowly in the older age groups. The variation in methods of obtaining food intake information were also substantial and known to significantly affect results. A further complication to interpreting and comparing the food intake data with that of the LINZ data, is that a more recent food composition database was used to analyse food intake in the present study.

Supplementation with vitamins and minerals was used by over 50% of the study group yet over 50% had received no nutritional advice from anyone. Although food intake habits were probably better than that found amongst the group of New Zealanders surveyed in 1989,⁴⁷ this group were still using supplements to improve their intake. Calcium was the most popular supplement which is probably the most appropriate supplement to use, if any, for this group of mainly older post-menopausal women whose mean intake was 780mg. Fat intake, and more specifically saturated fat, was reported to be consumed at levels greater than desirable. Whilst this study group were generally exercising for health reasons they were not choosing a desirable dietary intake which would specifically confer health benefits as recommended in the report of the nutrition taskforce.⁷⁸

More accurate characterisation of exercise habits of individuals in order to determine the effects of aging on body composition and thus risk of chronic disease is clearly needed. An appropriate field study tool for energy expenditure calculation

which does not require expensive research equipment or materials may be possible using PEPSA scores. These would need to be modified to reflect units of energy (as in the present research, see method), and added to a standard PAL (e.g. 1.5*BMR for light activity). Further research into this method of energy expenditure for older adults is warranted.

7 Conclusions

One of the important findings from this research was the gradual decrease in FFM with age for the females in the study group despite mean recorded exercise of nearly one hour per day. However more accurate characterisation of exercise habits of individuals in order to determine the effects of aging on body composition and thus risk of chronic disease is clearly needed.

Estimation of body composition by bioelectrical impedance is fast, it is easy to use and sufficiently accurate to warrant further use for field studies examining energy expenditure and exercise in this population. Further information on health status of individuals and screening for avoidance of participants with sub-clinical disorders affecting BIA measurement is an important consideration for future research. The addition of blood pressure measurements would also provide useful information related to the effects of exercise on this age group.

This study provides the evidence that the PEPSA scoring system for diary recording of activity together with a standard PAL may be an appropriate field study tool for estimating energy expenditure which does not require expensive research equipment or material.

Food intake estimation by food records was not an appropriate method for gathering food intake information. Apart from being very time consuming for both participants and during data entry, it appeared to be an inaccurate tool in that many individuals under-reported intake by this method. Other validated methods of food intake estimation for older adults must be sought which can be repeated over time, such as food frequency questionnaires. By comparison the calcium FFQ used was

quickly administered and provided an indicator of those individuals who were at risk of very low intake.

The future design of programs to encourage older New Zealanders to exercise should incorporate sound nutritional advice as a crucial contribution to the combination of lifestyle habits which promote healthy aging. Particular interventions should focus on eating a nutrient dense diet and a lowered fat intake, combined with activities which incorporate walking, an activity which is popular and appropriate for this age group. In addition, activities which include resistance training to promote improvement in muscle mass should be encouraged to help combat the inevitable age decline in fat free mass.

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Appendix A

Introductory article for “Healthier Lifestyles”

Newsletter of Sport North Harbour

June 1996

A Research Project

Health & Lifestyle Habits of Exercising Adults Aged 50+

The number of New Zealanders aged 50 years and above is expected to almost double in the next few decades. Health care costs for older adults are traditionally high and are expected to become an increasing burden of future income earners. Moderate exercise is consistently found to be a significant factor in maintaining or improving health and well-being for all adults. It is therefore important that research is carried out now to understand more about the habits of a relatively healthy age group of adults in our community who have chosen to exercise and who are likely to be 'ageing successfully'. The information gained could be used to encourage others to make positive lifestyle changes. With your help this unique study will help to address these needs.

To make the study as representative as possible, a random selection of people (approximately 100) who are participating in the Sport North Harbour KiwiSenior programmes will be made. This is done by Sport North Harbour on the computer and those people whose name comes up (just like Lotto draw), will be sent a letter asking them if they would like to volunteer with a consent form to return if this is the case. Please note that participating is *entirely voluntary*. However an anticipated bonus of being part of this research is that individuals will have a chance to learn more about their own health, exercise and eating habits and how they compare with older New Zealanders in general. So look for those letters in your mailbox around July.

The plan for this study involves keeping an exercise diary for a number of days to record your exercise and approximate length of time it is done for, e.g. walk for 15 minutes or play badminton for 30 minutes, (this is not a diary where all forms of activity need to be recorded such as climbing stairs, doing housework, etc.). At the same time people will need to record for three days what they have had to eat and drink and fill in a short questionnaire related to what they usually eat and some other health questions. The researcher will also need to take measurements of height and weight and use a simple test to measure your muscle. In other words, people in the study will not have to travel anywhere, the researcher will organise to meet with you before your exercise groups.

Naturally, as with all ethical research projects, the information collected will be kept strictly confidential. Personal identifying information will be destroyed at the end of the project and replaced with code numbers. Data presented and published will be for groups of people. However those participating will be encouraged to discuss their individual results with the researcher and a presentation and discussion of the grouped results will also take place for the benefit of all interested KiwiSeniors.

Appendix B

Information Sheet



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Information Sheet

Research Project - *Food Intake & Assessment Study*

My name is Sarah Ley and I am a mature postgraduate student undertaking this research project for a Masters Degree in Science at the Albany Campus. My supervisor is Dr Clare Wall, Department of Monogastric Research, Albany.

Your name has been selected from the mailing list of Sport North Harbour to be one of approximately 100 people invited to participate in this research project on the North Shore and Rodney District. I am investigating exercise, food intake, body muscle and health of adults who are taking part in exercise groups administered by Sport North Harbour. The results will be used to help with health education and our understanding of positive ageing for adult New Zealanders. This information is of concern to us all as we approach the next century.

It is planned to carry out the collection of information for this study between October and December 1996. The researcher will organise to meet participants before and after their exercise sessions and supply them with all their recording requirements. If you decide to take part, you will be asked to be involved in all four of the following activities:

- keep an **exercise diary** for 14 consecutive days recording what is done and approximate length of time it is done for e.g. walk for 30 minutes or play badminton for 15 minutes. (This is not a diary where all forms of activity need to be recorded such as climbing stairs, doing housework etc).
- keep a **3 day food record** at sometime during this period where all food and drink is weighed using scales provided for you, or estimated where food is eaten away from home.
- fill in **two short questionnaires**. One has questions related to age, reasons for exercising and the use of food supplements whilst the other has questions related to the foods you usually eat.
- the researcher takes one recording of **body measurements** for height, weight, and muscle mass using quick and simple techniques.

All information collected will be kept strictly confidential to the researcher by allocation of an identification number. All personal identifying information will be destroyed at the end of the research project and results will be presented and published as grouped data. At the end of the study participants will be encouraged to discuss their **individual** results with the researcher and will be given access to a summary of findings of the study when it is concluded. A presentation and discussion of the grouped results will also take place for the benefit of all those taking part.

Appendix C

Consent Form



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Food Intake & Exercise Assessment Study

CONSENT FORM

I have read the information sheet provided and fully understand the nature of the study and my part in it.

I am willing to take part in this study which will involve completing an exercise diary, a 3 day food record, allowing the taking of body measurements and completion of two questionnaires.

I understand that I have the right to withdraw from the study at any time without prejudice and that I have the right to decline to answer any particular questions.

I understand that my results will remain confidential, and that no material which could identify me will be used in future reports.

I, (*please print*) _____ consent to take part in this study.
(firstname) *(surname)*

Address: _____

Telephone: day _____ night _____

REGULAR EXERCISE GROUP:

Time: _____ Day of week: _____

Location: _____
(The researcher will contact you and arrange to meet you before or after one of these sessions)

Signature: _____ Date: _____

Your help with this research will be very much appreciated. Please return this consent form in the FREEPOST envelope provided. Any questions please telephone Sarah Ley on (09) 445-4183 or alternatively Dr Clare Wall (09) 443-9748 or leave a message for me with Fleur Daniels, Secretary, Information and Mathematical Sciences, Massey Albany (09) 443-9651.

Appendix D

General instructions letter for bioelectrical impedance
measurements



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Date _____

Dear _____

Thank you very much for agreeing to help me with my research. I look forward to meeting you when I visit your exercise group. As I would like to take some measurements before your group commences please arrive at:

Time: _____ Date: _____ Day _____

Place: _____

Please do not eat or drink for 2 hours before you come to your exercise session.

Simple measuring devices will be used to record your body muscle, height and weight.

If this time does not suit you, please telephone me and I will arrange a more convenient appointment. **Any queries please do not hesitate to contact me on: Ph 09 445-4183, or Dr Clare Wall on Ph 09 443-9748.**

I look forward to meeting you and once again thank you for agreeing to help me with my research. I trust you will also find it an interesting experience.

Kind regards

Sarah Ley.

Appendix E

14 day exercise diary



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**Food Intake &
Exercise Assessment Study**

14 DAY EXERCISE DIARY

ID Number: _____

Start Date: _____

If You Have Any Queries Please Contact:

Sarah Ley on Ph: 445-4183

or

Dr Clare Wall on Ph: 443-9748

14 DAY EXERCISE DIARY

Please record **ALL** your exercise over a **CONTINUOUS 14 DAY** period and attempt to have this period reflect your **USUAL** levels of exercise.

A simple way to record exercise is the **PEPSA POINTS SYSTEM** which was developed and used by Drs Bevan Grant and Noela Wilson for a group of adult New Zealanders. This system gives an approximate score for energy used and time taken in each exercise session. Make sure you record **ALL YOUR EXERCISE SESSIONS**, whether in a group or alone, formal and informal, indoor and outdoor - e.g. your Kiwisenior exercise groups, walking to the shops instead of taking the car or bus, exercising the dog, taking part in an aerobic session shown on TV. (However I would like you to **EXCLUDE HOUSEWORK, GARDENING** and household chores even though they do use up a lot of energy.)

FIRST OF ALL

Record the days of the week and the dates when you are **ABOUT TO START** your diary.

NEXT

Record at the end of each day the type of exercise you did (e.g. swim, walk etc), the number of minutes you exercised for and the points you decided on using the **PEPSA POINTS TABLE**. Record "0" if you haven't exercised that day. If you have exercised more than once, record each exercise, the time for each exercise separately and the points you decided on **SEPARATELY** - see example on next page.

AT THE END OF 14 DAYS

Note whether you consider this was your usual exercise level by ticking the appropriate box.

EXAMPLE

1
Day: Tuesday Date: 9/9/96

<i>Exercise</i>	<i>Time in Mins</i>	<i>Points</i>
Walk-Step	15	1
Swim	30	5

2
Day: Wednesday Date: 10/9/96

<i>Exercise</i>	<i>Time in Mins</i>	<i>Points</i>
0		0

PEPSA POINT TABLE

ACTIVITY	CONTINUOUS MINUTES OF EXERCISE									
	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>	<u>35</u>	<u>40</u>	<u>45</u>	<u>50</u>	<u>55</u>
Running	5	7	10	12	15	17	20	22	24	26
Jogging (5-8min/km)	4	6	8	10	13	15	17	19	21	23
Brisk walk (11-14min/km)	2	3	4	5	6	7	8	9	10	11
Slow walk (14+ min/km)/Line Dancing	0	1	2	2	3	4	4	5	6	7
Aerobics class (incl stretching)	1	2	3	4	5	6	7	8	9	10
Swimming (50m/up to 75secs)	2	4	6	8	10	12	14	16	18	20
Swimming (50m/75+ secs)/aquarobics	1	2	3	4	5	7	8	9	10	11
Cycling (15+ km/h)	1	3	5	7	10	12	13	14	15	16
Slow cycling (up to 15km/h)	1	2	3	4	4	5	5	6	7	8
Squash/line dancing	1	2	3	4	5	6	7	7	8	9
Tennis/badminton/table tennis	0	1	1	2	2	3	3	4	5	6
<i>As there are many activities which are not included above, please allocate PEPSA points based on how much effort was required to do the exercise.</i>										
IF YOU ARE	MINUTES OF EXERCISE									
	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>	<u>35</u>	<u>40</u>	<u>45</u>	<u>50</u>	<u>55</u>
Active, but not puffing	2	3	4	5	6	7	8	9	10	11
Active, puffing a bit	3	4	6	7	8	10	12	13	14	15
Very active, puffing	4	6	8	10	13	15	17	19	21	23
Very, very active (puffing a lot)	5	7	10	12	15	17	20	22	24	26

1

Day: _____ Date: _____

<i>Exercise</i>	<i>Time in Mins</i>	<i>Points</i>

2

Day: _____ Date: _____

<i>Exercise</i>	<i>Time in Mins</i>	<i>Points</i>

3

Day: _____ Date: _____

<i>Exercise</i>	<i>Time in Mins</i>	<i>Points</i>

13

Day: _____ Date: _____

<i>Exercise</i>	<i>Time in Mins</i>	<i>Points</i>

14

Day: _____ Date: _____

<i>Exercise</i>	<i>Time in Mins</i>	<i>Points</i>

14 Day Total Points:

Usual activity level: Yes No

GARDENING

How often have you gardened, mowed lawns or done other outdoor chores in the last **FOUR WEEKS**?

- | | |
|--|---|
| <input type="checkbox"/> Not at all | <input type="checkbox"/> Once a week |
| <input type="checkbox"/> Less than once a week | <input type="checkbox"/> Once or more a day |
| <input type="checkbox"/> A few times / week | |

On a normal day, how long did you spend gardening, mowing lawns or doing outdoor chores?

- | | |
|----------------------------------|--|
| <input type="checkbox"/> 15 mins | <input type="checkbox"/> 2 hours |
| <input type="checkbox"/> 30 mins | <input type="checkbox"/> 3-5 hours |
| <input type="checkbox"/> 1 hour | <input type="checkbox"/> 6 hours or more |

HOUSEHOLD CHORES

How often have you done household chores in the last **FOUR WEEKS**?

- | | |
|--|---|
| <input type="checkbox"/> Not at all | <input type="checkbox"/> Once a week |
| <input type="checkbox"/> Less than once a week | <input type="checkbox"/> Once or more a day |
| <input type="checkbox"/> A few times / week | |

On a normal day, how long did you spend doing household chores?

- | | |
|----------------------------------|--|
| <input type="checkbox"/> 15 mins | <input type="checkbox"/> 2 hours |
| <input type="checkbox"/> 30 mins | <input type="checkbox"/> 3-5 hours |
| <input type="checkbox"/> 1 hour | <input type="checkbox"/> 6 hours or more |

Appendix F

General Questionnaire



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**Food Intake &
Exercise Assessment Study**

General Questionnaire

Please note it is not compulsory to answer all questions

For Office Use Only

Height:

ID Number:

BIA:

Weight:

Question One

What is today's date?

/	/	
<small>day</small>	<small>month</small>	<small>year</small>

What is your sex?

Female Male

What was your age at 1st January 1996

What is your ethnic origin?

European	<input type="checkbox"/>	Maori	<input type="checkbox"/>
Pacific Island	<input type="checkbox"/>	Asian	<input type="checkbox"/>
Other	<input type="checkbox"/>		

Question Two

When did you start exercising with the Sport North Harbour programme? (approximate date)

/	/	
<small>day</small>	<small>month</small>	<small>year</small>

What Sport North Harbour exercises are you currently participating in? (List one or more)

What was the reason for your starting the Sport North Harbour Programme? (tick one or more)

Health	<input type="checkbox"/>	Social	<input type="checkbox"/>
Dieting	<input type="checkbox"/>	Other	<input type="checkbox"/>

Question Three

Did you exercise BEFORE starting the Sport North Harbour exercises?

No If NO, go to question 4.

Yes If YES, what types of exercise did you do?

(List one or more)

How often did you exercise BEFORE starting the Sport North Harbour exercises? (Tick ONE box)

Once a day or more	<input type="checkbox"/>	A few times a week	<input type="checkbox"/>	once a week	<input type="checkbox"/>
Once or twice a month	<input type="checkbox"/>	Less than once a month	<input type="checkbox"/>		

Question Four

Do you ever take any of these vitamin or mineral capsules/tablets **REGULARLY** (at least once a week)?
(For each supplement tick **ONE** box)

	<i>NO</i>	<i>YES</i>
Multivitamins or Multiminerals	<input type="checkbox"/>	<input type="checkbox"/>
B-complex vitamins	<input type="checkbox"/>	<input type="checkbox"/>
Vitamin C	<input type="checkbox"/>	<input type="checkbox"/>
Vitamin E	<input type="checkbox"/>	<input type="checkbox"/>
Vitamin B ₆	<input type="checkbox"/>	<input type="checkbox"/>
Iron	<input type="checkbox"/>	<input type="checkbox"/>
Calcium	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>

Question Five

Do you take any other dietary supplements **NOW** and **THEN** (e.g. when you have a cold)?

No If **NO**, go to question 6.

Yes If **YES**, what _____

Question Six

Have you ever been given advice about nutrition from **SOMEONE**?

No If **NO**, go to question 7.

Yes If **YES**, what was that person's occupation _____

Are you following that advice now? Yes No

Question Seven

Have you obtained nutrition information from **OTHER SOURCES**?

No If **NO**, go to question 8.

Yes If **YES**, what _____

Question Eight

Does anyone else live with you?

I live on my own

I live with a spouse/partner

I live with others e.g. childre/parents/non-relative

Question Nine

What was your household's income in the last 12 months, before tax?

Less than \$5,000

About \$10,000

About \$20,000

About \$30,000

About \$40,000

About \$50,000

\$60,000 or more

Question Ten

How many glasses of beer, wine and spirits do you drink altogether every week?

None or _____ glasses per week.

Appendix G

Three day food record



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Food Intake & Exercise Assessment Study

3 DAY FOOD RECORD

ID Number: _____

Your Days for Recording: _____

If You Have Any Queries Please Contact:

Sarah Ley on Ph: 445-4183

or

Dr Clare Wall on Ph: 443-9748

3 DAY FOOD RECORD (2 weekdays, 1 weekend day)

- ↳ Weigh and record ALL food and drink consumed.
- ↳ Weigh and record food and drink at the time of consumption and NOT from memory at the end of the day.
- ↳ Include ALL meals, snacks, sweets, drinks including water.
- ↳ Remember to **WEIGH ADDITIONS** to food already recorded such as sauces, dressings, gravy, sugar, spreads such as butter or margarine, jams and marmalade.
- ↳ Take your activity and food record diary with you when you go out if you are likely to be having something to eat or drink.
- ↳ Record preweighed food according to the label or packaging e.g. Swiss Maid fruit yoghurt - 150g, Cadbury Crunchie bar - 50g, .

WHEN YOU WANT TO EAT OR DRINK SOMETHING AT HOME:

1. Turn on the scales
2. Add a plate, cup, glass, if necessary, to the scales and press the zero button
3. Add one item, record the details of food in column provided and weight in next column and press the zero button.
4. Add next item and repeat recording and pressing the zero button after each addition until all food to be eaten has been recorded.
5. ENJOY your food or drink!
6. Reweigh any leftovers by adding a similar clean plate, glass or cup to the scales, pressing zero then weighing the leftovers. Write in any details of the food left over.

PLEASE NOTE : It is only necessary to weigh items such as your usual cup of tea or usual slice of bread and spread once. After weighing the first time, write in that weight or weights for the times when you use that food or drink again.

WHEN YOU WANT TO EAT OR DRINK SOMETHING AWAY FROM HOME:

1. Record the type of food
2. Record the quantity listed on the package if a convenience item is eaten or drunk.
3. Record the brand name or the restaurant, cafe where you ate - e.g. a small Espresso coffee and small homemade banana muffin, lightly buttered at "Cafe Takapuna".

DESCRIBING FOOD

DESCRIBE food and drink as accurately as possible giving the following details:

Cooking method for all foods (fried, grilled, steamed, poached, roast, boiled, microwaved, baked)

Type of food and brand names e.g.

Breakfast Cereal	-	Sanitarium Weetbix, Skippy Cornflakes
Milk	-	Tararua blue or green or added calcium
Cake	-	Ernest Adams Sponge, fruit
Biscuit	-	round wine, chocolate digestive
Fruit	-	raw apple, stewed, Watties canned in syrup, canned in juice, dried
Cheese	-	tasty cheddar, Camembert, blue vein.
Fish	-	fresh salmon, hapuka, smoked terakihi, canned tuna in water
Meat	-	pork loin chop, lamb fillet, chuck steak, minced rump.

It is very important that you **EAT AS NORMALLY AS POSSIBLE** during these 3 days and do not adjust your meals because you are keeping a record.

Appendix H

Calcium food frequency questionnaire

These questions are about the foods you **usually** eat. We would like you to indicate **how often** you usually eat each food and the serving size that most closely resembles the **amount** that you **usually** have.

For each food:

1. Please indicate how often you eat the food by writing the number of times **per day, or per week, or per month** in the appropriate column. If you do not eat the food, write 0
2. In the last column, describe approximately how much you would usually have as a serving. (you can describe the amount in any way that is easiest for you - eg tablespoons, cups, grams etc)

		AVERAGE LAST YEAR:			USUAL SERVING SIZE How much would you usually have for each serving? (write the number)
		Daily	Weekly	Monthly	
How often do you usually eat:		<i>(Put a number in the appropriate column. If you don't eat a food, write 0)</i>			
DAIRY PRODUCTS	Yoghurt				___pottle(s) OR ___tbsp
	Ice cream				___scoop(s)
	Custard				___cup(s) OR ___tbsp
	Milk shakes				___cup(s)
	Cheese sauces				___cup(s) OR ___tbsp
	White sauces				___cup(s) OR ___tbsp
EGGS	Egg				___egg(s)
	Scrambled with milk				___egg(s)
FISH	Canned salmon				___cup(s)
	Canned sardines				___sardine(s)
	Prawns/shrimps				___prawn(s)/ ___shrimp
CEREAL FOODS	Muesli				___cup(s) OR ___tbsp
	All bran cereal				___cup(s) OR ___tbsp
	Sweet biscuits/crackers				___biscuit(s)
	Chocolate biscuits				___biscuit(s)
	Plain cake				___slice(s)
FRUITS VEGETABLES NUTS	Broccoli				___cup(s)
	Spinach/Silverbeet				___cup(s)
	Dried fruit (ie figs,raisins,etc)				___piece(s) OR ___cup(s)
	Peanuts				___nut(s)
	Almonds				___nut(s)
VARIOUS	Chocolate				___bar(s) OR ___square(s)
	Orange juice				___glass(es)
	Soups made with milk				___cup(s)
	Tofu				___cup(s)
	Flan or quiche made with egg and cheese				___slice(s)
	Macaroni cheese				___cup(s)

MILK

1. How much milk in **total** do you usually have **each day**? (include **all** milk - ie in drinks, in cooking etc) (tick one box)

<input type="checkbox"/> More than 1 1/2 pints (1 litre)	<input type="checkbox"/> 1/2 pint (300 ml)	<input type="checkbox"/> none
<input type="checkbox"/> 1 1/2 pints (1 litre)	<input type="checkbox"/> 1/4 pint (150 ml)	<input type="checkbox"/> other (please specify)
<input type="checkbox"/> 1 pint (600 ml)	<input type="checkbox"/> less than 1/4 pint	_____

2. What types of milk do you usually have? (tick the box(s))

<input type="checkbox"/> Standard (homogenised), Whole Milk, or Powdered Whole Milk
<input type="checkbox"/> Trim, Super trim, Slim & Fit, Powdered skim, or Lite blue
<input type="checkbox"/> So Good, or So Good Lite
<input type="checkbox"/> I do not use any milk
<input type="checkbox"/> other (please specify) _____

3. How many mugs/cups of hot drinks (ie tea, coffee, milo etc) with **just a dash of milk added** do you usually drink **per day**?

(Write the number, if you don't have any, write 0)

_____ cups/day

4. How many cups/glasses of milk (plain or flavoured with coffee, chocolate etc) do you usually drink? **Not** counting drinks that just have a dash of milk added.

If you have a drink made with half milk and half water, please count as half a cup of milk.
(write the number you have **each day** OR **each week**).

_____ cups or glasses milk/day OR _____ cups or glasses milk/week

5. How often do you usually have breakfast cereal
(write the number of times **each day** OR **each week** OR **each month**).
If you don't have breakfast cereal, write 0

_____ cereal/day _____ cereal/week _____ cereal/month

6. How much milk do you usually add to your breakfast cereal?
(eg 1/2 cup, 1/4 cup etc). If you don't have milk with breakfast cereal, write 0.

BREAD

7. How many slices of bread do you usually eat each day? (or each week if you don't eat bread every day). Be sure to include **all** types of bread that you eat ie white bread, wholemeal, brown, multigrain, fruit bread, bread rolls. (note: one roll = approximately 2 slices of bread)

_____ slices/day OR _____ slices/week

8. Which size(s) slices of bread do you usually eat? (include self sliced and ready sliced bread)

sandwich or thin slice

medium slice

toast or thick slice

YOGHURT

9. What type of yoghurt do you usually eat?

fruit

natural or plain

soy yoghurt

do not eat yoghurt

CHEESE

10. From the diagrams on the next page, select the size of **hard cheese** (ie Cheddar, Colby, Edam etc) that is closest to the size you would usually cut for yourself and tick the appropriate box.

slice A

slice C

slice E

slice G

slice B

slice D

slice F

12. How many slices of hard cheese would you usually have per day (or per week or per month if you don't eat cheese every day)?

(Write the number. If you don't eat cheese, write 0)

_____ slices/day _____ slices/week _____ slices/month

13. How often do you **usually** eat the following types of cheese?

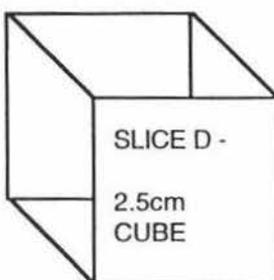
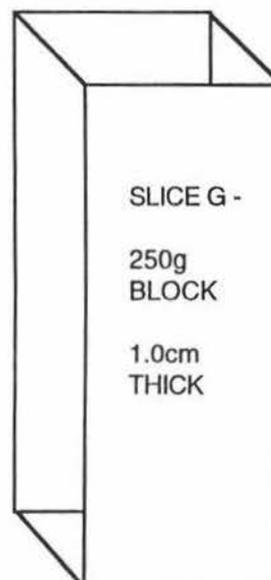
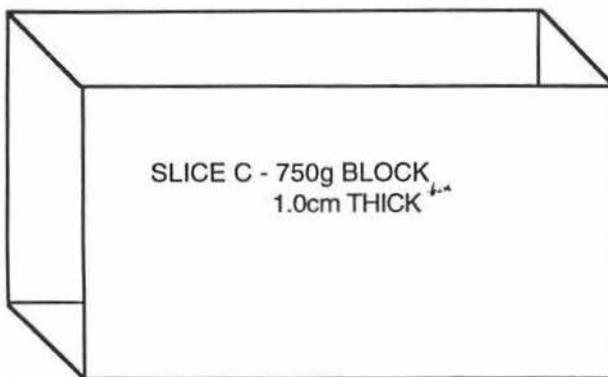
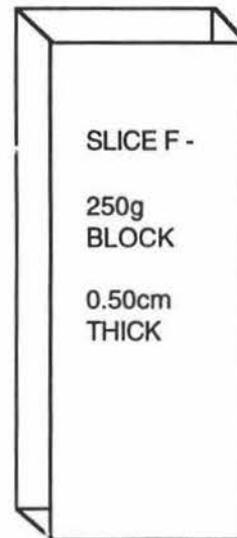
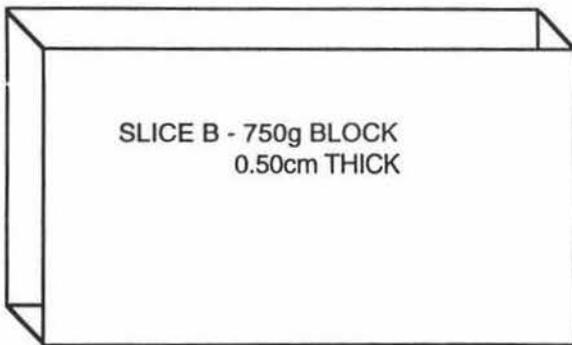
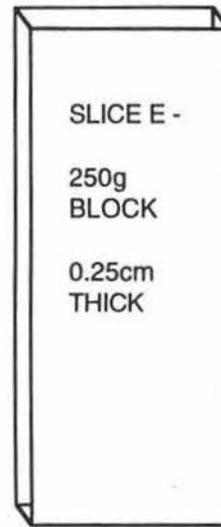
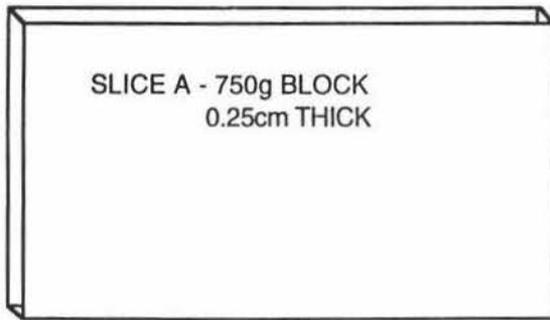
(Write the **number of times** per day, week or month in the appropriate column)

How often do you usually eat:	AVERAGE LAST YEAR:		
	Daily	Weekly	Monthly
	<i>Put the number in the appropriate column</i>		
Hard Cheeses (eg Cheddar, Gouda, Edam, Egmont, Colby, Processed)			
Delicatessen cheeses (eg Blue vein, Camembert, Parmesean, Mozzarella)			
Soft cheeses (eg Cream cheese, Cottage cheese)			
Cheese spread			

14. Would you like to clarify any of your answers?:

The following pictures show a range of slices from 250g and 750g blocks of cheese.
From these pictures:

- (i) Choose the slice that **most closely resembles the slice you would usually cut for yourself.**
- (ii) Tick the box corresponding to that selection on the **previous page** under the **CHEESES** section.



Appendix I

Individual results letter



MASSEY
UNIVERSITY

A L B A N Y

FACULTY OF SCIENCE

NUTRITIONAL SCIENCE PROGRAMME

04/06/97

Dear _____

Thank you very much once again for helping me with my research project - **Food Intake and Exercise Assessment Study**. I hope you found it as interesting to take part as I found the collecting of information. No doubt you have been waiting to hear more from me about your results. Since I last saw most of you near the end of 1996, I have been collecting information from a few more volunteers to bring up the numbers and putting all this information together into what I expect to be a very interesting outcome.

42 people completed all four parts of the project and below are some of the results - averages for the group, your individual result, and goals for New Zealanders based on current information from the Report of the Nutrition Taskforce 1991. Recommendations for calcium intake of 1000mg for women and 800mg for men have been made in a Ministry of Health document. Body mass index is a combined measurement of weight and height (weight/height²). There were no recommendations for exercise using the Pepsa points table, except that **inactive** older people are encouraged to aim for 25-40 points over the first few months of exercise. Clearly most of you do far more than that, which is wonderful!

	Average for Females	Average for Males	NZ Goals	Your result
Body mass index	26	26	20 - 29	
Fat free mass -impedance machine	66%	77%		%
Pepsa point exercise score	115	147		
Fat intake from food diaries	35%	35%	30-33%	%
Carbohydrate - from food diaries	46%	47%	50-55%	%
Protein intake from food diaries	16%	15%	12%	%
Calcium intake from questionnaire	860mg	840mg	1000/800mg	mg

As a group you appear to be doing really well with regard to goals for healthy New Zealanders. Keep it up and if you have any enquiries please don't hesitate to ring me - phone 09 445 4183.

Thanks again to all of you for your help.
Kind regards

Sarah Ley.

Appendix J

Final article for “Healthier Lifestyles”

Newsletter of Sport North Harbour

July 1997

Food Intake and Exercise Assessment Study

Sarah Ley, Nutritionist & Dietician

It was a wonderful change and totally inspiring to meet a group of such fit and healthy mature adults in the process of carrying out my study. The actual collecting of the information consequently whizzed by whilst the computer work and writing up has taken a lot longer.

I used a randomly selected group of people who were taking part in Sport North Harbour's KiwiSenior and RollStart programmes. My previous work had been with a group of older adults living in a resthome, many of whom were capable but did very little or no exercise.

Forty-two people completed the four parts of the study which involved keeping an exercise diary for 14 days, a food diary for three days, and two questionnaires. One of the questionnaires was designed specifically by a researcher in Dunedin to find out about calcium intake in adults. It is known that, along with exercise, calcium rich foods are very important for keeping bones healthy and helping to prevent osteoporosis. This condition is an enormous problem for many older people, particularly women.

To give you an idea of how you, as a group, shaped up compared with what the experts say we should be eating and what body size is healthy, I have used information from two sources. Firstly a nutrition taskforce report which provides recommendations for adult New Zealanders until the year 2000, and secondly a Ministry of Health paper which is called "Guidelines for Healthy Older People" published in 1996.

The column "New Zealand Goals" in the table on the next page contains this information. There were no recommendations for exercise using the Pepsa points table, except that inactive older people are encouraged to aim for 25 to 40 points over the first few months of exercise. Clearly most of the group do far more than that, which is wonderful!

Another really positive result of doing this study was an invitation to talk on radio about nutrition and exercise in later life with a colleague from Auckland Healthcare. We hoped to get the message across to everyone that "to maintain health and fitness and to stave off premature aging, a well-balanced diet and a little painless physical activity is probably all you need".

Thanks again to all those people who helped me with this project.

Table

A comparison of New Zealand goals and results from my research.

Measurements	NZ Goals	Average for Females	Average for Males
1. Body mass index	20–29	26	26
2. Fat free mass measured by impedance	–	66%	77%
3. Pepsa points exercise score	–	115	147
4. Fat intake from food diaries	30–33%	35%	35%
5. Carbohydrate intake from food diaries	50–55%	46%	47%
6. Protein intake from food diaries	12%	16%	15%
7. Calcium intake from questionnaire	1000mg women, 800mg men	860mg	840mg

Explanation

1. Body mass index is a combined measurement of weight and height, and gives a quick idea whether people are a healthy weight for their height.
2. Fat free mass gives an indication of the amount of body muscle and therefore fitness. Men are normally about 10% higher than women.
3. Pepsa points scoring system has a useful table to score exercise levels and was worked out by two researchers to encourage activity.
4. New Zealanders generally eat around 40% fat in their diet, the study group are much nearer the healthy goal of 30–33%.
5. Carbohydrates are recommended as good foods to have in plentiful amounts – e.g. bread, potatoes, pasta and rice. If we eat more of these we usually eat less fat and protein. Most New Zealanders don't eat quite enough.
6. Proteins are usually linked to fat intake and most New Zealanders eat too much for their health.
7. Calcium intake is much better than many New Zealanders, but some women could improve. The last nationwide survey showed women in the 50+ age only had only around 400mg per day.