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The range and validity of diet related practices in amateur body builders: a survey of the Illawarra Region's gymnasiums

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THE RANGE AND VALIDITY OF DIET RELATED PRACTICES IN AMATEUR BODY BUILDERS:
A Survey of the Illawarra Region's Gymnasiums

A major project submitted in partial fulfilment of the requirement for the award of

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ABSTRACT

This study was conducted to determine the current diet related practices of amateur body builders within the Illawarra region as well as to identify the principal sources of nutrition information used by these athletes.

A self-administered questionnaire was used to obtain information from athletes training at five Illawarra gymnasiums. Thirty two competitive and noncompetitive body builders participated in the study. The questionnaire consisted of fourteen questions both open and closed-ended and was used to investigate the following issues: the major sources, used by body builders, for obtaining nutrition information; the ease of access to the information; current diet related practices of amateur body builders; diet related practices resulting from the information gained; and whether there was a need for an educational resource targeting the dietary needs of amateur body builders.

The sources of nutrition information most often used by the respondents included articles from both body building magazines and other magazines, friends and fellow body builders and gym staff. The sources of information less frequently used included a dietitian, the television, advertisements and a coach or trainer. The major uses of the nutrition information included changing the quantity of nutrients (ie carbohydrates, fat and protein) within the diet, adapting the diet for training and the introduction of new foods into the diet.

One hundred percent of the respondents reported using dietary supplements or ergogenic aids either at the time the survey was conducted or had used them in the past.

The results of this study were used to develop a nutrition resource targeting the dietary needs of amateur body builders.

CHAPTER 1: INTRODUCTION

The leading causes of mortality and morbidity in Australia are lifestyle related. The diseases associated with diet are also associated with multiple environmental, behavioural, biological, social and genetic factors (McArdle et al., 1991). In 1990 46 percent of all deaths in Australia were due to cardiovascular disease (Lester, 1994). In a national survey of Australian adults, 43 percent of men and 35 percent of women were overweight or obese (Department of Community Services and Health, 1987). Scientific evidence points to a relationship between over-consumption of foods or specific food components (fat, alcohol, refined sugars, sodium) and lifestyle diseases impacting on the major causes of mortality and morbidity in Australia. These diseases include coronary heart disease, hypertension, stroke, diabetes, some cancers, liver and gallbladder diseases, dental caries, constipation and diverticulitis (Department of Community Services and Health, 1987).

Nutrition knowledge, skills and attitudes are the principal psychological variables thought to influence food choices and eating habits (Lester, 1994). Nutrition knowledge can influence attitudes and indirectly affect behaviour; it can also assist in the translation of knowledge into skills and practice (Department of Community Services and Health, 1987).

The principal sources of nutrition information are the mass media (particularly the print media); family, friends and school; health professionals and health organisations; and the environment (such as billboards, point-of-sale information, and food labels) (Lester, 1994). The extent to which this information is sought from each of these sources depends on gender, age, socioeconomic status and cultural tradition (Department of Community Services and Health, 1987). Nutrition information may also be unconsciously absorbed through exposure to both overt and indirect messages in the

media and the environment (Lester, 1994). A significant proportion of the population however, appears not to actively seek nutrition information (Lester, 1994).

A study conducted by Worsley and Crawford (1987) found although mass media predominate among sources of nutrition information, these most frequently used sources tend to have less credibility, while less frequently used sources, such as The National Heart Foundation and dietitians, are accorded the most trust. Women's magazines are a constant source of information on food and nutrition, albeit of varying accuracy (Reilly et al., 1993). These authors also noted that approximately half of the articles from a number of women's magazines were considered to contain misinformation. The print media obviously have the potential to influence a large proportion of the population, which means that it is important their information is appropriate and accurate.

Nutrition education is the process of teaching people how to acquire, prepare and consume foods that will promote good health (Department of Community Services and Health, 1987). Nutrition education can be directed at the community, an individual or to a particular group within the community with the purpose of modifying existing knowledge and attitudes. Nutrition education should aim to teach individuals:

* how to choose a healthy diet from the current food supply available to them;
* skills to evaluate nutrition information from a variety of sources; and
* how identify the reliable sources of nutrition information

in order to be less susceptible to the increasing amount of nutrition information which is confusing, misleading and sometimes dangerous (Department of Community Services and Health, 1987; Lester, 1994).

There is strong scientific evidence supporting the importance of regular physical activity as part of the population-wide approach to the prevention of heart and blood vessel disease and other health problems (Department of the Arts, Sport, the Environment and Territories, 1992). The minimum level of exercise required to maintain or enhance

cardiorespiratory fitness is physical activity sufficient to raise the heart rate, performed three or more times per week for at least 20 minutes each time (McArdle et al., 1991). In a study conducted by the Department of the Arts, Sport, the Environment and Territories (1992), it was found that only 15 percent of adult Australians could be classified as active at this level. Today regular exercise combined with a well balanced diet is promoted as being the key to good health.

It has only been within the last century that a real understanding of some of the details of nutritional effects on aging, general health, and athletic performance has emerged. Sports nutrition is now one of the most studied areas of nutrition, and many long-held concepts of good nutrition, particularly those relevant to athletes are being challenged (Burke, 1992). The importance of nutrition in sports is becoming increasingly recognised in both elite and amateur sporting levels. In the past the main focus of sports nutrition was pre-competition nutrition.

Most nutrition information concerns eating for weight loss. Yet there are a number of sports such as body building, weight lifting, football and field athletics, for which weight gain is extremely important. In attempting to achieve weight gain resulting in large body mass, considerable thought should be placed into both proper nutrition and physical training programs that can enhance gains in lean body mass, reduce gains in body fat, and allow achievement of optimal or maximum performance (Baechle, 1994).

Strength training for non-athletic purposes or general conditioning has become increasingly popular during the last decade (Komi, 1992). Unlike other competitive sports involving speed, strength, or endurance body building is based on the challenge to create a physique which emphasises muscle shape, definition and symmetry (Sandoval et al., 1989). These athletes exercise for the sole purpose of improving their physique, with little concern for athletic performance. The body builder who demonstrates low percentages of body fat in addition to a high level of muscularity represents the winning

physique (Spitler et al., 1980). Many factors, including nutrition play a role in the achievement, maintenance, and exhibition of muscularity.

The diet of the average Australian and the stereotypical diet of a body builders have many similarities. The Australian Health and Nutrition Survey conducted in 1988 found protein contributed approximately 16.5 percent to total energy intake, and fat and carbohydrate contributed 35.2 percent and 45.4 percent respectively (Lester, 1994). Similarly, the "typical" diet of a body builder is high in protein and fat with an inadequate supply of complex carbohydrates (Kleiner et al., 1990). Many of the nutrition philosophies and practices of body builders (such as extreme dehydrating regimens, multiple-drug use, rapid weight loss strategies, and use and abuse of dietary supplements and ergogenic aids) conflict with established views and can be dangerous to the health of the individual.

This study of the Illawarra region's amateur body builders provides more insight into the diet related practices of both competitive and noncompetitive body builders and assesses the need for a nutrition resource targeted at the dietary needs of body builders. Data pertaining to demographics, diet related practices and sources of nutrition information were collected using a self-administered survey delivered to body builders training at five Illawarra gymnasia.

Research Objectives

The specific objectives of this research are :

1. To identify what nutrition related information is required by amateur body builders.

2. To identify major sources from which amateur body builders obtain nutrition information.

3. To determine the ease of access to this information (ie ease to read/ understand/ implement).

4. To identify the current diet related practices of amateur body builders.

5. To determine the diet related practices resulting from nutrition information gained.

6. To determine whether there is a need for a nutrition education resource targeting amateur body builders.

7. To develop a resource if a need is identified from the study.

List of Definitions

Adipose tissue - The tissue within the body responsible for storing fat.

Aerobic exercise - Exercise lasting for longer than two minutes which requires oxygen during energy production; produces cardiovascular fitness.

Amino acid - The building blocks of proteins containing a central carbon atom with a nitrogen atom and other atoms attached.

Anabolic steroids - Hormones used illegally by athletes in an attempt to build muscle mass when ingested in conjunction with strength training.

Anaerobic exercise - Exercise lasting for a very short duration of time and which does not require oxygen during energy production.

Body building - The sport where athletes develop large muscle mass through intensive weight training and diet manipulation (Sandoval et al., 1989).

Bulking up - The process where body builders gain muscle mass whilst trying to minimise gains in body fat.

Carbohydrate - A compound containing carbon, hydrogen, and oxygen atoms; the two types are known as simple carbohydrates (sugars) and complex carbohydrates (starches). One gram of carbohydrate provides 16 kJ (4 Cals per gram).

Cutting-up - The process where a significant amount of body fat is lost and lean body mass is increased.

Diet - The term used to describe a regular daily food intake of an individual or population.

Dietary supplements - Substances generally fortified with vitamins and/or minerals and possibly macronutrients. They are used to supplement an inadequate diet or because athletes believe they will enhance performance.

Energy - In nutritional terms, energy refers to the number of kilojoules (or calories) which are released when a food is burned for fuel within the body.

Enzyme - A compound that speeds the rate of a chemical reaction within the body but is not altered by the chemical reaction.

Essential amino acids - Amino acids which are not effectively synthesised by humans and that must therefore be included in the diet. There are nine essential amino acids.

Ergogenic aids - Substances or devices used due to the belief that they will improve exercise and athletic performance by improving the production of energy (Bucci, 1993).

Fats - Organic substances which are insoluble in water. All types of fat are energy dense and contribute 37 kJ (9 Cals) per gram.

Glycogen - A carbohydrate made of multiple units of glucose containing a highly branched structure; glycogen is stored in the muscle and liver.

Hypertrophy - An increase in cell size.

Kilojoule (kJ)- A measure used to quantify energy; (1 calorie = 4.2 kJ).

Lean body mass (LBM) - The part of the human body which is free of all but essential fat. Lean body mass includes muscle, bone, organs, connective tissue, and other body parts.

Macronutrients - Protein, carbohydrates and fats are known as macronutrients as they are required in relatively large quantities.

Nitrogen balance - When the intake of nitrogen (protein) equals nitrogen excretion, a nitrogen balance exists.

Non-essential amino acids (NEAA) - Amino acids that can be readily made by the body.

Novice body builders - Individuals who have been body building for less than three years.

Protein - Compounds made of amino acids, containing carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur atoms, in a specific configuration. One gram of protein provides 17 kJ (4 Cals).

Pumped - The term used to describe the training phase where body builders define muscularity and vascularity by increasing blood flow through the region being exercised.

Recommended Daily Allowance (RDA)/ Recommended Daily Intake (RDI) Recommended intakes for nutrients that meet the needs of almost all people of similar age and gender.

Resistance training - Training performed with the use of weights in order to increase muscle mass.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction to body builders

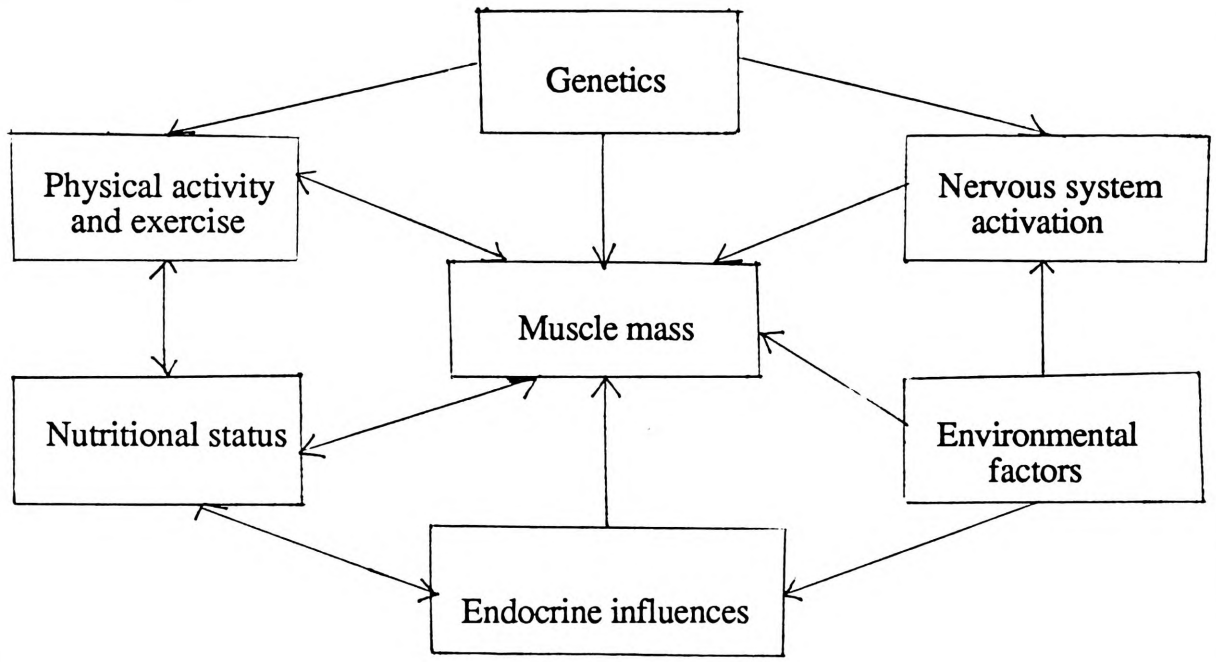
Body builders are not concerned primarily with strength or other parameters of athletic performance, but with their physique (Burke, 1992). These athletes use weight lifting to develop muscle definition and form (Katch et al., 1980). Body builders develop muscle mass through intensive weight training and definition of their muscles through a combination of dieting, weight lifting, aerobic exercise and possible use of steroids (Sandoval et al., 1989).

Competitive body building is becoming increasingly popular (Kleiner et al., 1990). Yet, aside from reports of the abuse of anabolic-androgenic steroids, there is very little scientific literature describing the health, dietary and training practices of these individuals (Kleiner et al., 1990).

The training year of a competitive body builder is broken into three phases (off-season, competitive season and the 'pumped' phase). Bulking up, or increasing overall muscle size is targeted during the off-season (Burke, 1992). Body fat levels are relatively high during this phase (Sandoval et al., 1989). Closer to the competition season, body builders begin to 'cut-up' (Burke, 1992). This involves losing body fat without decreasing muscle mass. The third phase occurs in the days or week prior to the competition. This phase allows the body builder to appear 'pumped', with clearly defined muscularity and vascularity which results from severe restriction of kilojoules, salt and fluid intake (Burke, 1992).

The development and maintenance of muscle mass is effected by a number of internal and external factors as illustrated in Figure 2.1.

Figure 2.1 Factors which effect muscle mass



Taken from Mc Ardle et al., (1991) page 475.

2.2 Dietary practices of body builders

Diet is an integral part of the body builder's training program. The importance of dietary practices is well reported in the literature. Some techniques emphasise reduction of kilojoules, particularly in those sports where weight loss is required to "make weight" and to increase competitiveness, whereas other sports require an increased kilojoule consumption ie field athletics (Burke, 1992). Body building however, has placed emphasis on the role of nutrition rather than energy in performance. However, many of the nutrition philosophies and practices of body builders conflict with established views. Much of the information is spread pervasively and persuasively through their circles, by word of mouth and through body building magazines (Burke, 1992). A study conducted by Kleiner et al., (1990) found books, magazines, friends and coaches were the sources of nutrition information used most often in both male and female competitive body

builders. Less frequently used sources included the radio or television, a formal nutrition class, and a dietitian.

While recent research suggests the stereotypical diet of a body builder was found to be very high in protein and fat and low in carbohydrates (Burke, 1992) this varies considerably among body builders from population to population. Spitler et al., (1980) found that the average distribution of kilojoules, as self-reported by male body builders, was 85 percent protein, 10 percent fat and 5 percent carbohydrate. A similar study of diet-related practices in body builders conducted by Kleiner et al., (1990) found the percent contribution of total energy from protein, fat and carbohydrate was 22 percent, 34 percent and 44 percent respectively. Hurley et al., (1984) reported dietary intakes of 20 percent of energy from protein, 45 to 50 percent from fat, and 30 to 35 percent from carbohydrate, in a group of eight competitive body builders. The considerable differences in macronutrient composition reported in these studies could have been due to methodological or time-related factors. Different diet recall methods used to obtain the information have been demonstrated to vary in ways of quantifying measurements and in the length of time chosen to obtain information, therefore the validity and accuracy in which the different methods represent a person's habitual eating pattern is questionable (Fanelli and Stevenhagen, 1986). On the other hand, the phase of training the subjects were undertaking at the time the study was conducted could also result in significant variations in diet related practices. As noted earlier, (Burke, 1992) body builders employ dramatic manipulation of diet, kilojoule and macronutrient content to 'cut-up' or appear 'pumped'.

The relatively low percentage of carbohydrate and high percentages of protein in the diets of body builders conflicts with what is typically recommended in the recent literature. A diet consisting of the following macronutrient composition is recommended for body builders during all training phases: 50-65 percent carbohydrate, 10-15 percent protein and less than 30 percent fat (Burke, 1992).

2.3 Energy requirements

The adequacy of energy intake is perhaps the single most important factor determining protein requirements of athletes focusing on strength gain (Lemon 1991). For athletes who are maintaining body weight, daily energy intake must equal daily energy expenditure. However, athletes attempting to stimulate muscle development require energy intake in excess of that required simply to fuel the extra activity. There is a paucity of information in respect to the amount of additional kilojoules (kJ) of energy necessary to form one kilogram of muscle tissue, nor is it known in what form this energy should be consumed (Williams, 1993; Baechle, 1994). Estimates vary significantly and range from about 2100 to 3360 kJ/kg of muscle (Williams, 1993). An additional energy intake of approximately 2200 kJ daily by an athlete attempting to gain 0.5 kg of muscle per week is a reasonable goal (Baechle, 1994). Furthermore, body mass gains should be relatively slow, about 0.5 to 1.0 kg/week; this rate tends to reduce fat gains (Burke, 1992). Prolonged weight gain (> 6 months), in which a relatively large gain in body mass is the goal, as often occurs in body builders, should occur at an even slower rate, 0.25 to 0.5 kg/week, to ensure that most of the gain is in lean body mass (Baechle, 1994).

2.4 Nutritional requirements for body builders

2.4.1 Protein

Protein is essential for all living organisms. Found primarily in the tissue, it makes up approximately 12-15 percent of our body weight. Proteins are relatively complex molecules that have enzymatic and structural functions and are important in a variety of biosynthetic and bioenergetic reactions related to body growth, maintenance and repair, and energy production (Horton, 1982). Amino acids are the building blocks of proteins and are essential for the functions described previously. Eight of the twenty three amino

acids (nine in children) cannot be synthesised in the body and therefore must be provided preformed in foods (McArdle et al., 1991). These are called essential amino acids. The remaining amino acids are termed non essential amino acids as they can be synthesised in the body at a rate that meets the demands for normal growth.

As occurs for most athletes the energy, protein, carbohydrate and fluid requirements are greater for the body builder than for a sedentary individual (Burke, 1992). Protein requirements for body builders are in excess of the requirement for sedentary individuals, not only because of the potential to enhance strength, but also to provide a supply of amino acids for any increased amino acid oxidation that may occur during training (Lemon and Proctor, 1991). Although there are many nutritional factors that can potentially affect strength training, protein is the single nutrient most often associated with strength improvement (Lemon, 1989).

Recommended protein intakes for athletes undergoing daily training are a controversial issue. Suggested protein intakes range from those slightly above that for nonathletic individuals, to the values that are twice or even four times that amount (Leemon et al., 1991; Tarnopolsky et al., 1992; Baechle, 1994). A specific athlete's need is dependent upon several factors including:

* exercise type, intensity and volume;
* length of training period;
* carbohydrate intake;
* environmental conditions;
* quality of protein ingested;
* steroid use;
* age;
* gender (Baechle, 1994; Williams et al., 1995).

Literature values for this additional protein requirement range from 1.0-2.3 g/kg/day depending on the factors previously described (Lemon et al., 1991; Tarnopolsky et al., 1992; Tarnopolsky, 1993). The major mechanisms by which protein requirements are increased by exercise include: the contribution of protein catabolism to fuel requirements of exercise, a positive nitrogen balance (ie increase muscle bulk) resulting from heavy resistance training, and repair/ recovery needs following muscle damage and efflux of muscle enzymes (Lemon et al., 1991; Tarnopolsky et al., 1992; KReader et al., 1993). Large individual variability exists with protein requirements of athletes. Novices may have higher protein needs than experienced body builders due to continual hypertrophy of muscle cells. Recent data indicate that protein requirements of experienced body builders (> 3 years of training) was approximately 0.9 g/ kg/ day, while those of novices during the first month of training are about 1.5 g/ kg/ day (Lemon, 1991). The use of anabolic steroids also warrants a greater protein requirement within the diet due to accelerated muscle growth.

Gains in muscle strength and size induced by specific techniques of weight training appear to be enhanced by protein intakes that exceed the current recommended allowances for the general population (Lemon, 1989). Insufficient intake of energy, a strategy often utilised by body builders, can also increase protein requirements (Lemon et al., 1991). Therefore, dieting may decrease the effectiveness of strength programs for individuals consuming what otherwise would be adequate dietary protein. When protein intake is insufficient, negative nitrogen balances occur (Tarnopolsky et al., 1992). In this situation, tissue protein (primarily muscle) is broken down to make amino acids available for other uses (Tarnopolsky et al., 1992; Goranzon and Forsum, 1985). On the other hand excess protein intake is converted to fat and stored in the adipose tissue within the body. Furthermore, carbohydrates can be displaced in a high protein diet, leading to fatigue and adverse effects on training quality (Lemon et al., 1992; Williams et al., 1995).

In 1988 the average Australian diet provided 16-17 perecent of energy as protein (Lester, 1994). This indicates that the average Australian consumes adequate protein and amino acids to meet their daily requirement. Surveys have shown that food consumption practices of both male and female body builders are significantly higher in protein than national averages (Spitler et al., 1980; Kleiner et al., 1990; Burke, 1992) and the recommended requirement for body builders.

2.4.2 Carbohydrate

Carbohydrates are the preferred metabolic fuel and are especially important in the performance of both aerobic endurance activities and in anaerobic activities involving high volumes of work eg repeated anaerobic bouts (Baechle, 1994). The energy derived from the breakdown of glucose and glycogen is ultimately used to power muscular contraction as well as all other forms of biologic work (Fogelholm et al., 1991). Glycogen is the polysaccharide synthesised from glucose in the process of gluconeogenesis and stored in muscle and the liver (McArdle et al., 1991). Muscle glycogen concentrations may be related to muscle strength and short term, high intensity (anaerobic) exercise. Because of the relationship of dietary carbohydrate to muscle and liver glycogen stores and to the protein sparing effect of the high concentrations of muscle glycogen, dietary carbohydrate is an important factor to consider in preparation for physical activity (Costill, 1988; Fogelholm et al., 1991).

Carbohydrate loading is practised by body builders prior to competition in order to increase muscle size and definition (Costill, 1988). Loading involves muscle glycogen stores being depleted by prolonged, exhaustive exercise, followed by 2-3 days of low-carbohydrate and low kilojoule diet (Fogelholm et al., 1991; Pascoe et al., 1993). Stores are then replenished by eating a high-carbohydrate diet and performing only light exercise (Fogelholm et al., 1991). Such a regimen will increase muscle glycogen stores 20-40 percent or more above normal (Coyle, 1993). Glycogen is stored in the muscle along

with water, which can cause some weight gain and the feeling of muscle stiffness and hardness (Costill, 1988).

Adequate intake and use of carbohydrates aid in the maintenance of tissue protein (Fogelholm et al., 1991) while, excess carbohydrate is converted to fat within the body. On the other hand, a diet with insufficient carbohydrates can lead to weight loss (lean tissue, fluid loss and adipose tissue), lethargy and earlier onset of fatigue when training (Coyle and Coyle, 1993; Pascoe et al., 1993).

2.4.3 Lipids

Lipids include both solid fats and liquid oils. The functions of lipids within the body include:

* a source of energy;
* structural components of cell membranes and the myelin sheath of neurons;
* transporters of fat-soluble vitamins, and
* the synthesis of cholesterol production of associated steroid hormones (Baechle, 1994).

While lipids are found in all cells, adipose cells are filled almost entirely with fat, and within muscle fibres vacuoles are the primary sites for lipid storage (Baechle, 1994).

Lipids are generally restricted in a body builder's diet especially when cutting up. Past research has reported body builders consuming foods low in fat (Kleiner et al., 1990; Lamar-Hildebrand et al., 1989; Sandoval et al., 1989). Sandoval et al., (1989) and Lamar-Hildebrand et al., (1989) found the body builders surveyed consumed high protein and low fat foods. Very few dietary records contained red meat or dairy products as protein sources due to the belief that these foods are high in fat. Instead low fat protein sources such as chicken breasts, lean fish, egg whites, and white tuna canned in water

were consumed. Intakes of lipids in excess of those required for cell membranes, transport of fat soluble vitamins, and production of steroid hormones and energy requirement, are stored in adipose cells. An excess of subcutaneous adipose tissue masks muscle bulk and definition so body builders reduce fat intake.

2.5 Body composition

Body composition is a primary concern for body builders. Both female and male competitive body builders are lean athletes having a large muscle mass in comparison to average men and women (Sandoval et al., 1989). Several studies have examined the percent body fat of competitive body builders (Elliot et al., 1987; Hurley et al., 1988; Sandoval et al., 1989; Kleiner et al., 1990) however, there is little research available describing body composition of noncompetitive body builders. In the general population the average woman has approximately 20 to 25 percent body fat, whereas men have about 10 to 15 percent (Stamford, 1987). The reported percent body fat of male and female competitive builders have ranged between 6.0 percent and 9.9 percent for males body builders and between 9.8 percent and 14.4 percent for female body builders (Katch et al., 1980; Elliot et al., 1987; Hurley et al., 1988; Sandoval et al., 1989; Kleiner et al., 1990). Sandoval et al., (1989) reported the lean tissue/fat ratios for the male and female body builders were between two to four times larger than those of the reference man (5.9) and woman (2.8), reflecting a larger proportion of muscle mass and lower body fat in these athletes.

2.6 Gender differences in nutrient intake

Nutrient composition of the diet may reflect a gender difference among body builders, as noted by Kleiner et al., (1990). In this study male body builders tended to consume 70 percent or greater of the American Recommended Daily Allowance (RDA) for most nutrients. Female body builders, however, consumed only 36 percent of the

recommended calcium intake (800 mg) and 75 percent of the recommended zinc intake (12mg) (Kleiner et al., 1990). Sandoval et al., (1989) reported both men and women consumed insufficient calcium. The men consumed 54 percent of the RDA for calcium while the women body builders consumed 60 percent of the RDA. Women however, consumed less iron than men, with men consuming 188 percent of the RDA and women only 76 percent. Zinc intakes were not measured in this study. Apparently due to the exclusion of certain foods ie red meat and dairy products from their diets, and a multitude of other common dietary practices, many body builders run a high-risk of developing vitamin and mineral deficiencies and relevant health related illnesses (Kleiner et al., 1990). The use of calcium and iron supplements are often recommended to body builders since these athletes often restrict red meat and dairy products as a way to reduce fat intake (Lamar-Hildebrand et al., 1989; Sandoval et al., 1989; Kleiner et al., 1990).

2.7 Dietary supplements

In the search for the ideal diet and elite performance, some athletes choose dietary supplementation and nutritional ergogenic aids. The concept of improved athletic performance resulting from dietary supplements and ergogenic aids is based on three beliefs: firstly, that the athlete has a greater requirement for many vitamins and minerals than the sedentary individual for whom most dietary recommendations have been designed (Mc Donald et al., 1988); secondly, that the athlete does not consume an adequate diet with regard to essential trace element content (Brouns, 1989); and thirdly, that this perceived low consumption of essential trace elements can result in a lowering of peak athletic performance and ultimately may lead to the development of some disease states (McDonald and Keen, 1988; Brouns, 1989). However, despite the strong beliefs of some athletes and trainers, there is remarkably little evidence supporting a positive effect of excessive dietary mineral supplementation on athletic performance (Mc Donald and Keen, 1988). Supplementation is only of any benefit to the athlete's health if their diet is deficient in a particular nutrient.

Studies of body builders have reported a high prevalence of supplement use (Katch et al., 1980; Faber et al., 1986; Sandoval et al., 1989; Bazzarre et al., 1990; Hickson et al., 1990; Kleiner et al., 1990). The majority of these studies involve competitive body builders, and there is little information available to allow comparisons to be made regarding the supplement use of competitive and noncompetitive body builders. Kleiner et al., (1990) studied 27 championship level body builders and found that 90 percent of the men and 100 percent of the women used dietary supplements, however the specific supplements were not identified. Data from this study were collected in the weeks leading up to and on the day of competition. Since Katch et al. (1980) found supplement dosages depended on the training cycle and that dosage size peaked during competition, this may explain the high incidence of supplement use.

Most of the commercial dietary supplements marketed for body builders are promoted as a means to influence metabolic processes that stimulate muscle growth and/or facilitate the loss of body fat, primarily by inducing endogenous production or release of either testosterone or human growth hormone (Brouns, 1989; Reader et al., 1993). It is thus easy to see why this strategy is attractive to body builders.

2.7.1 Protein and amino acid supplements

Protein supplement powders and amino acid supplements are two dietary supplements commonly associated with use by body builders. Amino acid supplements were first introduced to Australia in the early 1980s for use solely by weight lifters (Cardwell et al., 1995). Amino acid supplements and protein supplement powders are now widely marketed to weight lifters, body builders, other athletes and weight watchers (Cardwell et al., 1995). Protein powders are consumed to increase amino acid intake. In strength athletes, amino acid supplementation has been proposed to increase the availability of essential amino acids, enhance anabolic processes promoting tissue accretion, and accelerate the rate of recovery during training (KReader et al., 1993).

The study conducted by Grunewald and Bailey, (1993), reported amino acid and protein supplements were the largest category of supplements aimed at body builders through advertisements and articles within the body building magazines surveyed. There are many unsupported claims promoting amino acid containing supplements (Philen et al., 1992; Grunewald and Bailey, 1993; Cardwell et al., 1995). Such claims being made for these supplements include: improved performance; increased muscle bulk; improved power and energy; improved recovery from training; assist in weight gain; assist in weight loss; reduced cellulite; allay fatigue; increased testosterone levels; and release of growth hormone (Philen et al., 1992; Cardwell et al., 1995). Athletes are often persuaded to use amino acids because of the powerful marketing strategies of the supplement companies and personal endorsement by well-known athletes (Cardwell et al., 1995). Supplements are often very expensive and unnecessary in a well balanced diet. As discussed previously, body builders consume more protein than recommended for strength athletes, which means the additional protein and amino acids provided by supplementation are either converted to fat or excreted from the body.

2.7.2 Liquid meal supplements

Liquid meal supplements and sports drinks are used by a wide range of athletes. One of the primary nutritional concerns of body builders undertaking repeated prolonged exercise is the ability to restore muscle glycogen between sessions. Costill et al. (1988) reported that athletes who failed to ingest sufficient carbohydrate to match the demands of their heavy exercise schedules succumbed to chronic muscle glycogen depletion and fatigue. Liquid meal supplements are nutritionally complete liquids which have been manufactured as an alternative to solid food. Generally, they provide 1 to 1.5 kcal/ml, with the contribution of macronutrients ranging from 15 to 20 percent for protein, 50 to 70 percent for carbohydrates and the remainder as fat (Burke and Read, 1993). A broad range of vitamins and minerals are provided, typically with the RDA/RDI level of each being supplied by 500 to 1000ml of supplement. The reasons for using liquid meal

supplements include: to increase carbohydrate requirements of heavy training without bulk and gastric discomfort; if individuals have restricted time to prepare and eat meals; if individuals have reduced interest in food through fatigue or suppressed appetite; they increase energy with minimal bulk and minimal food preparation; and liquid meal supplements are nutrient dense (Burke and Read, 1993). Liquid meal supplements can be used by body builders as a pre-competition meal as they satisfy hunger without causing the stomach to protrude; they have no adverse effect upon energy stores and may increase the amount of desirable fuel; and finally, they aid in providing adequate hydration (Burke and Read, 1993).

Some research suggests the use of liquid meal supplements may even be a benefit to body builders. A study conducted by Hecker and Wheeler, (1985) reported that a group of competitive weight lifters achieved significantly greater increases in lean body mass while using liquid meal supplements in addition to their regular diet than the control group whose diet was unsupplemented.

2.7.3 Sports drinks

Sports drinks have become very popular amongst both athletes and the general population in the last few years. Sophisticated marketing campaigns have promoted sports drinks as a product which boosts energy and increases athletic performance. Sports drinks have been developed primarily for use during and after exercise, and in general contain carbohydrate in the concentration range of 5-10 percent, together with electrolytes, usually sodium and potassium (Burke and Read, 1993).

Isotonic and hypertonic sports drinks are available. Isotonic sports drinks contain carbohydrates at the same concentration as blood plasma (between 5 and 10g/100ml, or 5-10 percent weight per volume (w/v)) so the body can easily absorb them (Australian Consumer's Association, 1995). Lower levels do not provide sufficient carbohydrates to

replenish blood sugar levels during intense or prolonged exercising while concentrations above 10 percent w/v can take longer for the body to absorb which may lead to gastrointestinal discomfort (Burke, 1992; Burke and Read, 1993; Australian Consumer's Association, 1995).

The ingestion of sports drinks during exercise can be effective in enhancing performance as it prevents or ameliorates the exercise-induced changes to body homeostasis (Burke and Read, 1993). Homeostatic disturbances that would otherwise be detrimental to performance include a decrease in plasma volume, increases in both plasma osmolality and core temperature, and a decrease in available glycogen for continued muscular contraction (Burke and Read, 1993; Kleiner, 1994).

Sports drinks are beneficial to the performance of body builders if they are participating in prolonged sub-maximal exercise (ie. more than 60-90 minutes of continuous high intensity exercise) (Burke and Read, 1993). When exercising for less than 60 minutes, water is a more practical and economical beverage (Rehrer et al., 1990). During exercise it is important to keep the body well hydrated at a rate that keeps pace with sweat loss (eg to replace 80 percent of weight lost as fluid). The average rate of fluid lost as sweat during exercise is one litre per hour. Fluid requirements and fluid loss depends upon the individual, the intensity of exercise and the environmental conditions (Burke and Read, 1993). Fluids intake should commence early in the exercise session to attenuate the development of dehydration rather than treat an already developed state (Baechle, 1994). Rehrer et al. (1990) reported that dehydration may reduce the gastrointestinal emptying of sports drink consumed during exercise and increase the risk of gastrointestinal upset. Drinks should be consumed at regular intervals, in a volume that helps maximise total intake and gastric emptying while not compromising gastric discomfort (Burke and Read, 1993).

Post-exercise hydration needs will generally be met by a scheduled water intake. However, the use of commercial sports drinks may provide special advantage in recovery from prolonged exercise, particularly where more rapid recovery of fluid and fuel levels shorten recovery periods and enhance performance in future exercise bouts (Burke and Read, 1993). In particular competitive body builders may benefit from sports drinks after competition to replenish fluid and electrolyte losses, especially if diuretics and other dehydrating techniques have been used.

2.8 Ergogenic aids

Ergogenic aids are substances or devices used due to the belief that they improve exercise and athletic performance by improving the production of energy (Bucci, 1993). Some of the ergogenic aids currently used by body builders include γ-oryzanol/ ferulate (FRAC), inosine, chromium and creatine.

2.8.1 γ-Oryzanol/ Ferulate (FRAC)

FRAC is a mixture of ferulic acid esters of sterols extracted from rice, bran, corn and barley oils (Rosenbloom et al., 1992). Currently it is not known whether plant sterols have any positive effect on human muscle strength, but given that plant sterols are metabolised in the gastrointestinal tract and do not enter the blood intact, the desired effect on muscle is doubtful (Rosenbloom et al., 1992). FRAC is promoted by manufacturers to have the following effects:

* enhance muscle development by increasing testosterone levels;
* promote lean tissue by hypothalamic stimulation;
* augment anabolic hormone response to stress; and
* increase endorphin release (Rosenbloom et al., 1992; Williams, 1993).

As is the case with most of the ergogenic aids, there are little valid data to support these claims. However, a study conducted by Bonner and colleagues (1990) found ferulate

supplementation did not increase cortisol or testosterone levels but β-endorphin levels were significantly greater during the ferulate treatment period. Therefore, according to this preliminary study, the proposed action and use of ferulate may have some basis.

2.8.2 Chromium

Chromium is considered to be an essential component of the glucose-tolerance factor, which potentiates the effect of insulin and is currently being marketed as an anabolic aid for strength athletes, primarily in the form of chromium picolinate (Rosenbloom et al., 1992; Bucci, 1993; Kleiner, 1994). Chromium deficiencies may be widespread due to low dietary intakes, and initial research suggests that exercise may increase the excretion of chromium (Anderson et al., 1988). These findings put athletes who have low dietary intakes and exercise vigorously or for long duration at risk for developing chromium deficiencies, and resultant insulin intolerance (Bucci, 1993).

Research data investigating the effects of chromium supplementation are limited. A study conducted by Hallmark et al. (1993) reported no significant effect of chromium picolinate supplementation on lean body mass, body fat, or strength in weight training programs. Other studies investigating chromium supplementation have been poorly designed and therefore data available are not valid (Clarkson, 1991). Presently, no guidelines for chromium supplementation as an ergogenic aid are substantiated.

2.83 Creatine

In the body, creatine combines rapidly with phosphate to form creatine phosphate, a high energy compound stored in muscle (Williams, 1993; Kleiner, 1994). Creatine also acts as a buffer against lactic acid in muscles (Kleiner, 1994). Thus creatine phosphate levels should theoretically delay fatigue in repetitive, exhaustive, short-term exercise (Bucci, 1993). Several studies cited in Williams (1993) illustrated possible benefits of creatine

supplementation. Twenty to 25 grams per day of creatine monohydrate supplements were found to increase creatine content in muscle, increase muscle torque in repeated bouts of maximal isokinetic exercise, and increase body mass (either through increasing synthesis of contractile proteins or water retention) (Williams, 1993). Although there are no known side effects associated with taking one to ten grams of creatine per day (besides possible weight gain), there is some concern about possible liver and kidney damage if 40g or more is consumed in a day (Kleiner, 1993).

2.8.4 Inosine

Inosine is another ergogenic aid commonly associated with use by body builders (Klener et al., 1990; Rosenbloom et al., 1992; Williams, 1993). Inosine is not an amino acid, but a nucleoside involved in the formation of purines such as adenine (Williams, 1993). Inosine is both a precursor and a breakdown product of adenosine (McArdle et al., 1991). Increases of inosine in cells are thought to force additional synthesis of adenosine (and ultimately ATP) by providing precursors and inhibiting catabolism of adenine nucleotides (Bucci, 1993). Manufacturers claim inosine supplementation will lead to: activation of cellular function, stimulation of adenosine triphosphate (ATP) production; and facilitation of exercise intensity (Williams, 1993; Rosenbloom et al., 1992). Not one of these claims has been supported by research. Inosine is not converted to ATP in the cells under conditions of high demand for oxygen, instead it is converted to hypoxanthine (a compound that does not produce energy) and it is ultimately then converted to uric acid (Rosenbloom et al., 1992). Inosine is taken orally. Oral administration of inosine to rodents reveals substantial degradation of mucosa, rendering oral supplementation of inosine to have at best, dubious, and at worst hazardous value to humans (Bucci, 1993).

2.9 Side effects of supplement use and the use of ergogenic aids

The use and/or abuse of dietary supplements has the potential to be hazardous to the health of the user. A study conducted by Philen et al. (1992) reported the dose of folic acid in one product analysed was 25 times the US RDA of 400 μg. Products containing more than one mg of folic acid are treated as drugs under existing regulations, and high levels of folic acid may mask symptoms of pernicious anaemia, which could potentially lead to irreversible neurologic damage (Philen et al., 1992). The same study reported that in the advertisements for the dietary supplements, little, if any mention was made of possible side effects or of conditions that contraindicate their use (such as pregnancy, hypertension, or thyroid disease).

2.10 Anabolic-androgenic steroids

The most obvious effect of strength training is muscular hypertrophy. To help compensate for genetic limitations in hormonal status of in particular, testosterone, many strength-trained athletes have used ergogenous anabolic-androgenic steroids (AAS) effectively to maximise muscle growth and strength. In fact, many athletes view AAS as an essential component for success (McKillop et al., 1989; Williams, 1993; Wright and Stone, 1993). The use of AAS by athletes is illegal. Table 2.1 lists the suggested physiological basis promoted by peers, advertisements and articles to encourage use by athletes.

Abuse of anabolic steroids has been well documented in body builders and the potential for harmful side effects has been exposed (Sandoval et al., 1989; LaBree, 1991; Wright and Stone, 1993; Bahrke and Yesalis, 1994). Sandoval et al., (1989), reported 100 percent of the males in the study used AAS, whereas, all of the women indicated they had never used AAS. Of the males participating in the study conducted by Kleiner et al. (1990) 45 percent admitted using anabolic steroids. All women responded negatively to

questions of AAS use. Adverse reactions to anabolic steroid use may include liver disease; heart disease and stroke; cancer; kidney stones and diseases; sterility; impotence; hypertension; stunted growth in adolescents; psychological changes; irreversible virilization in women; and foetal damage (Kleiner et al., 1990; LaBree, 1991).

Table 2.1. Suggested physiological bases of AAS which are promoted to encourage use by athletes.

- ♦ Increase body weight
- ♦ Increase body mass
- ♦ Body composition
- ♦ Increase muscle size
- ♦ Increase muscle strength
- ♦ Blood volume
- ♦ Red blood cells (number and volume)
- ♦ Haemoglobin (myoglobin?)
- ♦ Anti-catabolic effects
- ♦ Faster recuperation/enhances ability to accumulate backlog of quality training necessary to win/improve
- ♦ Prophylaxis and therapy for hard and soft tissue injuries or disease
- ♦ Behavioural effects including increased aggressiveness, competitiveness, training drive and feelings of well being

Adapted from Wright et al. (1993) page 11.

2.11 Diuretics and laxatives

In addition to the problem of steroid abuse in body builders another concern within this athletic population is the occurrence of diuretic and laxative abuse (Burke and Read,

1993). Diuretics and laxatives can be potent perturbers of electrolyte status (Kleiner et al., 1990). Diuretics are drugs used to increase the output of urine, sodium and (possibly) potassium (American College of Sports Medicine, 1993). Diuretics are used by body builders prior to competition to dehydrate the skin with the belief that this will make the skin appear tightly stretched over the muscles.

The abuse of such a drug, in addition to fluid restriction and other dehydrating practices, may lead to multiple fluid and electrolyte abnormalities including decreases in serum levels of potassium, sodium and magnesium, and increases in serum levels of uric acid and glucose (American College of Sports Medicine, 1993; Lehne et al., 1994). Hypokalemic, hypochloremic alkalosis may also occur (American College of Sports Medicine, 1993). Adverse serum lipid effects of increased cholesterol, low-density lipoprotein cholesterol, and triglycerides have also been reported (American College of Sports Medicine, 1993; Weinmann et al., 1994). Another potential problem is intravascular volume depletion (hypovolemia), resulting in decreases in cardiac output, renal perfusion, and blood pressure (Kleiner et al., 1990). Futhermore, the abuse of diuretics has been linked with an increased risk in developing renal cell cancer (Weinmann et al., 1994).

Laxatives are used to ease or stimulate defecation (Lehne et al., 1994). Body builders use laxatives prior to competition to prevent abdominal protrusion. Chronic exposure to laxatives can diminish defaectory reflexes, leading to futher reliance on laxatives (Lehne et al., 1994). Laxative abuse may also cause more serious pathologic changes, including electrolyte imbalance, dehydration, malabsorption of nutrients, and colitis (Kleiner et al., 1990).

2.12 Weight loss techniques

Many of the weight loss techniques practiced by body builders are quite extreme and conflict with scientific methods. A study conducted by Kleiner et al., (1990) found nearly all of the subjects (100 percent of the females and 80 percent of the males) changed their diet as they approached competition. Fifty-five percent of the men and seventy-five percent of the women restricted their diets beginning four months to two months before the competition. Energy, fat and fluid restrictions were the primary changes in the dietary preparation for the competition, with the diets becoming extremely rigid as competition day approached. During the pre-competition week, the majority of the subjects drank only distilled water, believing that the salt content of the city water would cause fluid retention. Beginning 2 to 3 days before the event, all subjects reported highly restrictive fluid intakes and were involved in dehydrating practices such as running in rubberised suits, riding a stationary bike in a sauna while wearing a rubberised suit, and expectorating. Most of the subjects weighed-in during registration in a fasted, or nearly fasted state.

A study conducted by Lamar-Hilderbrand et al. (1989) examined the dietary and exercise practices of female body builders. Fluctuations in energy intake were noted among competitors during the data collection period. Before competition, mean energy intake for competitors was lower than the intake at weeks four and seven for non-competitors. Data collected during the eighth week found that competitors followed low-energy diet patterns until after the competition. Fat intake was significantly lower in competitors (11-17%) than non-competitors (27%). No other weight reduction methods were examined in this study.

Other weight loss techniques used by body builders include the use of diuretics and the use of suppressants and caffeine to curb the appetite and stimulate the fatigued athlete (Sandoval et al., 1989; Kleiner et al., 1990; Burke, 1991).

2.13 Validation of literature and methodology.

Most of the research available identifying the dietary practices of body builders has been conducted in America. Very little information describing these practices and the nutrition profiles of Australian body builders is available.

Many of the researchers examining the diet related practices of body builders have used questionnaires and a variety of diet recall techniques to obtain data and information from their subjects. Dietary assessment instruments are important tools in epidemiological studies investigating the relationship of diet and disease, dietary interventions, evaluation of supplemental food programs and a variety of other research areas (Howat et al., 1994). Over the past few decades efforts have been directed toward improving methods of dietary intake assessment (Block, 1982). Since the most accurate method ie direct measurement of food intake is difficult to manage, expensive to administer and time consuming for non-institutionalised individuals, other more appropriate tools must be used (Farris et al., 1985). The most widely used techniques for collecting dietary information include diet history, 24-hour recall, food records (estimated and accurately measured) and food frequency questionnaires (Block, 1982; Farris et al., 1985; Fanelli and Stevenhagen, 1986). These techniques vary in ways of quantifying measurements and in the lengths of time chosen to obtain information (Bingham, 1985).

Although the 24-hour recall method and the estimated one-day food record are minimally demanding upon resources there is still significant controversy related to these method's accuracy and overall validity to the extent to which they represent an individual's habitual food intake (Livingstone et al., 1992; Todd et al., 1993). Todd et al., (1993) conducted an experiment aimed to test the effectiveness of 24-hour recalls and estimated one-day food records compared to 30-day food intake records. These researchers concluded that any dietary assessment method producing results from a one-day dietary record provides a poor estimate of an individual's habitual (30 day) intake. They furthermore, reported

that upon questioning, very few subjects were able to remember accurately the types and amounts of food they had consumed in the previous 24 hours.

The 24-hour recall method can however be adapted to improve accuracy. Farris et al. (1985) found life-size photographs and visual resources representing portion sizes significantly increased the level of accuracy for individuals who were using the 24-hour recall method and the estimated food record method. With the use of multiple 24-hour recalls and estimated food records a more accurate picture of a person's habitual eating pattern can be developed (Fanelli and Stevenhagen, 1986).

There are many disadvantages using these diet recall techniques. The accuracy and validity of data is questionable. Keeping food records places a substantial burden on the subjects and makes them more aware of their food intake, which in turn may reduce their usual intake during the record keeping period or alternatively encourage them to record modestly (Fanelli and Stevenhagen, 1986; Mertz, 1992). Another problem is that the ability to accurately recall foods consumed and the portions eaten is significantly reduced with age (Fanelli and Stevenhagen, 1986). Accuracy is also reduced because people tend to record or recall what they feel the portion size should be according to common social beliefs and values. As an example sugary foods and high fat foods are often under-estimated whereas fruit and vegetable portions are over-estimated (Mertz, 1992). Furthermore, snack eating is difficult to accurately recall after 24 hours due to unconscious picking at food. One-day diet records are however more accurate for representing snacking because the record is kept simultaneously with consumption and therefore snacking is less likely to be overlooked (Livingstone et al., 1992).

Questionnaires are a popular tool used to collect data. The advantages and disadvantages of various types of questionnaire are displayed in Table 2.2.

Table 2.2 A comparison of three modes of data collection.

	Mail	Telephone	Face to Face
Cost	cheapest method per respondent	low to medium cost per respondent	most expensive method per respondent
Coverage	can reach a widely scattered sample	can reach a widely scattered sample, but only those with phones	depends on personal contact
Response Rate	lowest, especially with groups of low socioeconomic status	medium response rate	highest response rate
Standardisation	standardised	standardisation depends on the interviewer	standardisation depends on the interviewer
Privacy for asking sensitive questions	good, least likely to cause embarrassment	some 'anonymity' for giving replies	may be difficult
Probing	does no permit clarification, misunderstanding will go undetected	allows probing, reduces misunder-standing and missing answers	allows for probing, reduces misunder-standing and missing answers
Literacy	require literacy	not restricted by literacy but language skills important	not restricted by literacy but language skills important
Observation	no observation possible	listen to respondent	listen to and watch respondent

Taken from Hawe et al. (1990) page 139.

Many of the studies examining the dietary practices of body builders use competitive body builders. As mentioned previously, the diet of a competitive body builder changes in the lead up to competition. The stage at which data are collected in the body builder's training year is therefore very important to identify. Other down falls of many of the

studies examining dietary practices of body builders include drug and supplement use not being examined thoroughly. It is important to identify specific supplements being used by body builders to know the sources of various nutrients.

Limitations within the methodology used in these studies include small sample sizes, food records only kept for short periods and measurement inaccuracies (Tarnopolsky et al., 1992; Kleiner et al., 1990; Sandoval et al., 1989; Goranzon and Forsum, 1985). Not withstanding these limitations, this author believes valuable information can be obtained about the manner in which amateur body builders obtain information related to nutrition practices and the way in which the information is applied in dietary behaviours.

CHAPTER 3: METHODOLOGY

3.1 Methodology overview

Thirty two body builders (five females and twenty seven males) from five gymnasia within the Illawarra region volunteered to participate in this study. Eight of these body builders were competitive and the remaining twenty four did not compete in body building.

Gymnasia were selected on the basis that they had body building members training at their gymnasium.

The manager of the each gymnasium involved in this study was contacted by telephone prior to data collection. An appointment was made with each manager, where a letter of introduction was tendered(refer to Appendix I). This letter explained the aim of the study, the role of the manager during data collection, the role of participating body builders and provided contact telephone numbers of the researcher and the supervisor of this study. The manager of each gymnasium liaised with the researcher in recruiting the participants for this study. The mode of data collection was hand distributed questionaries to a selected sample. This mode of data collection has similar qualities to mail surveys (refer to Table 2.2) The body builders who volunteered participate in this study were notified with a covering letter (refer to Appendix II), attached to the questionnaire (refer to Appendix IV), detailing their involvement in the study.

A three page self-administered questionnaire consisting of fourteen multiple choice and close-ended questions was used to investigate the following issues:

* To identify the major sources, used by body builders, for obtaining nutrition information.
* To determine the ease of access to the information.

* To identify diet related practices of amateur body builders.
* To determine the diet related practices resulting from the information gained.
* To determine whether there is a need for an educational resource targeting nutrition for amateur body builders.

The major components of the questionnaire are briefly described.

Dietary practices. Three items on the questionnaire assessed current and previous diet related practices and how nutrition information influenced these practices. This section included questions investigating supplement and drug use, dietary changes made since starting body building, and how they used nutrition information to change their diet.

Nutrition Information. Six items on the questionnaire related to nutrition information. Information obtained from these questions included the major sources from which the subjects obtained nutrition information and those which influenced their dietary habits, the ease of access to this information (ie ease to read, understand and implement), and whether there was sufficient information available relevant to their needs and interests or whether there was a need for more information targeting the needs of body builders.

Demographic. The last five questions on the questionnaire were used to investigate the demographics of this group of body builders. Questions related to the subject's age, level of education, gender and length and type of involvement (ie whether competitive) within body building.

The data were collected in five different gymnasia within the Illawarra region over a three week period beginning six weeks prior to a local competition.

Informed consent was obtained from each subject, with parental consent for any subjects under eighteen years of age. Refer to Appendix III for the consent form. The protocol for this investigation was approved by the Human Ethics Committee at the University of Wollongong.

In order to protect the privacy of participants and participating gymnasia, no names were recorded on the questionnaires and a sealable envelope was supplied to each participant for the completed questionnaire. A box was provided to each gymnasia by the researcher for returned surveys and consent forms which had been completed.

3.2 Method of analysis

Data were sorted and displayed using Macintosh Excel and Stat View 512+ and were reported in simple frequency distribution tables. Simple statistical comparisons of frequency were made for most of the results. The chi squared statistic was used to compare responses between the subgroups of noncompetitive and competitive body builders through analysis of contingency tables. The chi square test requires that each expected frequency should not be "too small". The statistical literature has not achieved unanimity on what constitutes as "too small" (Concover, 1980), but it is generally agreed that any values less than one is definitely too small. In several situations, expected frequencies were less than one, and consequently the chi square test could not be performed. Responses were considered to be statistically significant if $p < 0.05$.

Chapter 4: RESULTS

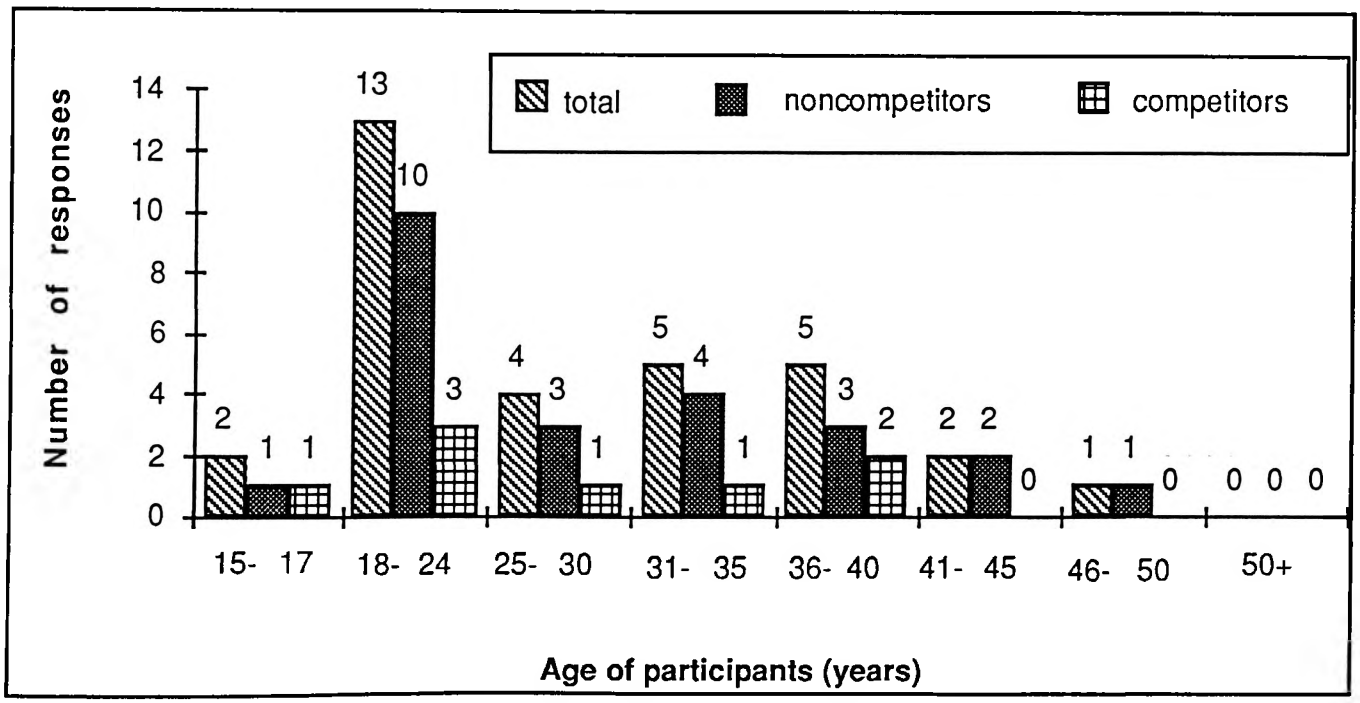
4.1 Demographics

The sample consisted of 32 amateur body builders attending gymnasiums within the Illawarra region. Of the 32 respondents 27 (84.5%) were male and five (15.5%) were female.

Seventy five percent (n=24) were noncompetitive body builders and the remaining 25 percent (n=8) were competitive body builders.

The respondents' ages ranged from 15 to 50 years. Sixty percent (n=19) of the respondents were less than 31 years of age. Refer to Figure 4.1.

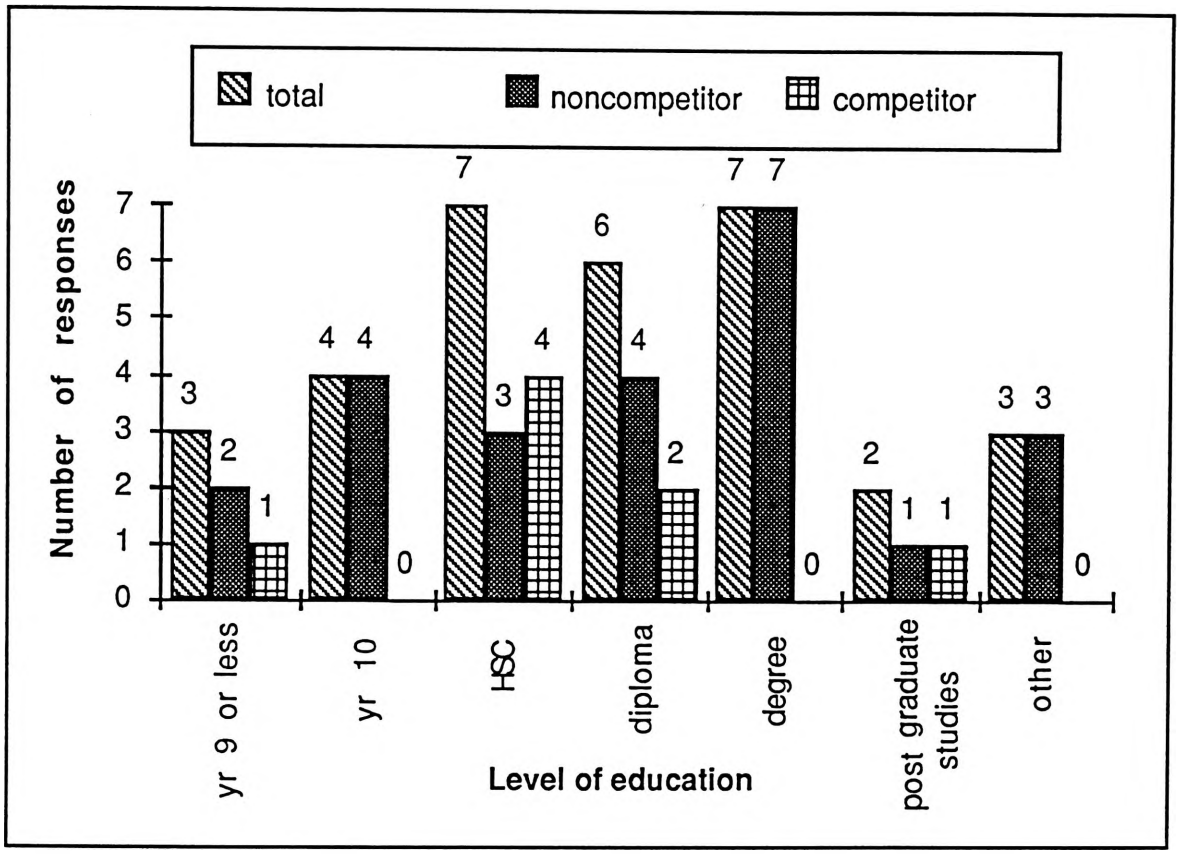
Figure 4.1. Age distribution of respondents.



Sixty nine percent (n=22) of the respondents had either completed the higher school certificate (HSC) or tertiary education. Thirty one percent of the respondents (n=10), had

ceased formal education before year 11 at secondary school (this result includes the three responses to "other" which included two respondents ceasing formal education after year 11 and one respondent ceasing formal education after completing an intermediate certificate). These results are represented in Figure 4.2.

Figure 4.2. Level of Education.

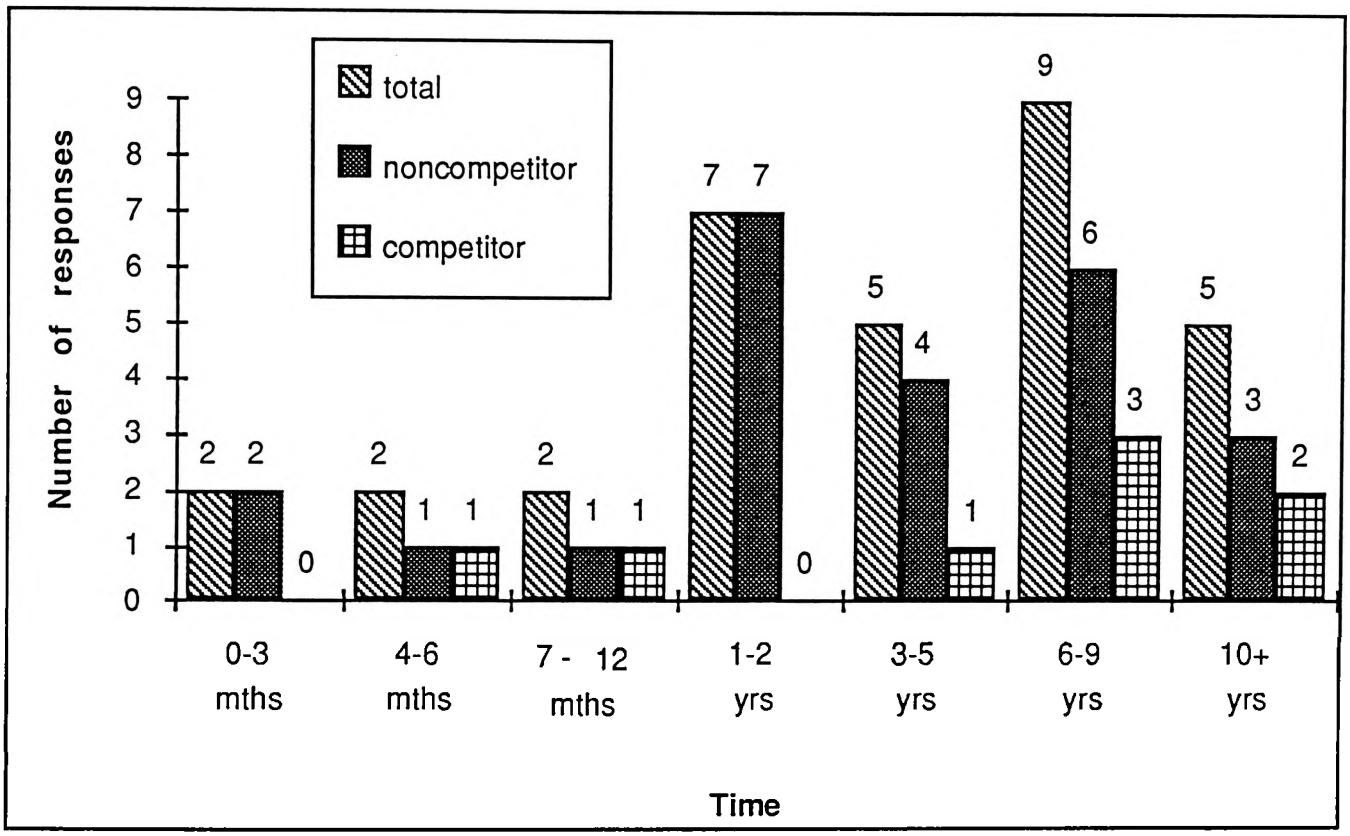


*HSC = Higher school certificate.

4.1.1 Length of time involved in body building

The length of time the respondents had been involved in body building ranged from less than one month to greater than ten years. However, 81 percent of the respondents (n=26) had been involved in body building for longer than one year. Refer to Figure 4.3.

Figure 4.3. Length of time involved in body building.

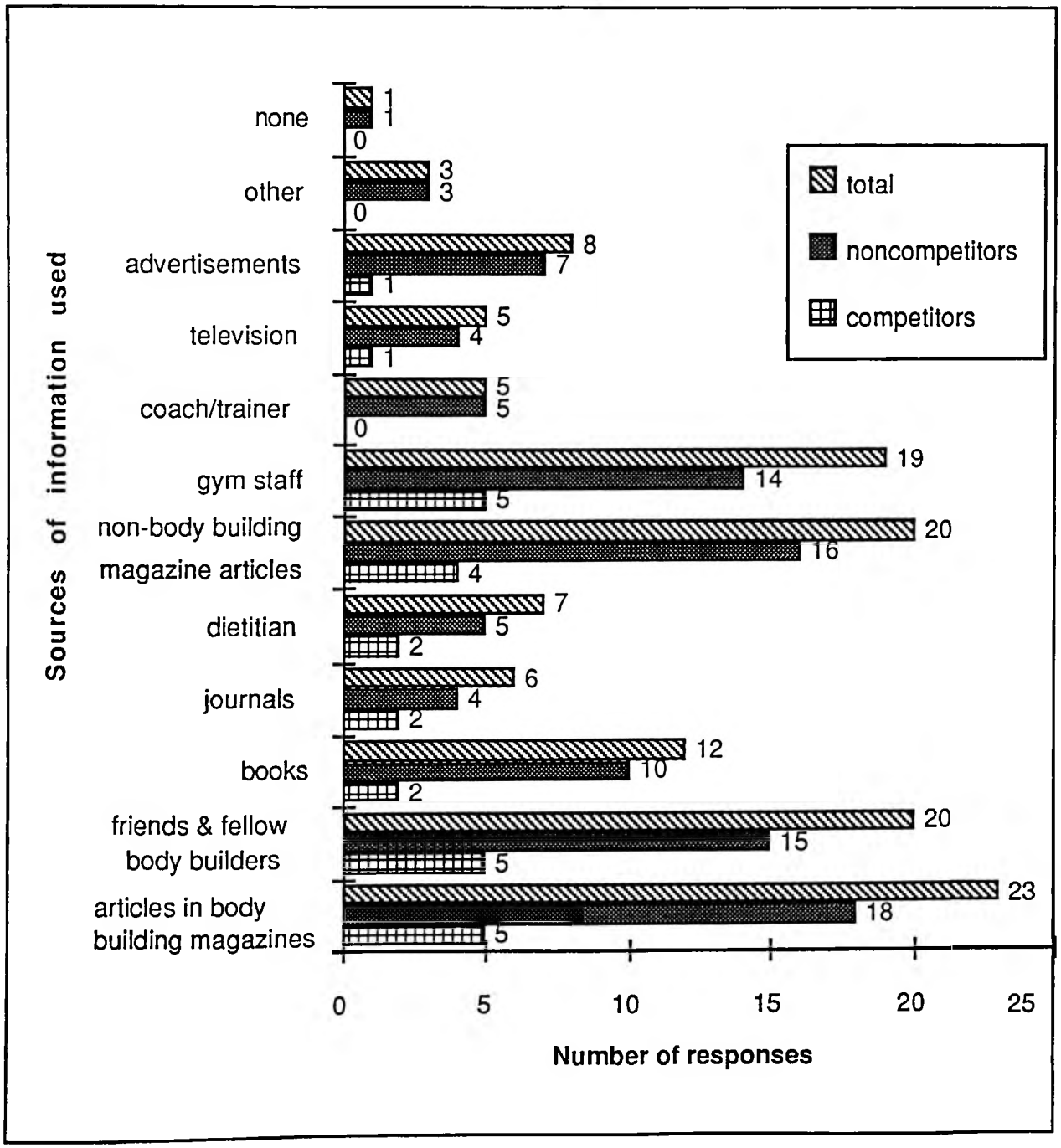


4.3 SOURCES OF NUTRITION INFORMATION

4.3.1 Sources of nutrition information used

Respondents were asked to report all the sources which they used to obtain nutrition information. Figure 4.4 illustrates these results.

Figure 4.4. Sources of information used by respondents.



Articles in both body building magazines and non-body building magazines, friends and fellow body builders, and gym staff were the sources of nutrition information most often used in this population of body builders. The sources used less frequently included journals, a dietitian, the television, advertisements and a coach/trainer. Three respondents chose the "other" option. When asked to specify which other source(s) they received most of their nutrition information the three responses included "trial", "health food outlets" and "How my body responds to it. If it feels good".

4.3.2 Effect of nutrition information on respondent's diet

Respondents were asked if the sources of nutrition information they used influenced them to make changes to their diets. Figure 4.5 displays the response to this question.

Figure 4.5. Effect of nutrition information on respondent's diet.

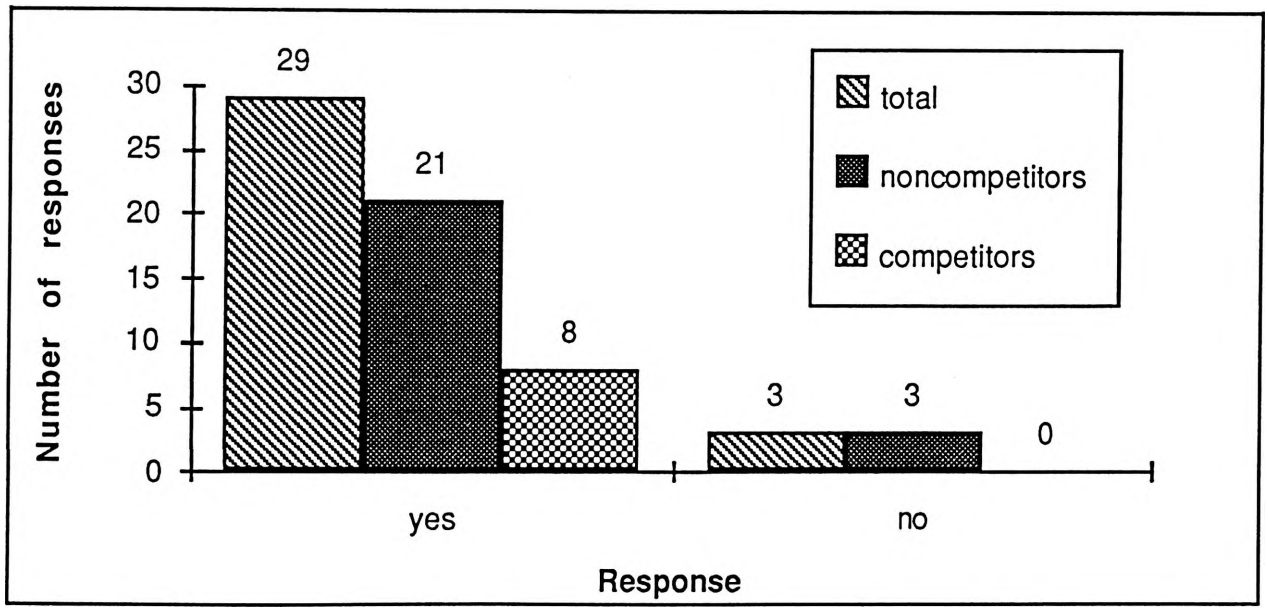


Figure 4.5 indicates ninety one percent of the thirty two respondents claimed nutrition information influenced their diet related practices. Due to a very small expected frequency the chi square test could not be used to test for a significant association between noncompetitive and competitive body builders and whether nutrition information received influenced them to make dietary changes.

Respondents were then asked to rank in order of which sources influenced their dietary practices the most, the sources of information listed in Figure 4.5. Table 4.1 displays the number of responses in which grouped sources of nutrition information were given a first preference (as being the most influential in relation to dietary changes). This question was not answered by all respondents so the total number of responses in Table 4.1 does not add up to thirty two. Using the chi square test it was found that there was not a significant difference (X^2=2.844; d.f=1; p=0.0917) between competitors and noncompetitors in their ratings of the most influential sources (ie articles in body building magazines, articles in other magazines, friends and fellow body builders and gym staff). Nor was there a significant difference between competitors and noncompetitors in their ratings of all other sources (X^2=2.987; d.f.=1; p=0.084)

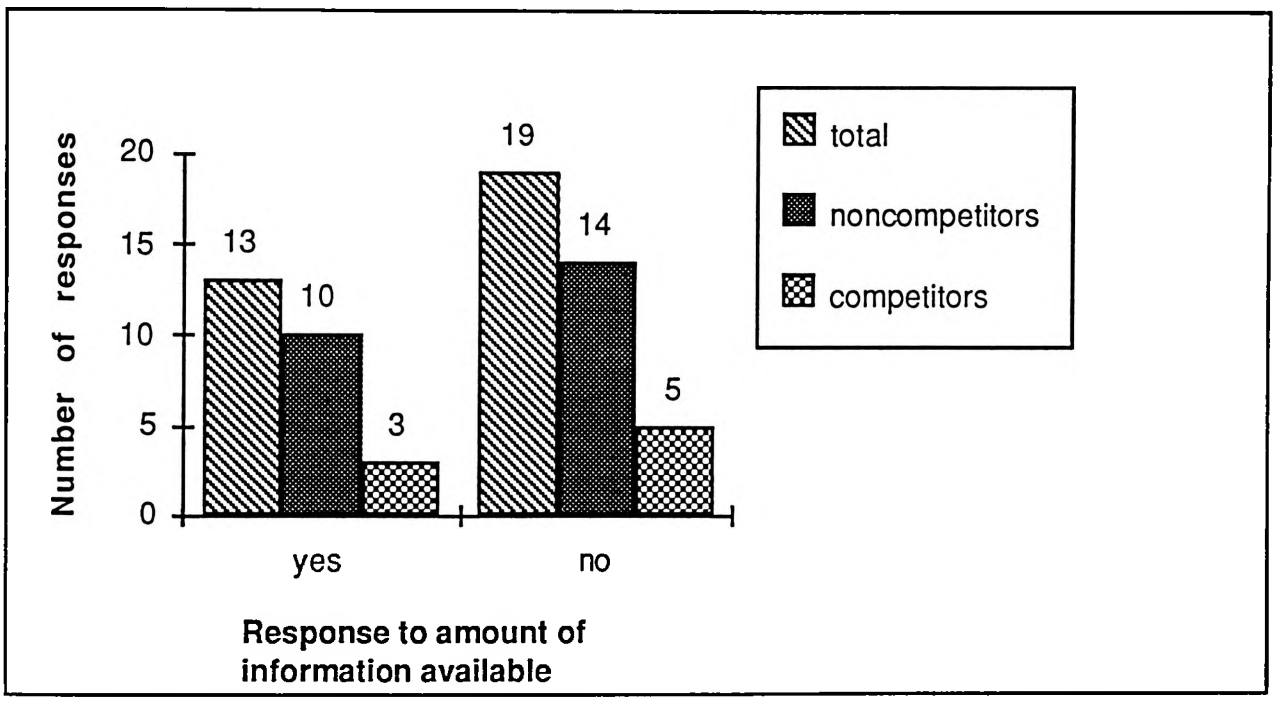
Table 4.1 Sources ranked as most influential to dietary practices

Sources	Number of responses (noncompetitors)	Number of responses (competitors)
* articles (body building magazines) * articles (other magazines) * friends and fellow body builders * gym staff	13	7
* books * journals * dietitian * coach/trainer * television * advertisements	7	0

4.3.3 Availability of information

Fifty nine percent (n=19) of the thirty two respondents considered there was an insufficient availability of nutrition information and the remaining forty one percent (n=13) considered there was sufficient information relating to the dietary needs of body builders. Refer to Figure 4.6 for these results.

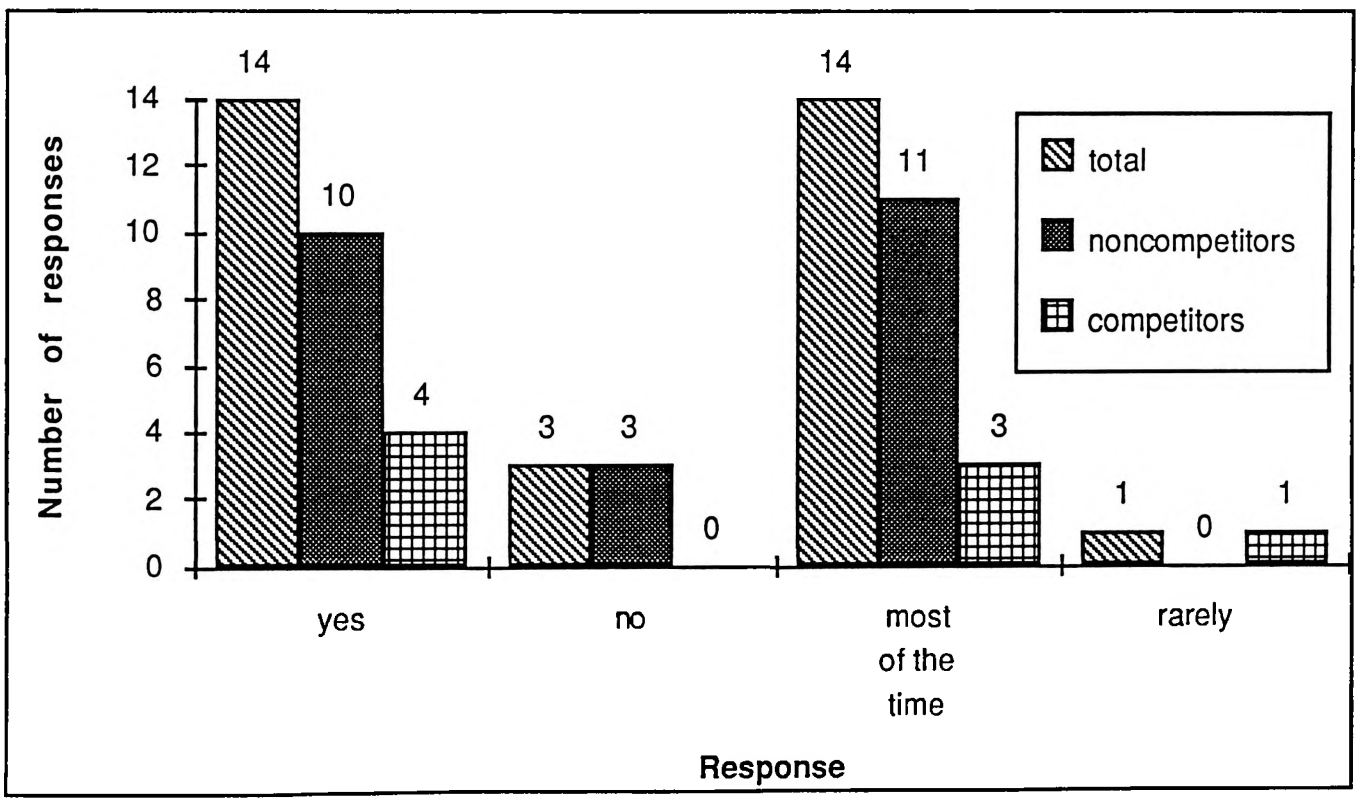
Figure 4.6. Availability of information.



4.3.4 Understanding of information

The respondents were asked more specifically about the sources of information available. It was found that eighty eight percent of the respondents reported they either always understood the nutrition information or they understood the information most of the time. Three of the respondents (9 percent) claimed that they could not understand the information available. One respondent claimed that the nutrition information was rarely understandable. This information is represented in Figure 4.7.

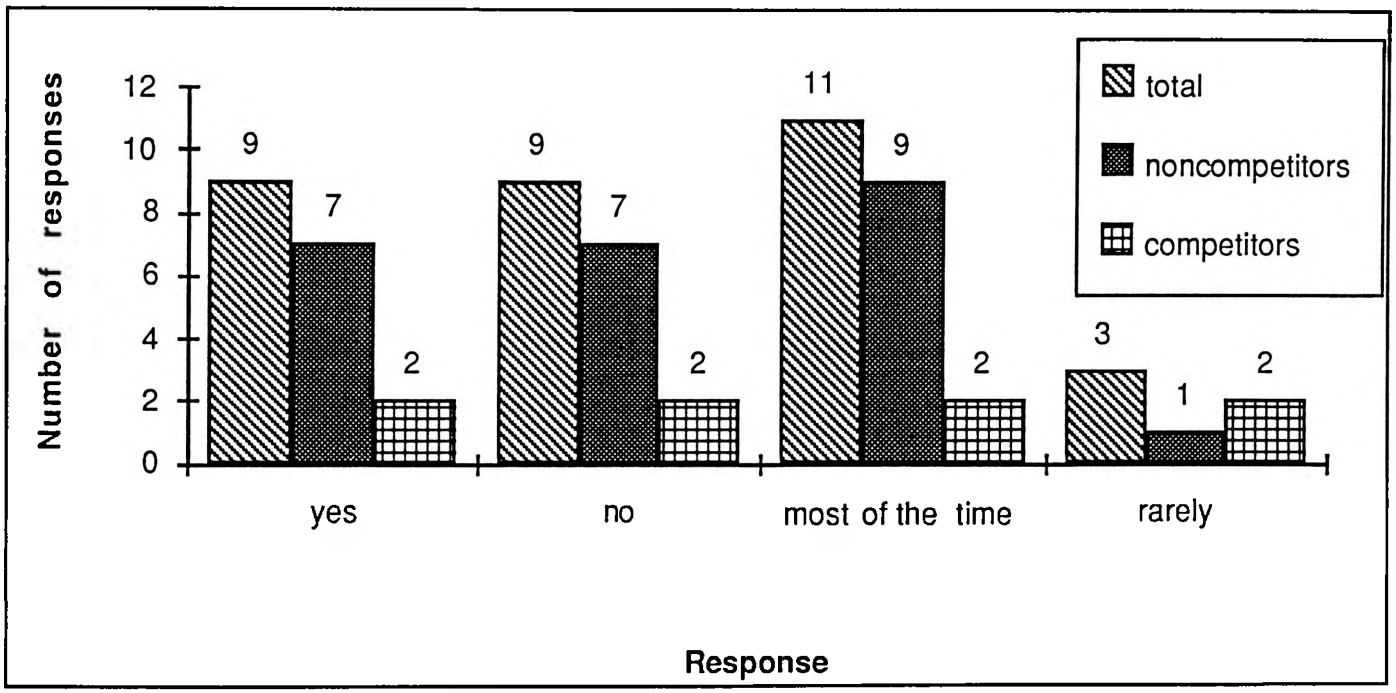
Figure 4.7. Understanding of information.



4.3.5 Interest in topics covered in the sources of information

Of the 32 respondents 28 percent (n=9) found the topics covered in the sources of nutrition information interesting and 34.5 percent (n=11) found the topics interesting most of the time. Twenty eight percent (n=9) of the respondents reported they found the topics covered were not interesting and the remaining 9.5 percent claimed they rarely found the topics interesting. This information is displayed in Figure 4.8.

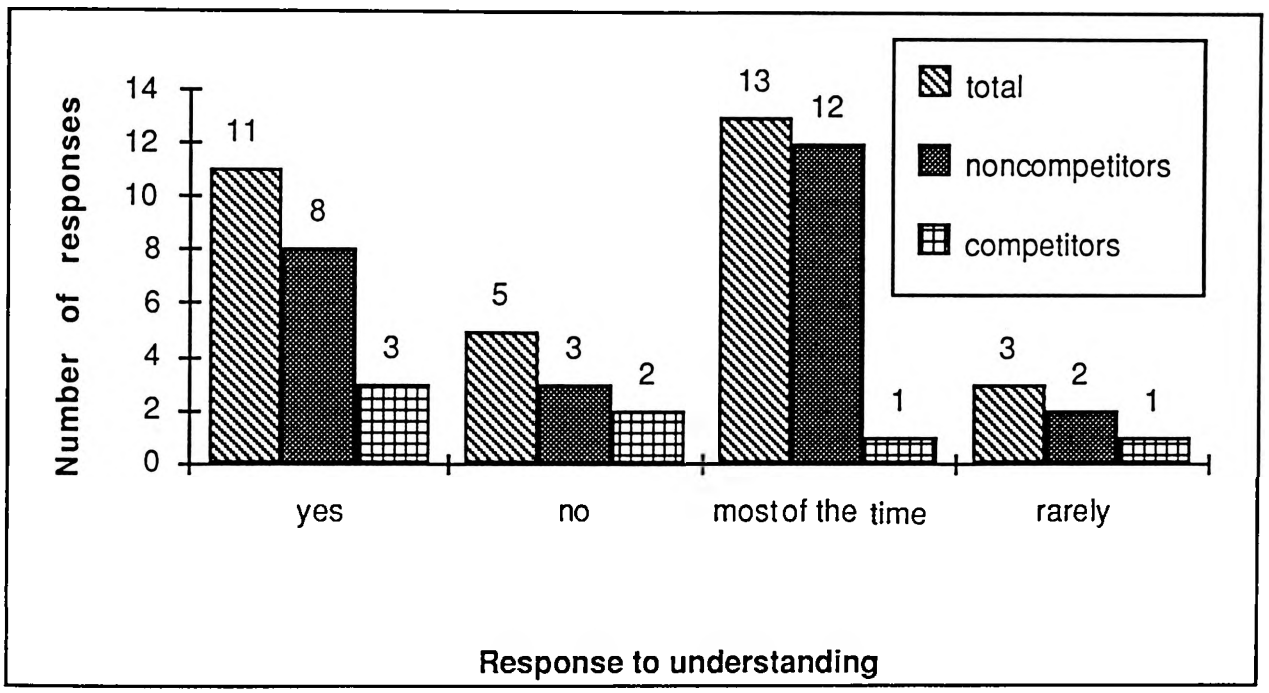
Figure 4.8. Interest in topics.



4.3.6 Understanding of words used

In this sample three quarters of respondents found the words used in the sources of nutrition information either easy to understand (34.5 percent) or understandable most of the time (40 percent). The remaining eight respondents found the words difficult to understand (16 percent) or difficult to understand most of the time (9.5 percent). Refer to Figure 4.9.

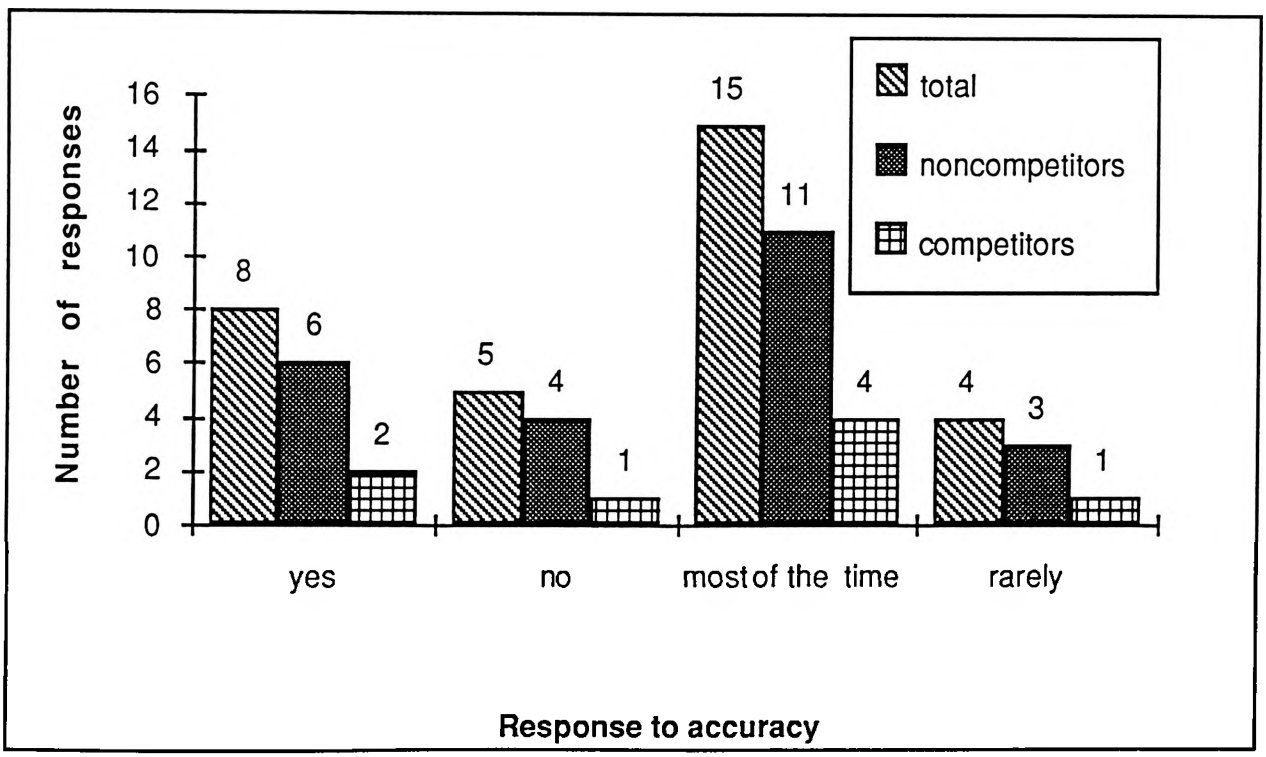
Figure 4.9. Understanding of words.



4.3.7 Accuracy of information.

Respondents were asked to choose one of the four options provided which best described the accuracy of information found in the various sources of nutrition information. One quarter of the respondents (n=8) said the information was accurate while 47 percent (n=15) found the information accurate most of the time. Of the remaining 28 percent (n=9), five respondents (16 percent) reported the information was inaccurate and four respondents rarely found the information accurate. This information is presented in Figure 4.10.

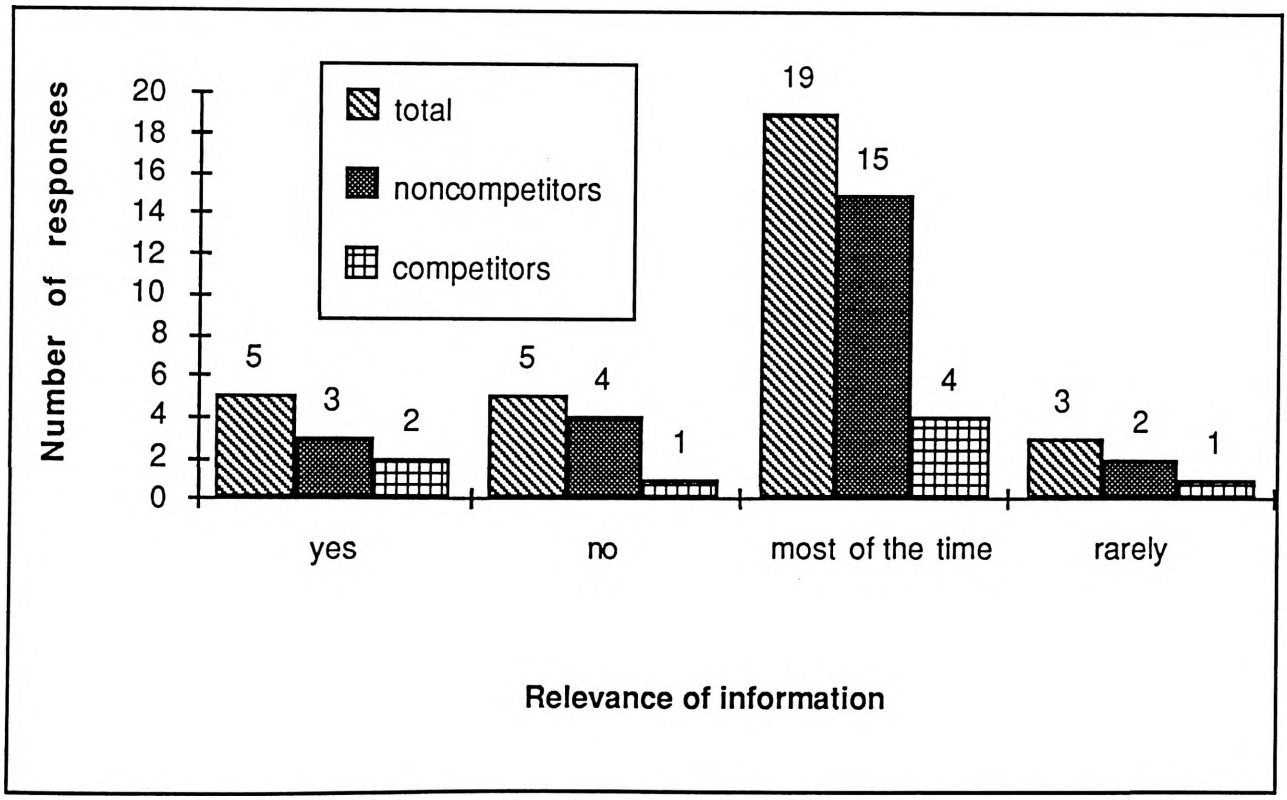
Figure 4.10. Accuracy of information



4.3.8 Relevance of information

Respondents chose one of four answers which best described the relevance of information to their own dietary needs. An equal number of respondents reported that the information was relevant to their dietary needs (n=5; 16 percent) as reported that the information was not relevant to their dietary needs (n=5; 16 percent). The majority of respondents (n=19; 59 percent) reported that the information was relevant to their dietary needs most of the time. The remaining 9 percent (n=3) claimed the information was rarely relevant. This information is represented in Figure 4.11.

Figure 4.11. Relevance of information.



4.3.9 Areas of interest

Respondents were asked to rank a list of eight diet related topics in order of most interesting to least interesting. There was also an option of "other" provided in case the respondents had any other topics they were especially interested in. An option of "none" was also provided. One respondent responded to "other". This respondent was interested in information regarding "eating before training to increase energy". One respondent chose the "none" option.

The highest ranked topics included protein requirements, carbohydrate requirements and fat loss techniques. Table 4.2 displays the number of responses in which each topic was given a first, second or third preference.

Table 4.2 Topics ranked as top three preferences

topic	number of responses (noncompetitors)	number of responses (competitors)
supplements	3	0
bulking techniques	4	4
sample diets/ meal plans	4	0
protein requirements	16	5
carbohydrate requirements	18	4
energy requirement	7	4
recipes	3	1
fat loss techniques	8	8

The chi square test was used to determine whether there was a significant difference between the responses of the competitive and noncompetitive body builders. A significant difference was not found when analysing the responses of competitive and noncompetitive body builders for the following topics: bulking techniques (chi square: X^2=3.556;.d.f=1; p=0.0593), sample diets (chi square: X^2=1.524; d.f=1; p=0.217), protein requirement (chi square: X^2=0.046; d.f=1; p=0.8299), carbohydrate requirement (chi square: X^2=1.745; d.f=1; p=0.1864), energy requirement (chi square: X^2=1.154; d.f=1; p=0.2826) and recipes (chi square: X^2=0; d.f=1; p=1). A significant difference was found between the responses of the competitive and noncompetitive body builders for the topic "fat loss techniques" (chi square: X^2=10.667; d.f=1; p=0.0011). The proportion of responses was significantly higher for competitive body builder for reporting an interest in this topic. The chi square test could not be used to test for a significant difference for the topic "supplements" due to a very small expected frequency.

4.4 DIET RELATED PRACTICES

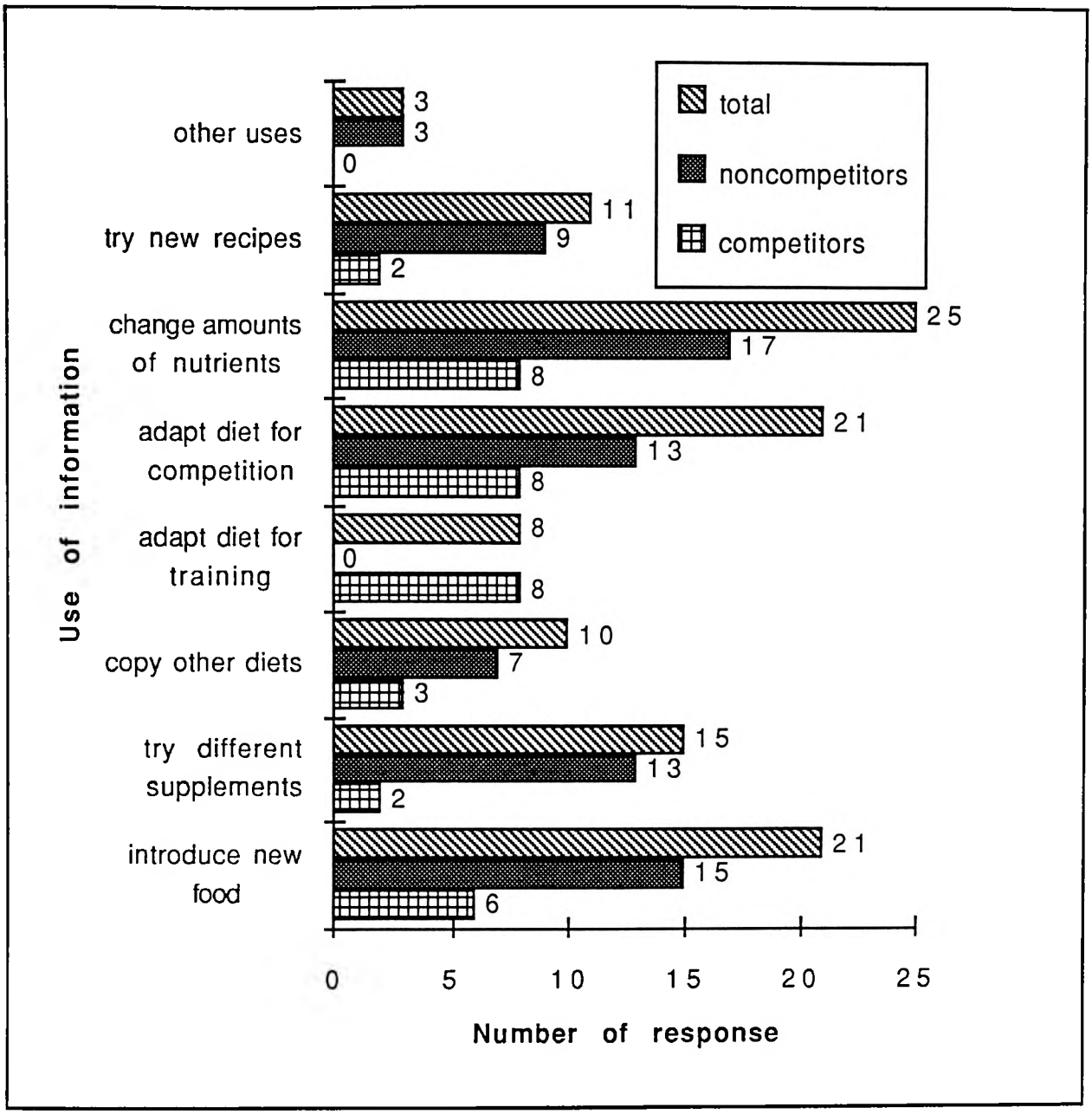
4.4.1 Use of information

Respondents were asked to report how they used nutrition information to change their diet. A choice of eight options was provided. One of the eight choices was an "other" option so any uses other than the seven options could be reported. Figure 4.12 displays these results.

The most popular uses of the nutrition information received by the respondents included changing the amounts of nutrients (ie carbohydrate, protein and fat) in their diet, introducing new foods into their diet and adapting their diet for training. All of the competitive body builders reported using nutrition information to change their diet for competition. Three respondents chose the "other" option. These respondents also used the information to reduce the amount of fat in their diet, replace processed foods with "more natural foods" and, adapt eating times. No respondents chose the "none" option.

The chi square test was used to test if there was a significant difference between the responses from the two sub-groups. There was no significant difference between noncompetitors and competitors in the use of nutrition information for any of the following: introducing new foods (X^2=0.416; d.f=1; p=0.5191), trying different supplements (X^2=2.05; d.f=1; p=0.1522), copying other's diets/meal plans (X^2=0.194; d.f=1; p=0.6597), trying new recipes (X^2=0.416; d.f=1; p=0.5191), and changing the amount of nutrients in their diet (X^2=2.987; d.f=1; p=0.084). There was a significant difference between noncompetitors and competitors using the information to change their diet for training (X^2=5.587; d.f=1; p=0.0181). Competitive body builders were more likely than noncompetitive body builders to use the nutrition information they received to change their diet for training.

Figure 4.12. Use of information



Supplement and drug use

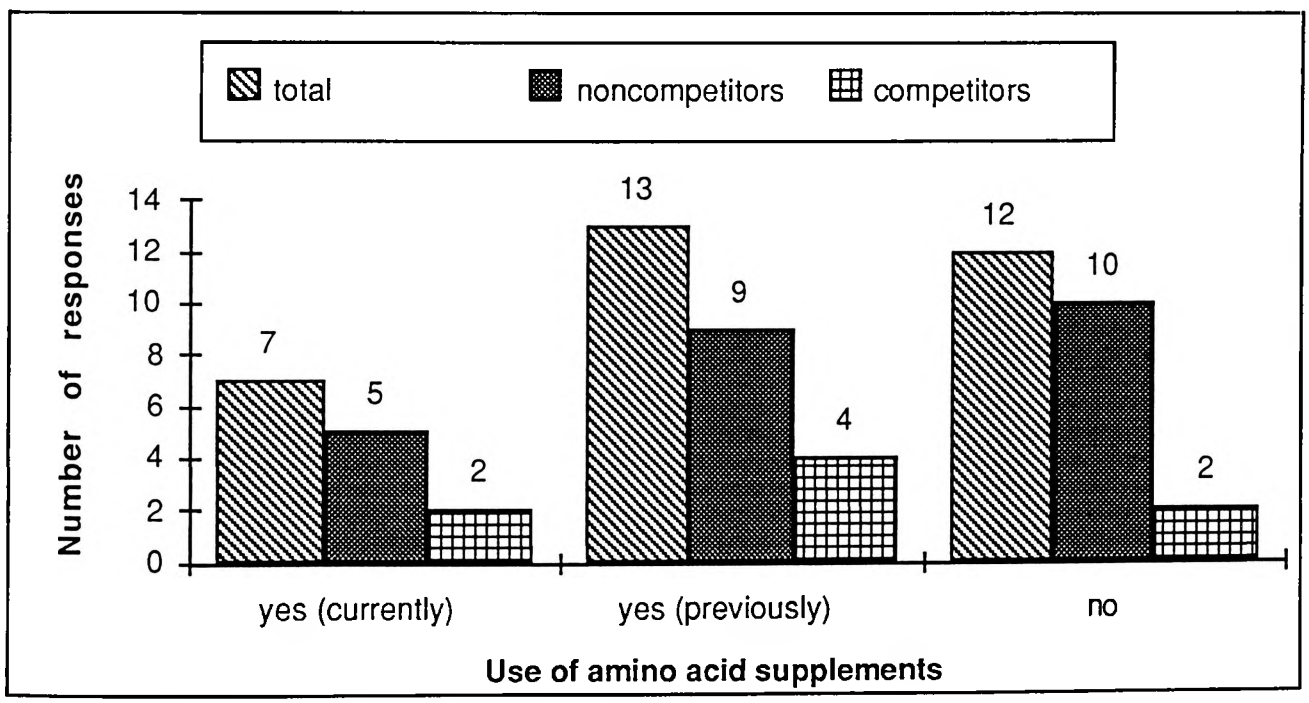
One of the questions in the survey was designed to investigate the use of a number of supplements, ergogenic aids and drugs. To each supplement, ergogenic aid or drug the respondent was provided with three choices examining their usage, these included "yes currently", "yes previously" and "no". The chi square test was used to test if there was any significant difference between the proportions of responses from noncompetitive and competitive body builders. In the contingency tables the "usage" factor consisted of two

levels. The first level was if the respondent had used the particular supplement, ergogenic aid or drug either previous to the time the study was conducted or whilst the study was conducted, and the second level was those who had never tried the particular substance.

4.4.2 Use of amino acid supplements

Of the thirty two respondents, 62.5 percent (n=20) were either using amino acid supplements at the time the survey was conducted (n=7; 22 percent) or had previously used these supplements (n=13; 40 percent). The remaining twelve respondents (37.5 percent) reported that they had never used amino acids supplements. These results are displayed in Figure 4.13.

Figure 4.13. Use of amino acid supplements

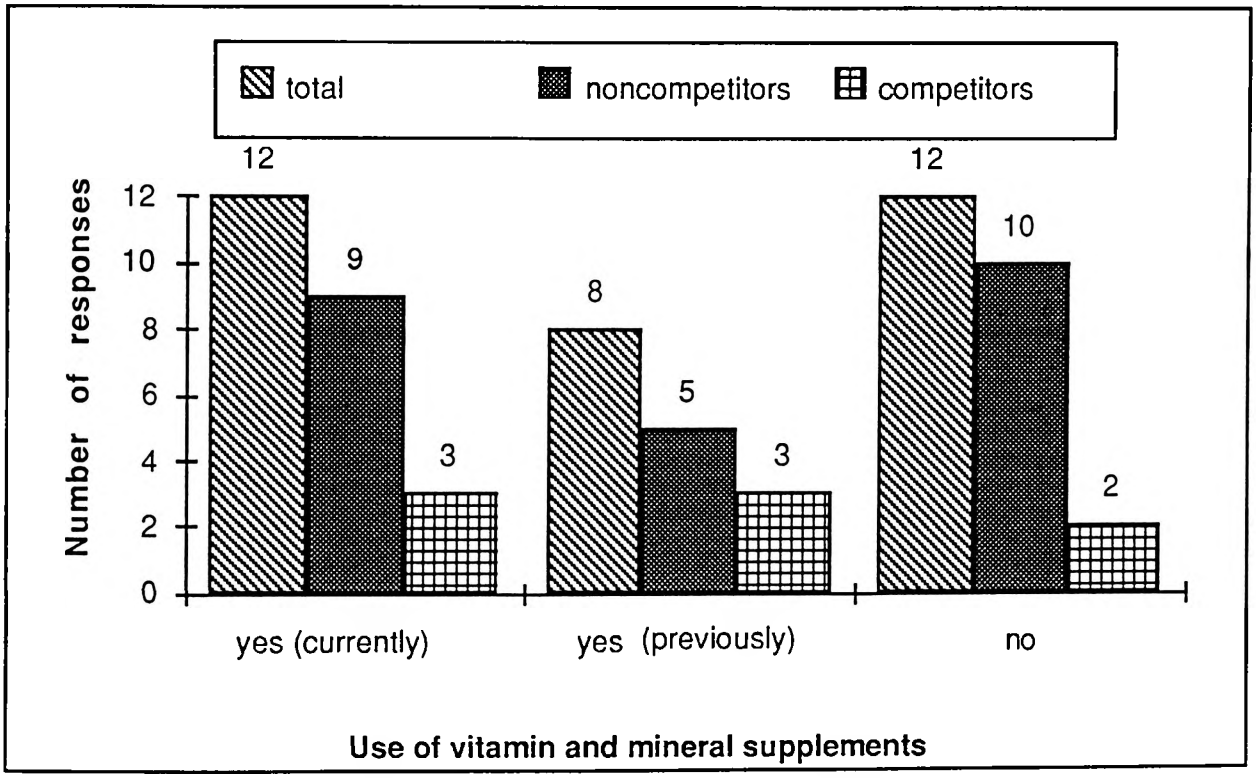


Using the chi square test it was found that there was not a significant difference between the use of amino acid supplements by competitive and noncompetitive body builders (X^2=0.711; d.f=1; p=0.3991).

4.4.3 Use of vitamin and mineral supplements

The majority of respondents (62.5 percent; n=20) were either using vitamin and mineral supplements at the time of the survey (37.5 percent; n=12) or had used these supplements in the past (25 percent; n=8). The remaining 37.5 percent (n=12) of the respondents had never used vitamin and mineral supplements. Figure 4.14 illustrates these results.

Figure 4.14. Use of vitamin and mineral supplements.

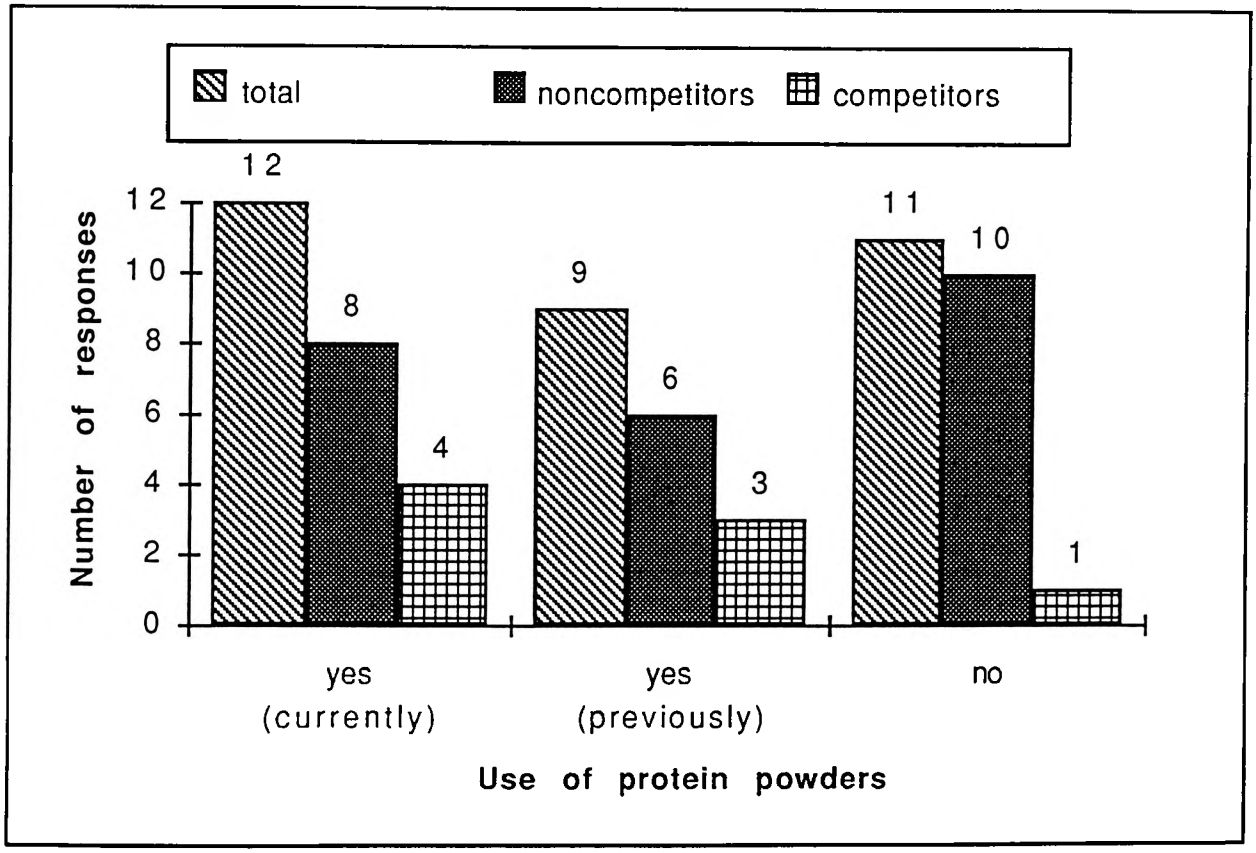


Using the chi square test, it was found that there was not a significant difference between the use of vitamin and mineral supplement by competitive and noncompetitive body builders (X^2=0.711; d.f=1; p=0.3991).

4.4.4 Use of protein powder supplements

Sixty six percent of the respondents (n=21) had either used protein powders in the past (28 percent; n=9) or were using protein powders at the time of the survey (38 percent; n=12). Of the thirty two respondents only 34 percent (n=11) had never used protein supplements. This information is presented in Figure 4.15.

Figure 4.15 Use of protein powder supplements

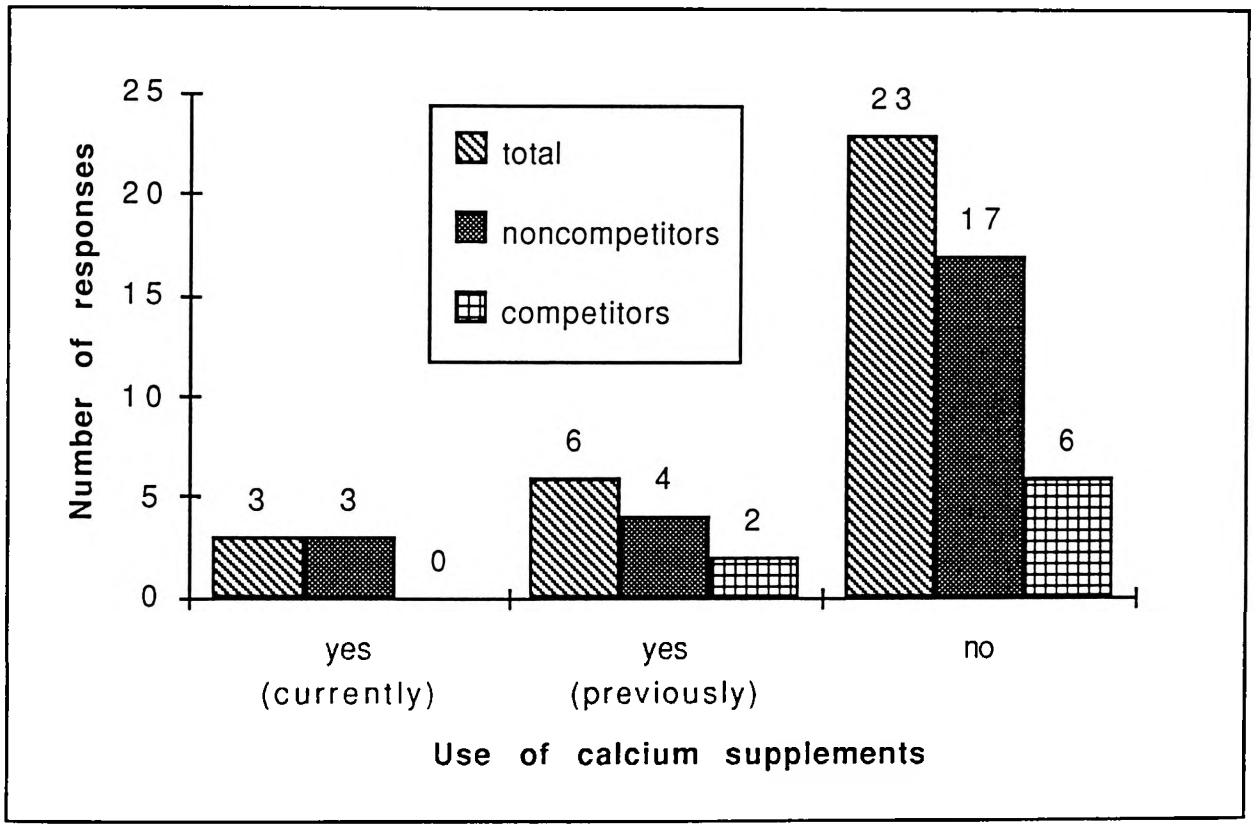


There was not a significant difference found between the use of protein powders by noncompetitive and competitive body builders (chi square: X^2=2.263; d.f=1; p=0.1325).

4.4.5 Use of calcium supplements

The majority of respondents (72 percent; n=23) reported that they had never used calcium supplements. Nine percent (n=3) of the respondents were using calcium supplements at the time of the survey and the remaining 19 percent (n=6) of the respondents reported the use of calcium supplements in the past. Figure 4.16 illustrates these results.

Figure 4.16. Use of calcium supplements

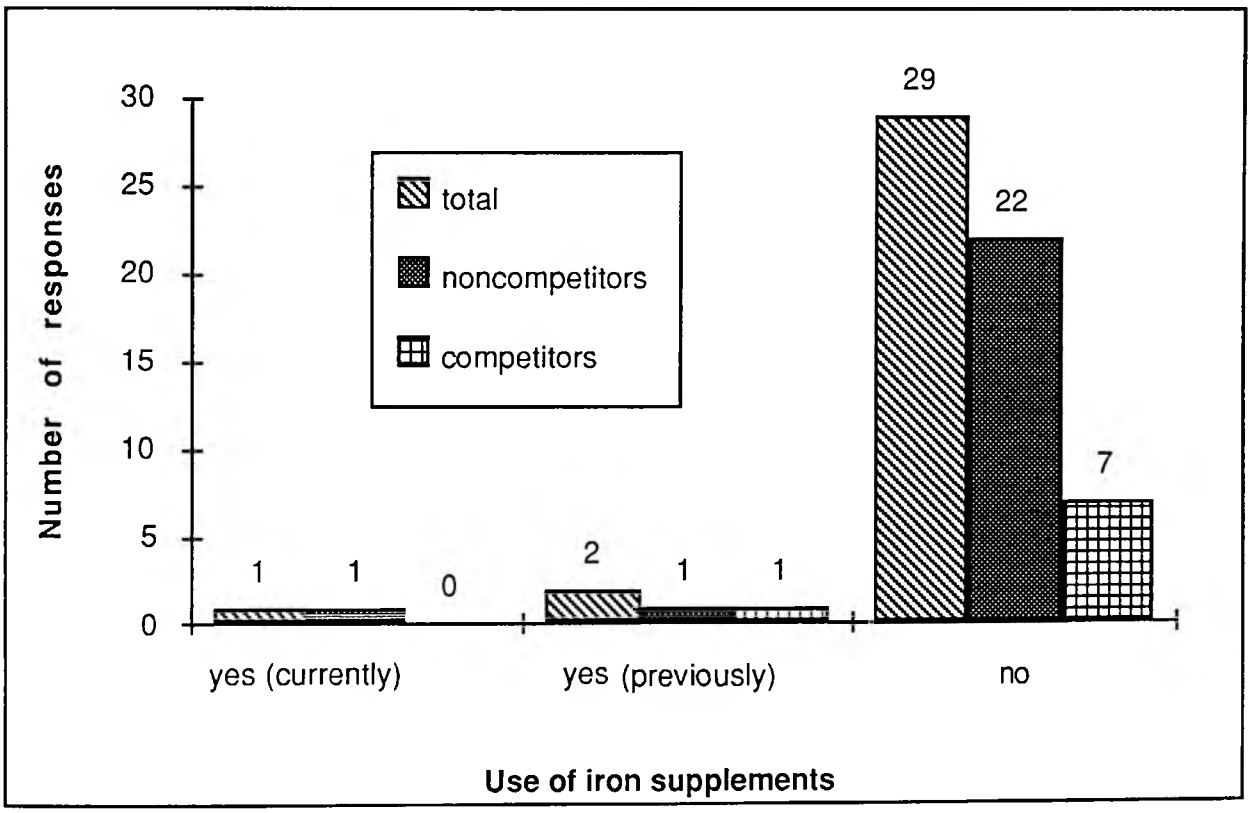


Using the chi square test it was found that there was no significant difference between the use of calcium supplements by the two subgroups (competitive and noncompetitive body builders) (X^2=0.052; d.f=1; p=0.8204).

4.4.6 Use of iron supplements

Ninety one percent of the respondents (n=29) reported that they had never used iron supplements. Only one respondent (3 percent) reported the use of iron supplements at the time of the survey. The remaining two respondents (6 percent) reported they had previously used iron supplements. This information is displayed in Figure 4.17.

Figure 4.17. Use of iron supplements

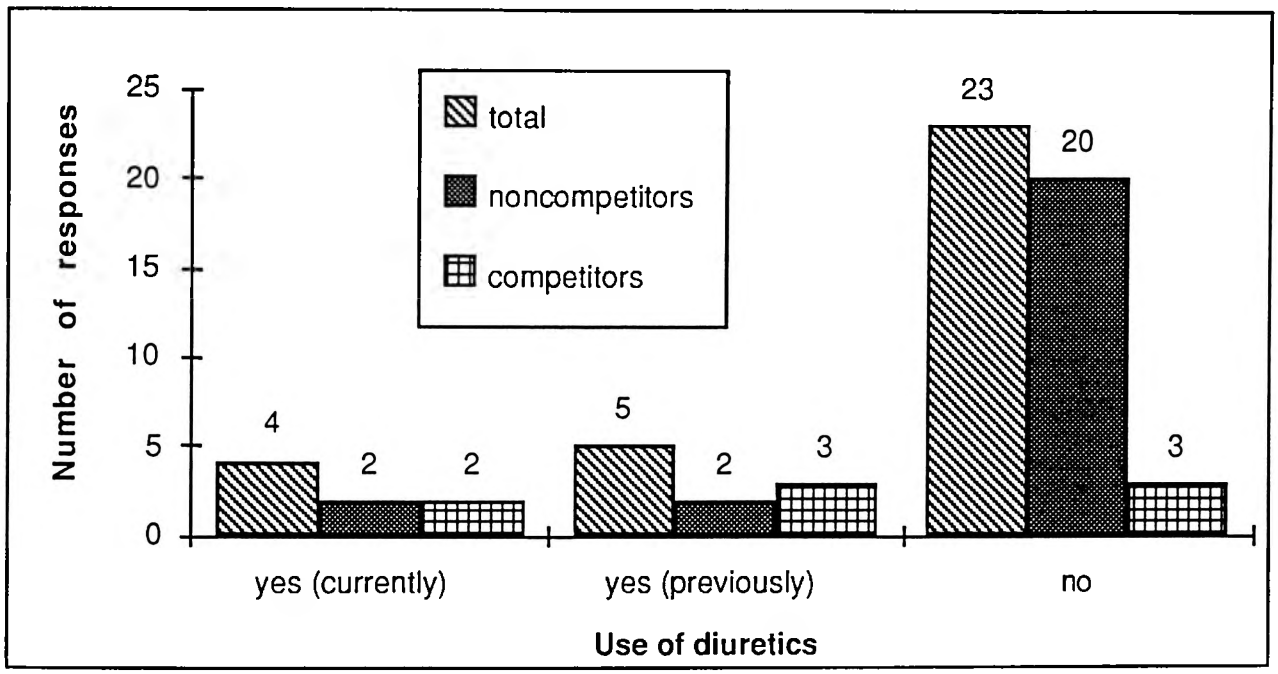


The chi square test could not be used to test if there was a significant difference between the use of iron supplements by noncompetitive and competitive body builders due to two of the expected frequencies being too small.

4.4.7 Use of diuretics

Twenty eight percent of the respondents (n=9) reported that they had either used diuretics previously (16 percent; n=5) or were using diuretics at the time the survey was conducted (12 percent; n=4). The majority of respondents (72 percent; n=23) claimed they had never used diuretics. Refer to Figure 4.18 for an illustration of these results.

Figure 4.18. Use of diuretics.

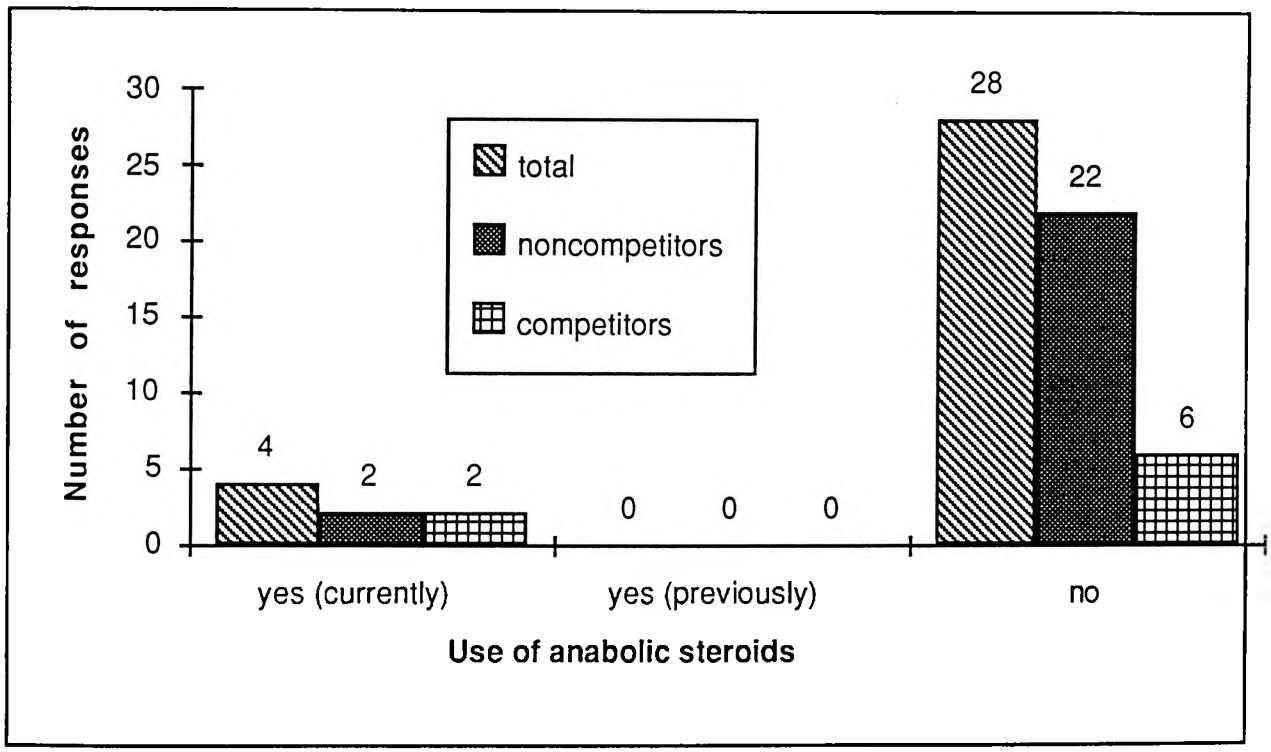


A significant difference was found between the use of diuretics by noncompetitive and competitive body builders (chi square: X^2=6.235; d.f=1; p=0.0125). Diuretic use was more prevalent in competitive body builders.

4.4.8 Use of anabolic steroids

Eight seven and a half percent of the respondents (n=28) reported that they had never used anabolic steroids. The remaining 12.5 percent (n=4) reported that they were using anabolic steroids at the time the survey was conducted. No respondents reported previous use of anabolic steroids. This information is represented in Figure 4.19.

Figure 4.19. Use of anabolic steroids

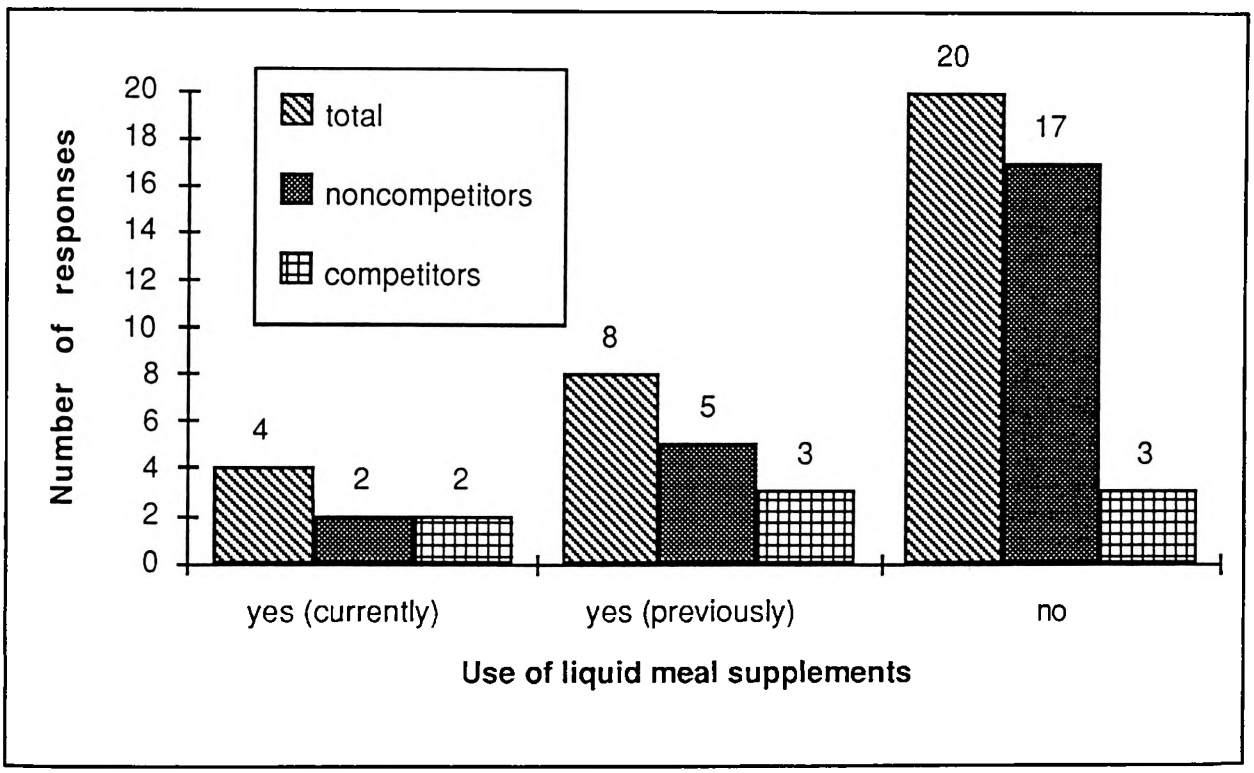


Using the chi square it was found there was not a significant difference between anabolic steroid use by competitive and noncompetitive body builders (X^2=1.524; d.f=1; p=0.217).

4.4.9 Use of liquid meal supplements

Only 37.5 percent of the respondents (n=12) reported that they had either used liquid meal supplements in the past (25 percent; n=8) or were using them at the time this survey was conducted (12.5 percent; n=4). The majority of the respondents (62.5 percent; n=20) reported that they had never used liquid meal supplements. Refer to Figure 4.20.

Figure 4.20. Use of liquid meal supplements

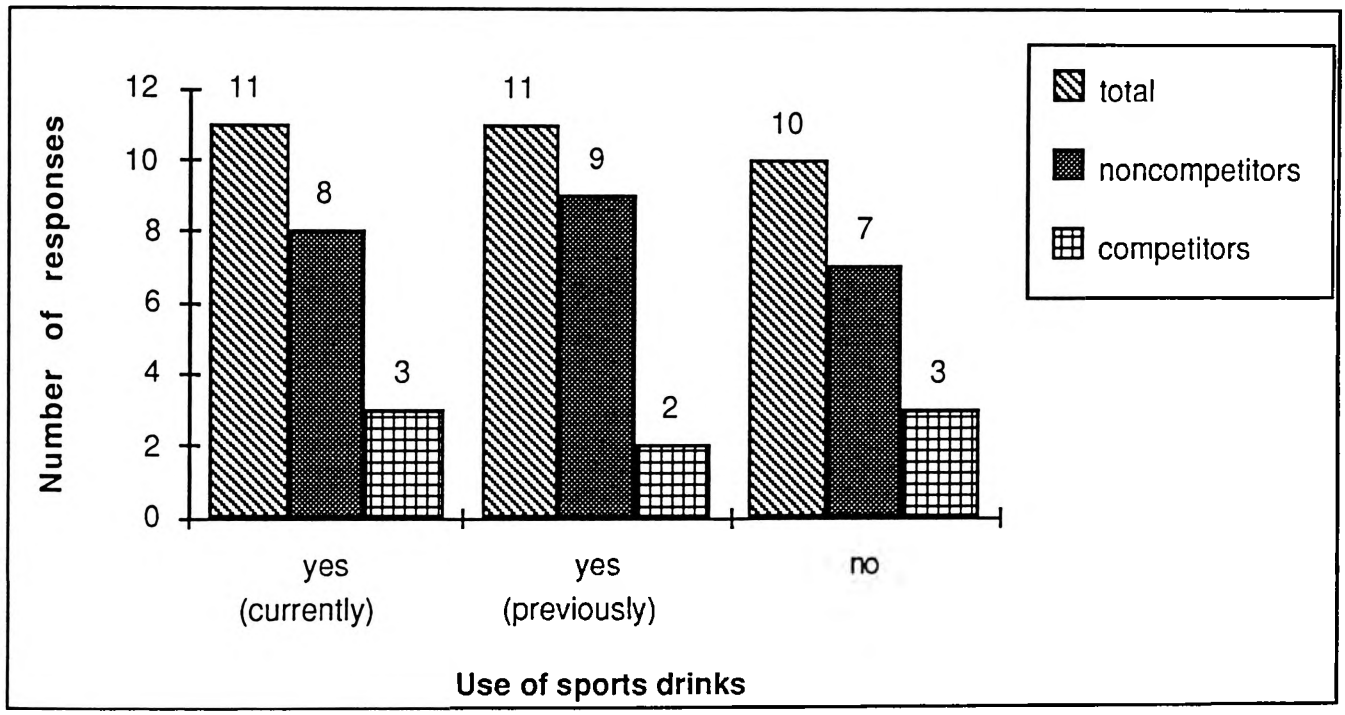


A significant difference was not found between the proportion of liquid meal supplements use by competitive and noncompetitive body builders (Chi square: X^2=2.844; d.f=1; p=0.0917).

4.4.10 Use of sports drinks

Sixty nine percent of the respondents (n=22) reported that they had either used sports drinks in the past (34.4 percent; n=11) or were using sports drinks at the time of the survey (34.5 percent; n=11). The remaining 31 percent of the respondents (n=10) reported they had never used sports drinks. This information is represented in Figure 4.21.

Figure 4.21.. Use of sports drinks

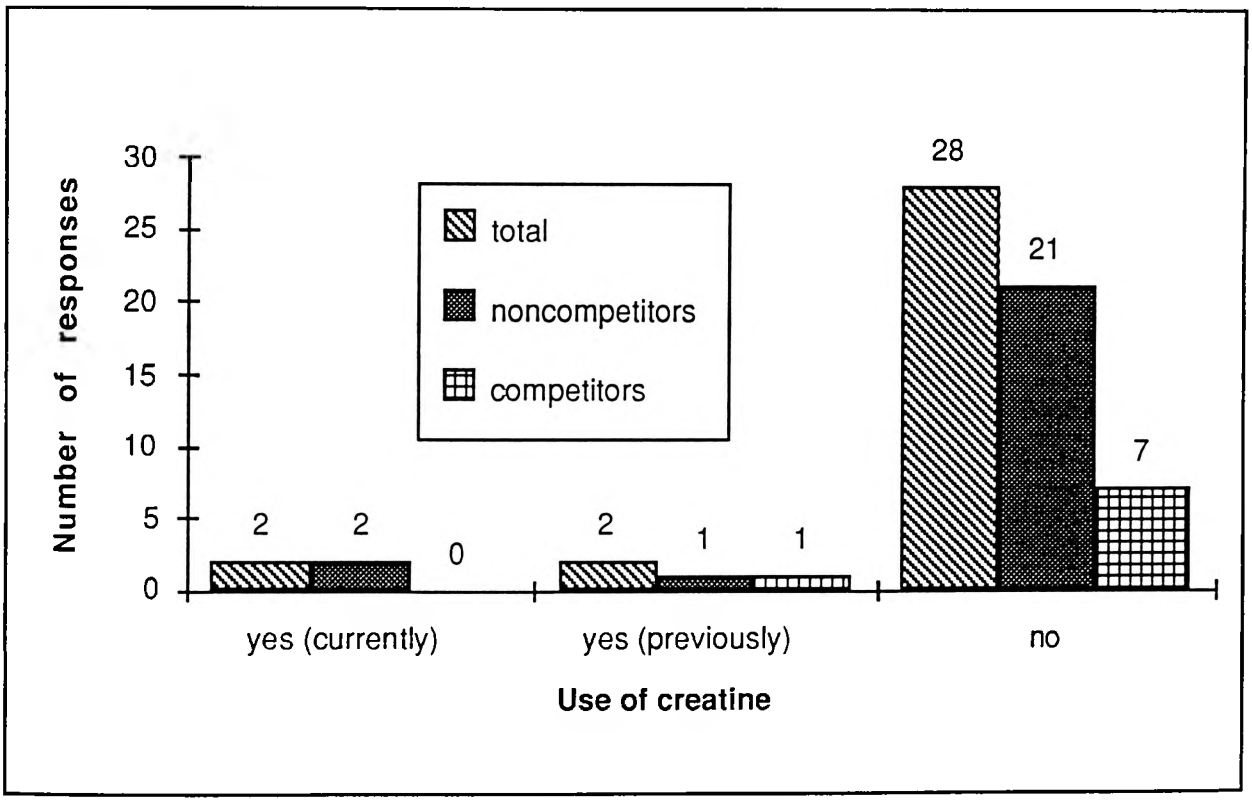


Using the chi square test it was found that there was not a significant difference between the use of sports drinks by competitors and noncompetitors (X^2=0.194; d.f=1; p=0.6597).

4.4.11 Use of creatine supplements

The majority of respondents (88 percent; n=28) reported never using creatine supplements. An equal number of respondents (n=2; 6 percent) reported that they had either used creatine supplements in the past or were using creatine supplements at the time of the survey. This information is displayed in Figure 4.22.

Figure 4.22. Use of creatine supplements

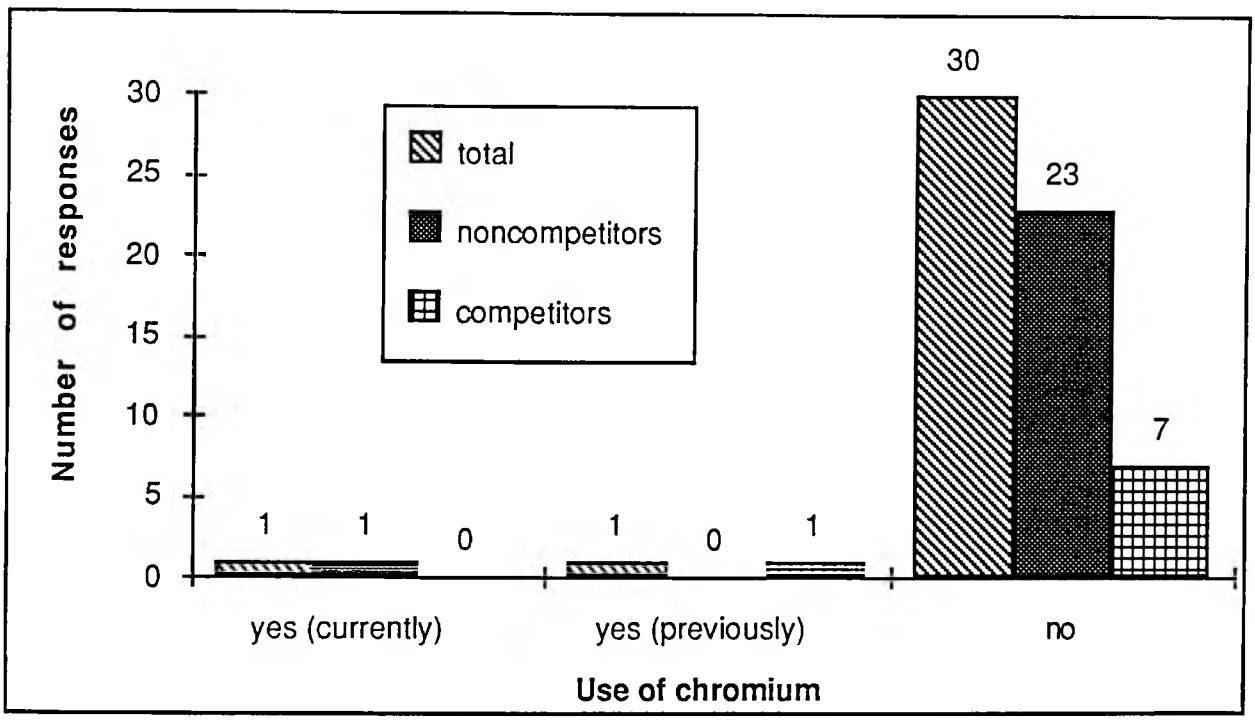


Using the chi square test it was found there was not a significant difference between the use of creatine supplements by competitive and noncompetitive body builders (X^2=0; d.f=1; p=1).

4.4.12 Use of chromium supplements

Ninety four percent of the respondents (n=30) reported they had never used chromium supplements. One respondent (3 percent) had used chromium supplements in the past and one respondent reported using chromium supplements at the time the survey was conducted. This information is displayed in Figure 4.23.

Figure 4.23. Use of chromium supplements

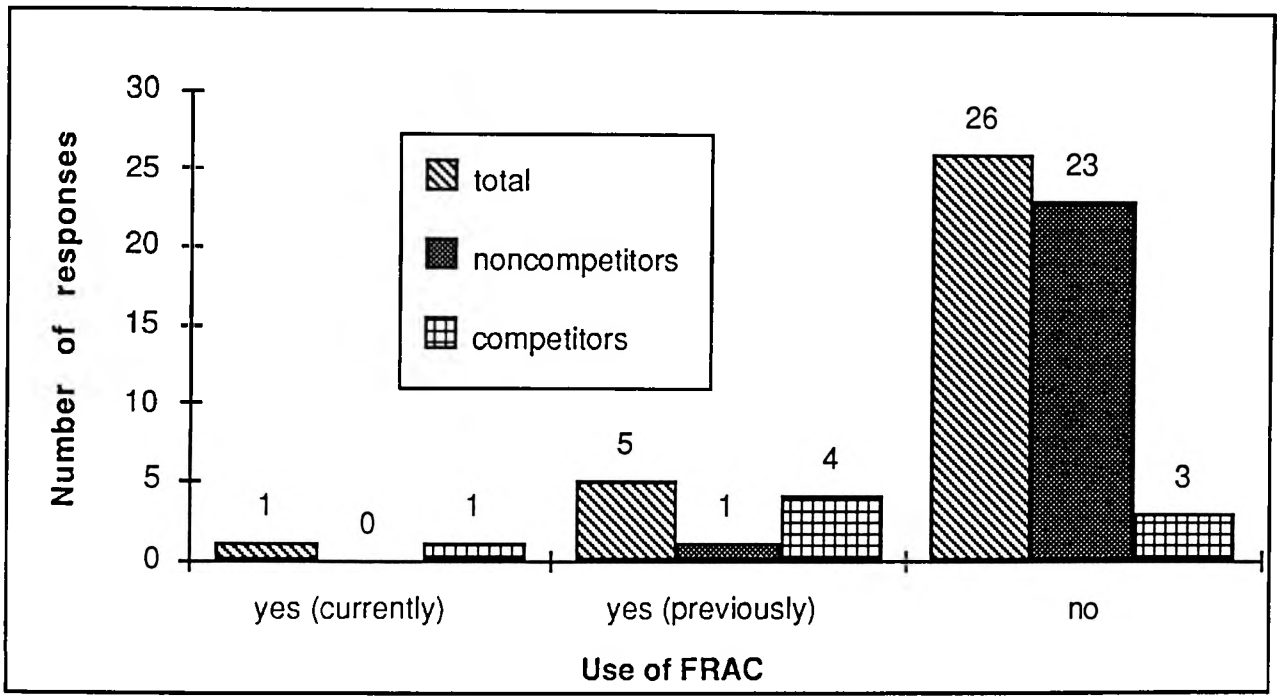


The chi square test could not be used to test if there was a significant difference between the use of chromium by noncompetitive and competitive body builders due to two of the expected frequencies being too small.

4.4.13 Use of FRAC

Of the 32 respondents 81 percent (n=26) reported they had never used FRAC. Five respondents (16 percent) reported they had used FRAC in the past. Only one respondent reported using FRAC at the time the survey was conducted. Figure 4.24 displays these results.

Figure 4.24. Use of FRAC

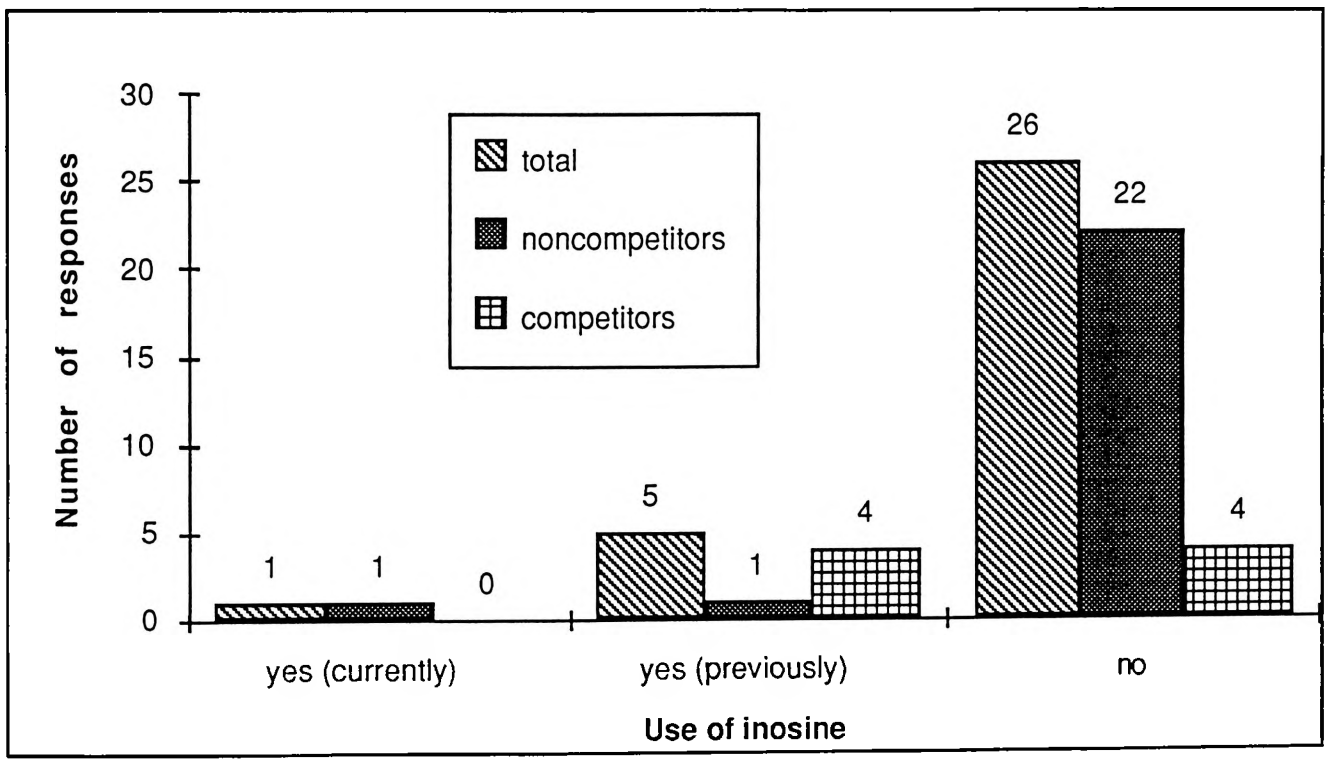


Using the chi square test it was found there was a significant difference between the use of FRAC in noncompetitive and competitive body builders (X^2=13.402; d.f=1; p=0.0003). The use of FRAC was more prevalent in competitive body builders than noncompetitive body builders.

4.4.14 Use of inosine supplements

Of the 32 respondents 81 percent (n=26) reported they had never used inosine supplements. Five respondents (16 percent) reported they had used inosine supplements in the past. Only one respondent reported using these supplements at the time the survey was conducted. Figure 4.25 displays these results.

Figure 4.25. Use of inosine supplements.



A significant difference was found between the use of inosine supplements by noncompetitive and competitive body builders (X^2=6.838; d.f=1; p=0.0089). Inosine use was more prevalent in the competitive body builders.

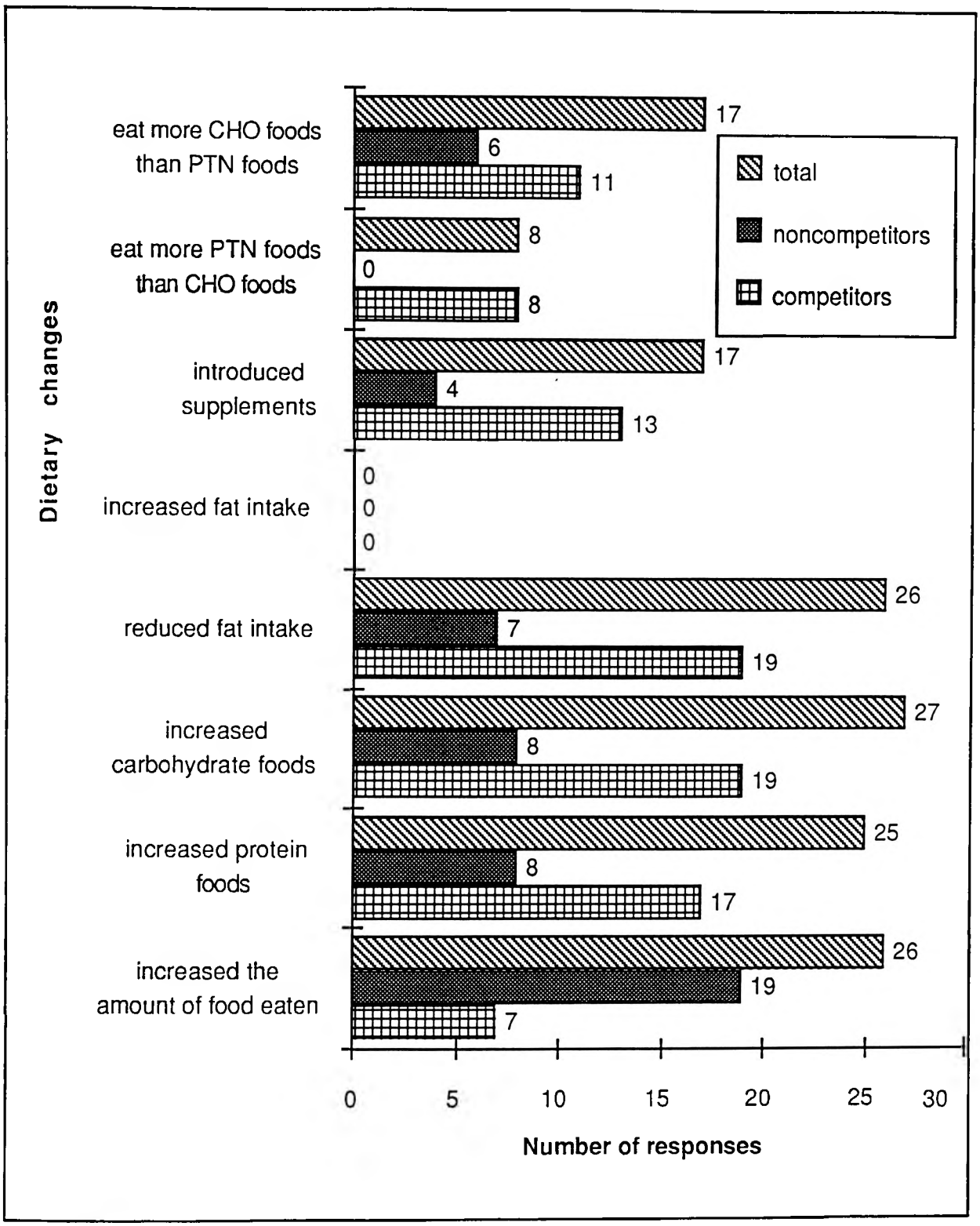
4.4.15 Dietary changes

Respondents were asked what were the main changes they had made to their diet since they had started body building. Respondents were required to choose from a list of eight possible dietary changes they may have made. The choices of "other" and "none" were also provided. The results are represented in Figure 4.26.

The chi square test was used to test if there was a significant difference between the responses of the competitive and noncompetitive body builders. It was found that there was not a significant difference for any of the following choices: increased the amount of food eaten (chi square: X^2=0.274; d.f=1; p=0.601); increased the amount of protein foods consumed (chi square: X^2=2.987; d.f=1; p=0.084); increased the amount of carbohydrate foods consumed (chi square: X^2=1.975; d.f=1; p=0.1599); decreased fat (chi square: X^2=0.274; d.f=1; p=0.601); introduced supplements (chi square: X^2=0.042; d.f=1; p=0.8379); and eat more protein foods than carbohydrate foods (chi square: X^2=3.556; d.f=1; p=0.0593); eat more carbohydrate foods than protein foods (chi square: X^2=2.05; d.f=1; p=0.1522).

No respondents reported increasing the amount of fat in their diet since starting body building. Two respondents reported "other" changes made to their diets. These changes included increasing the amount of fluid consumed and eating more "healthy" foods. One respondent chose the "none" option.

Figure 4.26 Dietary changes made since starting body building

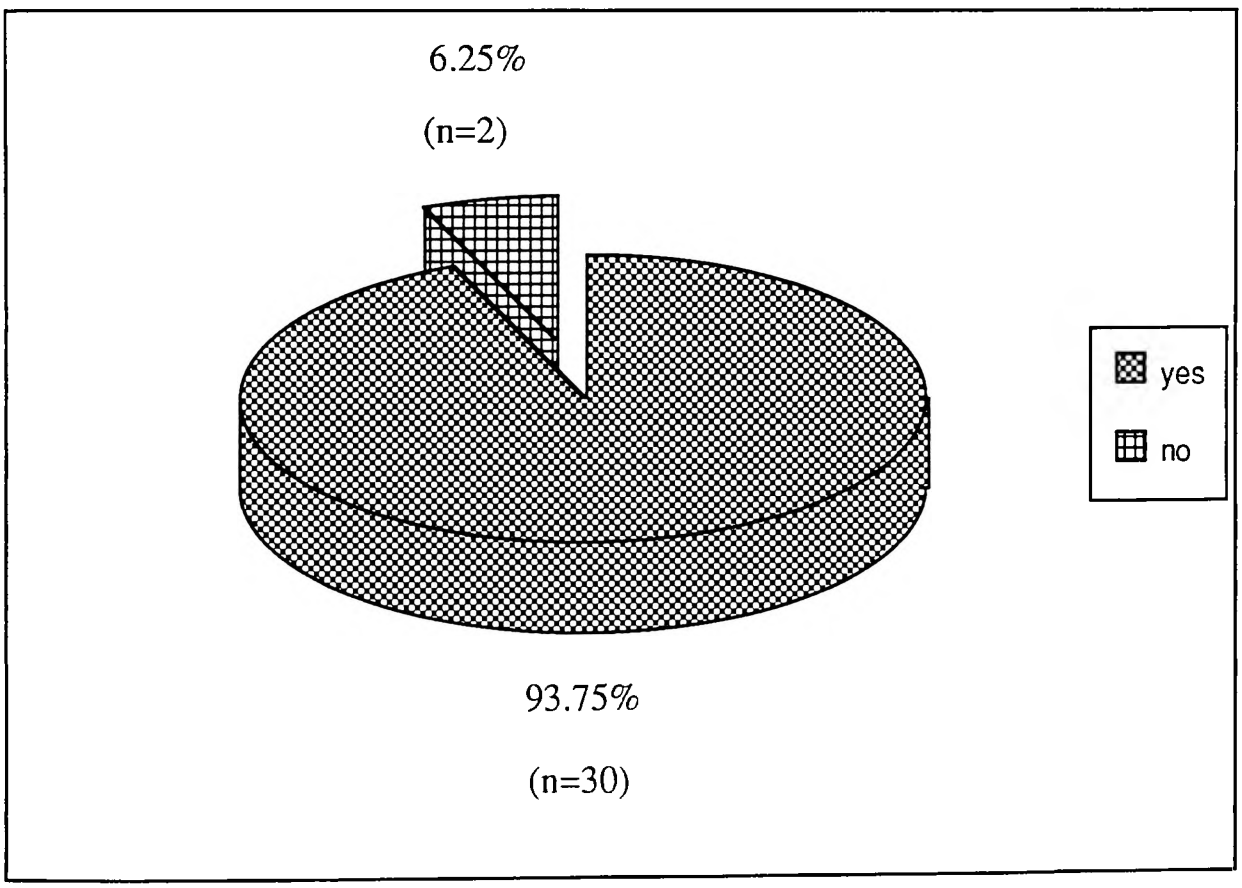


* CHO = carbohydrate; PTN = protein

4.5 Interest in resource being developed

Respondents were asked if they would be interested in the development of a nutrition booklet targeting the dietary needs of body builders. 93.75 percent of the respondents (n=30) reported they would be interested in such a booklet. Only two respondents (6.25 percent) claimed they would not be interested. Refer to Figure 4.27 for these results.

Figure 4.27. Interest in resource being developed



CHAPTER 5: DISCUSSION

The results obtained from this study describe the following in relation to amateur body builders within the Illawarra region:

* the diet related practices of this population,
* diet related practices resulting from nutrition information received,
* what nutrition information is required,
* the major sources of nutrition information used by the respondents,
*the ease of access to nutrition information (ie ease to read/ understand/ implement)

Results from this study are based on the self-reported information collected from thirty two amateur body builders from the Illawarra region through the use of a questionnaire. A readily apparent hypothesis is that certain diet related practices will be unique to competitive body builders due to dietary and physical preparation for competition.

The sample size of this study is similar to previous studies which have investigated the dietary practices of body builders. Therefore, comparisons can be made using a similar scale. Much of the literature available describing diet and training practices of body builders is focussed on competitive body builders (Sandoval et al., 1989; Kleiner et al., 1990; Hickson et al., 1990). Few studies have compared competitive body builders to noncompetitors, therefore much of the information obtained from this study is unique.

5.1 Demographics

Thirty two amateur body builders from five of Illawarra's gymnasia participated in this survey which examined the diet related practices and sources of nutrition information used by amateur body builders. This sample size was considered representative of the amateur body builders who train at gymnasiums within the Illawarra region. All major

body building gymnasia from Warrawong to Fairy Meadow (the gymnasium furthest north which has body building clientele) were exposed to this survey.

Of the 32 respondents 27 were male and five were female. The high male to female ratio (84.5: 15.5 percent) of respondents is a reflection of the body building population. A higher proportion of body builders were male. The sex of respondents was not considered an important variable in this study and comparisons of results according to sex were not made.

The respondents' ages ranged from 15 to 50 years. The majority of the respondents (53 percent) were aged between 18 to 30 years. All ages were well represented with the exception of 46 years and over. This could be due to fewer older individuals being involved in this sport.

Approximately 75 percent of respondents were noncompetitive body builders and the remaining 25 percent were competitive. This may also reflect the body building population as a smaller proportion of individuals involved in body building actually compete in this sport. Comparisons between competitive and noncompetitive body builders were made in this study.

The length of time the respondents had been involved in body building ranged from less than one month to greater than 10 years. The majority of body builders, both competitive and noncompetitive, had been involved in the sport for longer than one year. This could suggest that these respondents had well established diet related practices and set ideas with regard to nutrition. A higher proportion of both the competitive and noncompetitive body builders (six competitors and thirteen noncompetitors) were experienced body builders ie they had been training for three or more years. The remaining thirteen respondents (two competitors and eleven noncompetitors) were novice body builders ie they had been training for less than three years.

An interesting result in this study is the respondents' level of education. The majority of respondents had completed the Higher School Certificate or tertiary studies such as a degree, diploma, TAFE certificate, postgraduate studies etc. This is significantly higher than the average education level of the Illawarra region's residents, where forty to seventy five percent of males aged fifteen years and over are without post-school qualifications and fifty-five to eighty-five percent of females aged fifteen years and older are without post-school qualifications (McDonald et al., 1991). This high level of education found in this sample may be explained by the majority of the gymnasia being situated in the northern end of the Illawarra region. Residents within the Northern Suburbs have been identified as having higher educational attainment than the residents within the Southern Suburbs of the Illawarra region (McDonald et al., 1991). Another factor which may have contributed to the higher education level amongst the respondents is that the Sport and Recreation Gymnasium is situated at the University of Wollongong. It is reasonable to expect then that more university students may have been exposed to the present study than previous studies investigating body building. Furthermore it is possible that individuals with a higher education are more willing to participate in a study of this kind due to a higher level of literacy.

5.2 NUTRITION INFORMATION

The sources of nutrition information used by body builders has been examined in only one study previously undertaken (Kleiner et al., 1990). There is little literature available regarding how information is used by body builders to manipulate and adapt their diet for the purpose of the sport of body building. No other studies reviewed have examined the sources of information with regard to their relevance, accuracy of content and 'readability' by potential clients.

5.2.1 Sources of information used by body builders

Articles from both body building magazines and other magazines, friends and fellow body builders and gym staff were the sources of nutrition information most often used by the respondents. The sources less frequently used included a dietitian, the television, advertisements and a coach or trainer. Similar results were found by Kleiner et al., (1990) who studied the dietary practices of 27 competitive body builders. These researchers reported books, magazines, friends and coaches were the sources most frequently used, and the radio and television, a formal nutrition class, and a dietitian were the sources used least. The role of the coach in providing nutrition information may have been more significant in that study due to the competitive characteristic of the sample.

5.2.2 The influence of nutrition information on diet related practices.

A significantly higher percentage of respondents reported that the nutrition information they received did influence them to make changes to their diet. The sources which influenced their diet the most included body building magazines, friends and fellow body builders and gym staff. Although articles in magazines was reported to be one of the most frequently used sources of nutrition information, it was not rated as one of the sources which influenced dietary changes.

It was found that both competitive and noncompetitive body builders found the same sources most influential with regard to influencing dietary changes.

5.2.3 Evaluation of nutrition information

The nutrition information currently available was reported by most of the respondents as generally being intelligible (easy to understand and worded appropriately), accurate and relevant to their own dietary needs. Although a significant number of respondents (28%)

claimed the information was not interesting, however, the majority of respondents did report that the information was usually (34.5%) or always (28%) interesting. With consideration to the sources most frequently used ie body building magazines, friends and fellow body builders and gym staff, these results are expected. The high level of education of the respondents would be one factor which may contribute to the sources being reported as understandable. Most of the sources frequently used by the respondents would target a body building audience and therefore the information may be specific to this population. The accuracy of the information available is questionable due to the sources being derived from individuals who are not experts in this field.

5.2.4 Areas of interest

The dietary topics reported most frequently as the main areas of interest included "protein requirements", "carbohydrate requirements", "fat loss techniques" and "energy requirements". The areas reported as least interesting included "supplements", "sample diets/meal plans" and "recipes". Literature reviewed in this report found that the diets of body builders have been inappropriate in terms of macronutrient distribution (Kleiner et al., 1990; Hurley et al. 1984; Spitler et al., 1980). These studies found the percent contribution of total energy for protein and fat was too great and the contribution of carbohydrates was insufficient to meet the needs of these athletes. The weight loss techniques practised by competitive body builders have also been found to contradict with recommended practices (Sandoval et al., 1989; Lamar-Hilderbrand et al., 1989; Kleiner et al., 1990; Burke, 1991) placing the health of body builders at risk. It is thus clear that there is an obvious need for body builders to receive more information with regard to recommended macronutrient distribution and appropriate weight loss techniques.

No significant difference between the competitive and noncompetitive body builders was evident for the areas of interest, in relation to nutrition, for the following topics: bulking

techniques, sample diets, protein requirement, carbohydrate requirement, energy requirement, and recipes. However, competitive body builders reported a greater interest in fat loss techniques. This could be due to fat loss or cutting up being an important phase in the competitive body builder's training year in the lead up to competitions. This phase is not necessary for noncompetitive body builders.

5.2.5 Needs assessment for a nutrition resource being developed

Fifty nine percent of the respondents believed that there was insufficient information available relating to the dietary needs of body builders. A greater proportion of respondents (93.75%) expressed an interest for the development of a nutrition resource targeting the dietary needs of body builders. It is obvious then there is a need for a nutrition resource to be developed specifically targeting the needs of amateur body builders.

5.3 DIET RELATED PRACTICES OF AMATEUR BODY BUILDERS

A major component of this study was the investigation and comparison of the diet related practices of competitive and noncompetitive body builders. There have been few studies comparing the dietary practices of these two groups. Most of the literature available examines the dietary practices of competitive body builders, whereas little information exists for noncompetitive body builders .

5.3.1 Use of nutrition information

It was found that the most frequently reported uses of nutrition information included changing the quantity of nutrients (ie carbohydrates, protein and fat) within the diet, adaptation of the diet for training and the introduction of new foods into the diet. All of the competitive body builders reported using the information to make changes to their diet

in preparation for competition. The major uses of nutrition information correspond with the areas reported as most interesting by this sample of body builders (ie energy, protein and carbohydrate requirements and fat loss techniques).

The uses of nutrition information that were less frequently reported included trying new recipes, following diets and meal plans developed by other people, and trying different supplements. These results also correspond with the areas of interest least frequently reported by the respondents (ie supplements, sample diets/ meal plans, and recipes).

With the high prevalence of supplement use within this sample it would have been expected that one of the major uses of the nutrition information would have been "to introduce supplements into their diets".

No significant difference between competitive and noncompetitive body builders' use of nutrition information was evident as measured by the chi square test.

5.3.2 The use of supplements, drugs and ergogenic aids

The questionnaire used in this study was designed to investigate the use of a number of supplements, ergogenic aids and pharmaceutical drugs which are commonly associated with use by body builders. Dosage size and frequency of use were not investigated in this study nor was the phase of training identified in this study. Much of the information available which relates to the use of supplements, ergogenic aids and pharmaceutical drugs within the body building population relates to competitive body builders therefore little comparisons can be made between the results obtained from this study with previous research.

The results from this study demonstrated 100 percent of the respondents were either using supplements, drugs or ergogenic aids at the time the survey was conducted or had

used them in the past. The majority of noncompetitors (n=20; 83 percent) had either used more than one type of supplement or ergogenic aid either prior to the survey or whilst the survey was conducted. In comparison three-quarters of the competitive body builders (n=6) had used five or more different supplements or ergogenic aids either prior to the survey or whilst the survey was conducted. The high prevalence of supplement used by body builders has been documented in a number of past studies (Katch et al., 1980; Faber et al., 1986; Kleiner et al., 1989; Sandoval et al., 1989; Bazzarre et al., 1990; Hickson et al., 1990). The majority of these studies examined competitive body builders, and there is little information available to allow comparisons to be made regarding the use of supplements and ergogenic aids by competitive and noncompetitive body builders. Kleiner et al. (1989) studied 27 championship level body builders and found that 90 percent of the men and 100 percent of the women used dietary supplements, the specific supplements however were not identified. Data from this study were collected in the weeks leading up to and on the day of competition. Katch et al., (1980) found supplement dosages depended on the training cycle and that dosage size peaked during competition and this may explain the high incidence of supplement use identified in the present study. The training phase was not identified in this study and therefore comparisons cannot be made to these particular findings from the study conducted by Katch et al., (1980).

The supplements which were used most frequently by the body builders included sports drinks, amino acid supplements, protein powders and vitamin and mineral supplements. There was no significant difference found with regard to the proportion of use of these supplements and ergogenic aids by competitive and noncompetitive body builders.

It is not suprising that both amino acid supplements and protein powders were amongst the most commonly used supplements. This result may reflect the accessibility of these products to the client base - body builders. Furthermore, protein powders and amino acid supplements have been found to be the largest category of supplements promoted in body

building magazines (Grunewald et al., 1993) which was found to be one of the sources used most by the respondents in this study.

Sports drinks are only beneficial to the body builder if they are participating in prolonged sub-maximal exercise (ie more than 60-90 minutes of continuous high intensity exercise) (Burke and Read, 1993). When exercising for less than 60 minutes, water is a more practical and economical beverage (Rehrer et al., 1990).

The use of the following supplements were reported least: chromium, iron supplements, calcium supplements, FRAC, inosine and creatine. A number of studies investigating the diet related habits of male and female competitive body builders have found calcium and iron intakes have been significantly smaller than the recommended daily intakes for these micronutrients (Sandoval et al., 1989; Kleiner et al., 1990) . Apparently due to the exclusion of certain foods ie red meat and dairy products from their diets, and a multitude of other common dietary practices, many competitive body builders run a high-risk of developing vitamin and mineral deficiencies and concomitant health related illnesses (Kleiner et al., 1990). The use of calcium and iron supplements is often recommended to body builders since these athletes often restrict red meat and dairy products as a way to reduce fat intake (Lamar-Hildebrand et al., 1989; Sandoval et al., 1989; Kleiner et al., 1990).

The use of FRAC and inosine was found to be more prevalent in the competitive body builders. There was no significant difference found with regard to the proportion of use of iron supplements and creatine by competitive and noncompetitive body builders.

The use of anabolic steroids is illegal. It is also dangerous to the users' health. Four respondents (two competitors and two noncompetitors) reported that they were using anabolic steroids at the time the survey was conducted. No respondents reported using anabolic steroids prior to the survey. Other studies investigating the use of anabolic

steroids by competitive body builders reported high use rates and gender differences in frequency and magnitude of use of AAS. Sandoval et al. (1989) reported 100 percent of the males in the study used AAS, whereas all of the women indicated they had never used AAS. Of the males participating in the study conducted by Kleiner et al. (1990) 45 percent of the male body builders admitted using anabolic steroids. All women responded negatively to questions of AAS use. Twenty eight percent of this sample did not respond to this question and were counted as a "no" response for statistical purposes. One explanation of this phenomenon is that although anonymity and confidentiality were provided to the respondents the threat of being identified prevented the respondents from replying. It was found there was no significant difference between the use of anabolic steroids by the two groups.

The incidence of diuretic use was higher than the reported use of anabolic steroids. Twenty eight percent of the respondents reported that they had previously used diuretics or were using diuretics at the time the survey was conducted. The incidence of diuretic use was higher in competitive body builders. Diuretics are used by body builders prior to competition to dehydrate the skin with the belief that this will make the skin appear tightly stretched over the muscles. With this in mind it was unexpected to find that of the nine respondents who reported using diuretics, four of these respondents were noncompetitors.

CHAPTER 6: CONCLUSION

As a result of this study, the following conclusions are appropriate:-

1. The sample of the thirty two amateur body builders surveyed in this study contained characteristics of age range, gender representation and time involved in the sport considered to represent the population of body builders within the Illawarra Region. The representation of education however, was skewed towards higher education levels so it is possible that individuals not possessing secondary education were under-represented.

2. The range of diet related practices was identified amongst thirty two amateur body builders. The use of supplements was found to be extremely common in both competitive and noncompetitive body builders. The use of ergogenic aids however, were reported less frequently than dietary supplements. Vitamin and mineral supplements, sports drinks, protein powders and amino acid supplements were the supplements most frequently used by the respondents. The normal diet should supply an adequate amount of amino acids and micronutrients to meet daily requirements if a wide variety of foods from the five food groups are consumed. Therefore it is believed these supplements would not be necessary. Since a large energy intake is required by body builders, nutrient deficiencies should only occur if the individual excludes certain foods from their diet.

The use and abuse of anabolic steroids and diuretics is often associated with the body building population. These substances have the potential to be dangerous to the user's health as a number of adverse side effects associated with steroid use and the use of diuretics have been reported in the literature. Furthermore, the use of anabolic steroids is illegal. There is an obvious need to increase the awareness of body builders in relation to the adverse reactions and dietary requirements associated with the use of both steroids and diuretics.

3. The major sources of information used by amateur body builders were identified and included:

* articles within magazines (both body building and other magazines)
* friends and fellow body builders; and
* gym staff

The accuracy of the information obtained from these sources is questionable.

4. The respondents found the nutrition information currently available to be intelligible, accurate and relevant to their own dietary needs, although the amount of nutrition information was identified as being insufficient by the majority of the respondents. It was found that some of the sources of information currently available are not being accessed by the body building population involved in this study. Journals, books and dietetic advice are the sources of nutrition information which are not being used by these athletes. These avenues would be valuable sources of nutrition information and support to body builders. Increased accessibility to these sources by body builders could reduce the risk of health related conditions evident in the literature.

5. The survey revealed that the diet related practices and use of nutrition information between competitive and noncompetitive body builders were similar. However, competitive body builders were identified using diuretics, FRAC and inosine more frequently than noncompetitive body builders. Competitive body builders used nutrition information to change the diet for both training and in preparation for competitions more so than noncompetitive body builders. Another difference between these two groups included competitive body builders reporting a greater interest in information regarding fat loss techniques.

6. The questionnaire used in this study was developed to identify whether there was sufficient nutrition information available to body builders. The areas of nutrition were

most desired and used by the body builders and whether there was an interest for a nutrition resource to be developed. This study identified the need for more nutrition information available for body builders as well as a need for more information investigating amateur body builder's diet related habits and their use of nutrition information as they progress through the various stages of the training year.

A need for an education resource was identified. Furthermore, the project identified the range and type of information considered important by the body builders for inclusion in an education resource. The booklet should contain information in relation to the following topics:

* Energy
    - -requirements
    - -for weight loss
    - -for weight gain
* Protein
    - -requirements
    - -sources
    - -ideas to increase protein intake
* Carbohydrate
    - -requirements
    - -sources
    - -ideas to increase carbohydrate intake
* Fat
    - -requirements
    - -sources
    - -methods to reduce fat in the diet

An easily readable nutrition booklet can be used by body builders to increase their knowledge about nutrition and as a result may reduce the health related problems associated with this athletic population. The body builder accessing the nutrition resource

that was designed as a component of this study would thus be more informed and could make more educated decisions in relation to their diet and the sources of nutrition information they use.

Refer to Appendix V for the draft copy of the nutrition booklet which was developed using the information from this study. The booklet has been designed to be used by amateur body builders.

Limitations of the Study

(i) The questionnaire has not been validated to test the reliability and validity of the responses.

(ii) The sample size prevented some statistically significant comparisons (using the chi square test) being performed on the two subgroups.

(iii) There was no means of reminding participants to return completed surveys as the gymnasium staff distributed the questionnaires to participants and collected the replies. A larger sample size may have been achieved if the gymnasium staff had been asked to make a list of names of those individuals who received a questionnaire as a follow up strategy.

(iv) The questionnaire was not piloted. As a result the questions that involved respondents to rank options were poorly answered by a significant number of respondents. Piloting the questionnaire would have helped to identify problems with the questionnaire.

(v) A few questions appeared ambiguous for respondents, therefore the results may have been biased by incorrect perceptions of some questions. This could have been rectified if the questionnaire had been piloted.

(vi) It was difficult to perform statistical tests on questions requiring respondents to rank a number of options as some respondents did not complete these questions correctly.

(vii) this investigation relied on accuracy of recall and honesty in answering questions related to the impact of diet related practices an body builders. It is possible that a

longitudinal study involving repeated interviews and diarising of behaviours could provide even more accurate information.

Recommendations for further study/ involvement with body builders

(i) A validation of the questionnaire should be undertaken.

(ii) A larger sample size would enable a more complete investigation into the diet related practices of amateur body builders through increasing exposure to female body builders and competitive body builders.

(iii) An investigation of diet related practices of amateur body builders encompassing a state wide or national sample would also improve the quality and range of information related to Australian athletes. Such an investigation would add significantly to the data currently available about the practices of Australian body builders.

(iv) A longitudinal study over one or more seasons would be valuable in providing additional information about diet related practices of amateur body builders.

(v) A longitudinal study into the impact of nutritional advice on diet related practices of amateur body builders could verify the manner in which the information is applied.

(vi) The resource developed in response to the current survey should be evaluated in respect of the ease of access, relevance etc.

(vii) The Dietitians Association of Australia should assist body builders to endorse diet related practices that are healthy and tailored to the needs of amateur body builders ie gradual weight loss/gain.

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Appendix I.

Rebecca Fisher
29 Hill Street,
Austinmer, 2515.

26.7.95

Dear Manager,

I am a currently in my 5th and final year studying a Masters in Science, specialising in Nutrition and Dietetics at the University of Wollongong. I have an exercise science background as I studied a double major in Nutrition and Human Movement Science for my undergraduate science degree.

I am conducting a small study investigating the dietary practices of body builders. I consider this an important area due to the lack of scientific literature available concerning nutritional profiles and dietary practices used by body builders.

This study is concerned with identifying the range and validity of diet related bulking (body building) strategies in amateur body builders within the Illawarra. The aim of this project is to determine whether there is a need for an educational resource designed specifically for body builders.

The study is directed to individuals who participate in body building and requires them to complete a 3 page questionnaire. The questionnaire is designed to investigate the following issues:

1. To identify major sources for obtaining nutrition information.

2. To determine the ease of access to this information (ie ease to read/ understand/ implement).

3. To identify the current nutrition related practices of amateur body builders.

4. To determine the diet related practices resulting from information gained.

5. To identify what information is required by amateur body builders.

6. To determine whether there is a need for a nutrition educational resource targeting amateur body builders.

All participants and participating gyms will remain anonymous. Neither your gym nor the participant can be identified through the completed questionnaire.

The role of each participant within the study is to complete one questionnaire. No further involvement is required. Your role or the role of the staff would be to distribute a questionnaire to appropriate gym members and monitor the return of the questionnaires.

The time allocated for data collection is one week. This would occur during the period between Monday the 31st July to Sunday 6th August.

If you have any questions or would like to obtain the findings of this study, once completed, you can contact me on (042) 672 042 or Owen Curtis, the supervisor of this study, on (042) 213 881.

Yours Sincerely

Rebecca Fisher

Appendix II.

Rebecca Fisher
29 Hill Street,
Austinmer ,2515.

31.7.95

Dear Participant,

Diet is an important part of the body builder's training program, but , there is little information reported in the research literature about nutritional profiles and dietary practices used by body builders.

The aim of this study is to investigate the diet related practices of amateur body builders within the Illawarra region.

Information from this study will be used to determine whether a nutrition education resource (ie booklet) is needed and if so, the information you provide will be used to develop the resource and its contents.

Your only role within this study is to complete the attached questionnaire. No further involvement is required.

All personal information from this study will be confidential. All questionnaires are anonymous ie neither you nor the gym you attend can be identified through the completed questionnaire.

☞ Please complete the attached consent form and place in provided box.

☞ If you are under the age of 18 years please get the consent form signed by your parent or guardian and return it to your gym.

☞ Fill in the attached questionnaire as accurately and honestly as possible.

☞ Seal the completed questionnaire within the envelope provided.

☞ Place the completed questionnaire and consent form in the box provided at reception.

☞ **ONLY** the questionnaire should be placed in the envelope. The consent form can be placed in the box separate from the questionnaire. This ensures the questionnaire is anonymous.

For further information please contact Rebecca Fisher on (042) 672042.

Thank you for your participation.

Yours sincerely

Rebecca Fisher

Appendix III.

CONSENT FORM

I ....., agree by signing this consent form that :
(please print full name)

☆ I will be participating in a study which aims to investigate the diet related habits of body builders.

☆ My role within this study is to complete the attached questionnaire. No further involvement is required.

☆ I am under no obligation to participate within this study.

☆ I understand I can not be identified through the completed survey. I will remain anonymous and my name and any information provided will remain confidential.

☆ I will keep the attached copy of the consent form.

☆ I may obtain further information at anytime from Rebecca Fisher by phoning (042) 672042.

☆ If I have any concerns I may contact Owen Curtis, the supervisor of this study at Wollongong University on: (042) 213 881.

☆ If futher information is required I may contact the ethics committee on: (042) 213 903.

Please note-if you are under 18 years of age, you will need to have this form signed by your parent/ guardian

.....	.....	.....	.....
Date	Signed	Parent / Guardian (if under 18 years of age)	Date

Appendix IV.

NUTRITION SURVEY

Please answer all questions by placing a tick (✓) in the appropriate box . When asked to 'rank', think carefully before answering. Be honest with your answers -remember you cannot be identified through this survey.

1. **Where do you receive *most* nutrition and food information?**
(tick as many as appropriate in column 1.)

1.	2b.	
☐	___	articles in body building magazines
☐	___	articles in magazines (other than body building)
☐	___	books
☐	___	journals
☐	___	dietitian/ nutritionist
☐	___	friends & fellow body builders
☐	___	gym staff
☐	___	coach/ trainer
☐	___	television
☐	___	advertisements (ie magazines, television, newspaper etc)
☐	☐	other (please specify).....
	☐	none

2a. **Does this information influence you to make changes to your diet?**

☐ yes
☐ no

2b. **If YES, rank the above sources (see question 1, column 2b) in order of which influences your dietary habits the most ?** (1= highest to 10= lowest)

3. **Do you think there is enough information available related to the dietary needs of body builders?**

☐ yes
☐ no

4. **How do you use the information to change your diet?**
(tick as many as appropriate)

☐ introduce new foods
☐ try different supplements
☐ copy other diets / meal plans
☐ adapt diet for competition
☐ adapt diet for training
☐ change amounts of nutrients (eg protein, fat, carbohydrate)
☐ try new recipes
☐ other (please specify).....
.....

5. **Do you think the information available :**

	yes	no	most of the time	rarely
Is easy to understand ?	❒	❒	❒	❒
Covers topics you are interested in ?	❒	❒	❒	❒
Uses words you understand ?	❒	❒	❒	❒
Is accurate ?	❒	❒	❒	❒
Is relevant to your dietary needs ?	❒	❒	❒	❒

6. **Which diet related issues are you most interested in. Rank in order from highest to lowest.?** (1= highest to 8= lowest)

___ supplements
___ recommended bulking practices
___ sample diets
___ amount of protein required
___ amount of carbohydrates required
___ amount of kilojoules/ calories required
___ recipes
___ methods to reduce body fat
❒ none
❒ other (please specify).....

7. **Since starting body building what are the main changes you have made to your diet (includes food & beverages) ?**
(tick as many as appropriate)

❒ increased the amount of food eaten
❒ increased protein foods (eg meat, poultry, eggs, dairy products, fish, etc)
❒ increased carbohydrate foods (eg bread, cereal, pasta, rice, potatoes, fruit, etc)
❒ reduced fat
❒ increased fat
❒ introduced supplements
❒ eat more protein foods than carbohydrate foods
❒ eat more carbohydrate foods than protein foods
❒ none
❒ other (please specify).....

8. **Have you used any of the following ?**

	yes (currently)	yes (previously)	no
Amino acid supplements	❒	❒	❒
Vitamin/ mineral supplements	❒	❒	❒
Protein powders	❒	❒	❒
Calcium supplements	❒	❒	❒
Iron supplements	❒	❒	❒
Diuretics	❒	❒	❒
Anabolic steroids	❒	❒	❒
Liquid meal supplements (e.g sustagen)	❒	❒	❒
Sports drinks	❒	❒	❒
Creatine	❒	❒	❒
Chromium	❒	❒	❒
FRAC	❒	❒	❒
Inosine	❒	❒	❒

9. **How long have you been involved in body building ?**

- ❒ 0-3 months
- ❒ 4-6 months
- ❒ 7 months- 1 yr
- ❒ 1-2 yrs
- ❒ 3-5 yrs
- ❒ 6-9 yrs
- ❒ 10 + yrs

10. **Do you compete in body building ?**

- ❒ yes
- ❒ no

11. **Which level did you cease formal education ?**

- ❒ year 9 or less
- ❒ year 10 certificate
- ❒ HSC
- ❒ other (please specify).....
- ❒ diploma
- ❒ degree
- ❒ post graduate studies

12. **Are you ?**

- ❒ female
- ❒ male

13. **How old are you?**

- ❒ younger than 15
- ❒ 15-17
- ❒ 18-24
- ❒ 25-30
- ❒ 31-35
- ❒ 36-40
- ❒ 41-45
- ❒ 46-50
- ❒ 50 +

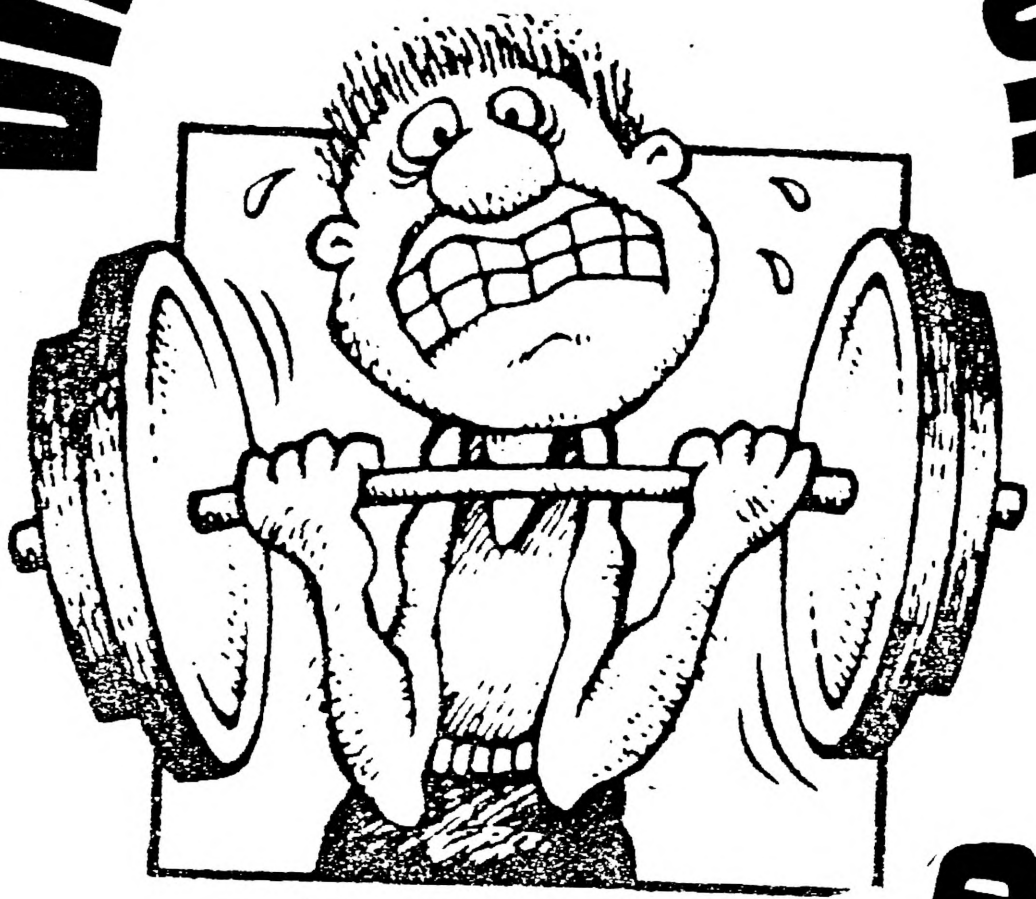
14. **Would you be interested in a nutrition booklet specific to body building?**

- ❒ yes
- ❒ no

Thank -you for your participation

Appendix V.

DIETARY HANDBOOK FOR BULKING-UP



Rebecca Fisher

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List of Definitions

Adipose tissue - The tissue within the body responsible for storing fat.

Aerobic exercise - Exercise lasting for longer than two minutes which requires oxygen during energy production; produces cardiovascular fitness.

Amino acid - The building blocks of proteins containing a central carbon atom with a nitrogen atom and other atoms attached.

Anabolic steroids - Hormones used illegally by athletes in an attempt to build muscle mass when ingested in conjunction with strength training.

Anaerobic exercise - Exercise lasting for a very short duration of time and which does not require oxygen during energy production.

Bulking up - Is a term used to describe the practice of weight gain, where fat gains are minimal and large gains in lean body mass are achieved.

Carbohydrate - A compound containing carbon, hydrogen, and oxygen atoms; the two types of carbohydrates are known as simple carbohydrates (sugars) and complex carbohydrates (starches). One gram of carbohydrate provides 16 kJ (4 Cals).

Cutting-up - The term used to describe the process where body fat levels are significantly decreased and lean body mass is increased.

Diet - The term used to describe a regular food intake of an individual or population.

Energy - In nutritional terms, energy refers to the number of kilojoules (or calories) which are released when a food is burned for fuel within the body.

Enzyme - A compound that speeds the rate of a chemical reaction but is not altered by the chemical reaction.

Essential amino acids - Amino acids that are not effectively synthesised by humans and that must therefore be included in the diet. There are nine essential amino acids.

Ergogenic aids - Are substances or devices used due to the belief that they will improve exercise and athletic performance by improving the production of energy.

Fats - Are organic substances which are insoluble in water. All types of fat are energy dense and contribute 37 kJ (9 Cals) per gram.

Glycogen - A carbohydrate made of multiple units of glucose containing a highly branched structure; glycogen is stored in the muscle and liver.

Hypertrophy - An increase in cell size.

Kilojoule (kJ)- A measure used to quantify energy. (1 calorie = 4.2 kJ)

Lean body mass (LBM) - The part of the human body which is free of all but essential fat. Lean body mass includes muscle, bone, organs, connective tissue, and other body parts.

Macronutrients - Protein, carbohydrates and fats are known as macronutrients as they are required in relatively large quantities.

Nitrogen balance - When the intake of nitrogen (protein) equals nitrogen excretion, a nitrogen balance exists.

Non-essential amino acids (NEAA) - Are amino acids that can be readily made by the body.

Novice body builders - Individuals who have been body building for less than three years.

Protein - Compounds made of amino acids, containing carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur atoms, in a specific configuration. One gram of protein provides 17 kJ (4 Cals).

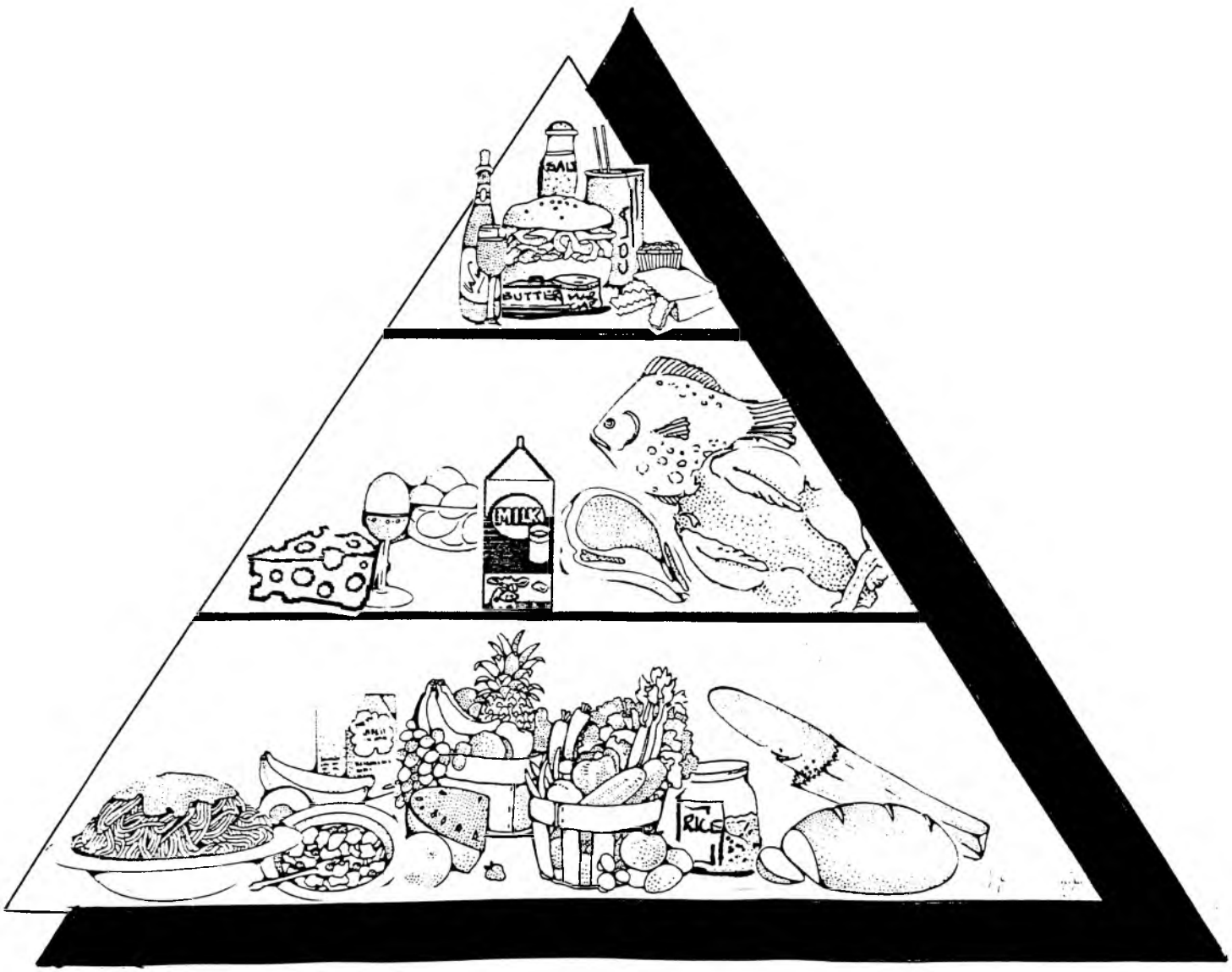
Pumped - The term used by body builders to describe when the body appears very muscular with defined vascularity.

Recommended Daily Allowance (RDA) - are recommended intakes for nutrients that meet the needs of almost all people of similar age and gender.

HEALTHY DIET PYRAMID

A balanced diet can be explained using the healthy diet pyramid. The healthy diet pyramid illustrates the proportions we should eat different types of food. For example:

1. **EAT MOST** of breads, cereals, legumes, fruit and vegetables.
2. **EAT MODERATELY** from lean meat, seafood, poultry, eggs, nuts and dairy products.
3. **EAT LEAST** of butter, margarine, oil, alcohol, sugars and salt.



READING FOOD LABELS

Many products now provide "Nutrition Information" on the packaging, like the one shown below.

NUTRITION INFORMATION

SERVING SIZE: 35g

	PER 35 g SERVE	PER 100g
ENERGY	515kJ	1470kJ
PROTEIN	3.3g	9.4g
FAT	0.9g	2.5g
CARBOHYDRATE		
-TOTAL	25.0g	71.4g
-SUGARS	8.4g	24.1g
DIETARY FIBRE	3.4g	9.6g
CALCIUM	10mg	30mg
SODIUM	100mg	280mg
POTASSIUM	135mg	385mg

INGREDIENTS: WHOLE WHEAT, SUGAR, DRIED FRUITS (SULTANAS, APRICOT, APPLE), WHEATGERM, DESICCATED COCONUT, SALT, FLAVOUR, FOOD ACID (CITRIC), VITAMINS (B1, B2, C, NIACIN)

Useful information on food packages includes:

SERVING SIZE: The average serving size as well as information per 100g usually appears in the nutrition information panel. The serving size is not always the same as you would have. If you wish to work out the nutrients from your serving size weigh your serve and calculate the nutrients using the "per 100g" values.

PER 100g: When comparing products always look at the "per 100g" because the recommended serving size differs for each product.

FAT: Use the "per 100g" figure to compare products. Look for products with less than 10g of fat per 100g (this means they contain less than 10% fat).

CARBOHYDRATES:

Total: This includes both complex carbohydrates and sugars.

Sugar: This is how much sugar is in the product. Choose products with less than 15g of sugar per 100g (this means they contain less than 15% sugar)

DIETARY FIBRE: Use the per 100g figure to choose between products. The daily recommended intake of fibre is 30g.

SODIUM (SALT): Choose products lowest in salt, or look for products which are salt reduced or no added salt.

INGREDIENTS LIST: This lists all ingredients in order of quantity, from most to least. Look for different sources of fat, salt and sugar.

LOOK FOR OTHER WORDS ON THE INGREDIENTS LIST THAT MEAN FAT AND SUGAR.

Other words that mean fat	Other words that mean sugar
Butter	Sucrose
Oil	Glucose
Margarine	Maltose
Milk solids	Lactose
Coconut oil	Syrup
Palm oil	Honey
Lard	Mannitol
Copha	Fruit juice concentrate
Dripping	Caster sugar
Cream	
Mono or diglycerides	
Sour cream	
Toasted	
Baked	

Reading the Packaging

- Reduced fat means the product has at least 25% less fat than the original product.
- Low fat means the product has less than 3 grams of fat per 100 grams if it is a solid food item. If the food item is a liquid it has to contain less than 1.2 grams of fat per 100 grams.
- Lite/light can mean taste, colour, weight, fat, salt, sugar so it is important to read the ingredients list and look at the nutrition panel.

ENERGY

When losing weight or trying to "bulk up" the same goal applies. You want to achieve muscularity without gaining body fat. Weight gains and weight losses should be relatively slow. If weight is lost too quickly then there will be a greater amount of muscle lost. If weight is gained too quickly then there will be a greater amount of fat gained. So it is obvious that you need to find a happy balance. It is just as important to get the amount of macronutrients right. Growth and development of muscle depends largely on getting this distribution correct. Below is a table outlining recommended macronutrient distribution (ie distribution of carbohydrates, fat and protein) for various energy intakes.

Various levels of energy intake and kilojoule/kilocalorie distribution and macronutrient distribution

		Energy intake							
	% energy	2000 cal **8400 kJ**	g	3000 cal **12600 kJ**	g	4000 cal **16800 kJ**	g	5000 cal **21000 kJ**	g
CHO	55%	1100	275	1650	412	2200	550	2750	687
		4620		**6930**		**9240**		**11550**	
Fat	30%	600	67	900	100	1200	133	1500	167
		2520		**3780**		**5040**		**6300**	
Protein	15%	300	75	450	112	600	155	750	187
		1260		**1890**		**2520**		**3150**	

* Carbohydrate (CHO)= 4 cal/g (16 kJ/g), Fat = 9 cal/g (37 kJ/g), Protein = 4 cal/g (17 kJ/g)

WEIGHT LOSS

It is recommended that weight loss should occur at a rate of **0.25 to 0.5 kg per week.** At this rate, the body will be able to maintain this lower weight for a longer period of time and there will be less risk of losing muscle mass.

The best methods to reduce body fat include:

* **Increase the amount of aerobic activity performed** (ie. walking, running, swimming, cycling, aerobics etc). The energy cost of sports activities are presented in the table below.

Energy Cost of Sports Activities

Activity	Energy cost (kcal/min)	Energy cost (kJ/min)
Sitting	1 - 1.5	4.2 - 6.3
Standing	1 - 1.5	4.2 - 6.3
Aerobics	6 - 11	25 - 45
Basketball (mean value for a game)	1 - 15	4.2 - 63
Cycling at 4 km/hr	7	29.5
Football (while active)	6 - 14	25 - 59
Jogging at 10 km/hr	7 - 9	29.5 - 38
Sprinting	18 - 22	76 - 92.5
Volleyball (mean value for a game)	3 - 6	13 - 25
Walking (10 minutes per km)	5 - 9	21 - 39
(8 minutes per km)	6 - 11	25 - 45
Weight training (mean values)		
Circuit	9 - 10	38 - 42
Priority	5 - 10	21 - 42
Small muscle mass	3 - 7	13 - 29.5
Large muscle mass	6 - 18	25 - 76
Combination (with emphasis on large muscle mass)	9 - 10	38 - 42

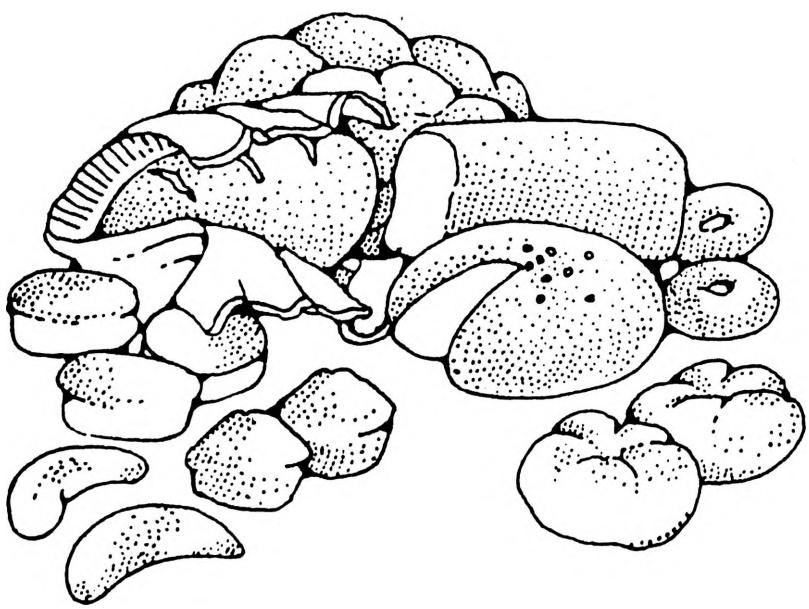
* **Decrease the amount of fat eaten.** Fat has over twice as much energy as protein and carbohydrates. For more information refer to the section on fat.

* **Decrease the amount of energy consumed.** To lose 0.25 to 0.5 kg per week, subtract 1500-2200 kJ from your current daily energy intake. When calculating your daily energy intake include all your meals, snacks and drinks you would usually have over 24 hours.

* **Eat 5-6 small frequent meals per day** rather than three main meals. This way of eating is sometimes referred to as "grazing". People used to believe that eating in between meals would make you fat but it all depends on what you eat. The benefits of small frequent meals include: you can reduce the amount of food you eat with a smaller risk of feeling hungry, and your body will much prefer this mode of eating. Your metabolic rate can increase by eating smaller, more frequent meals.

* **Increase high fibre foods.** Foods high in fibre provide more bulk to your diet which make you feel fuller. High fibre foods are usually low in fat, sugar and energy and high in complex carbohydrates. When increasing the amount of fibre in your diet do it gradually or else you may experience abdominal pains and wind. Also drink plenty of fluids when you increase the fibre in your diet or you may find you will become constipated. Over the page is a list of high fibre foods.

By combining a few of these weight loss techniques, weight loss will be more effective and easier to do.



High Fibre Foods

HIGH FIBRE CHOICE	GRAMS PER SERVE
BREAD	
Wholemeal bread	1.8g per slice
Rye bread (dark)	2.4g per slice
Wholemeal lebanese bread	3.5g per pocket
CEREALS & GRAINS	
All-Bran	19g per cup
Bran Flakes	8g per cup
Fibre-Plus	12g per cup
Weet-Bix/Vita-Brits	4g per 2 biscuits
Rolled oats (porridge)	3.4g per cup
Wheat bran	2.2g per tbsp
Rice bran	2g per tbsp
Wholemeal flour	16g per cup
Wholemeal pasta	9g per cup
Brown rice	3g per cup
LEGUMES	
Red kidney beans	12g per cup
Lentils (boiled)	4g per 1/2 cup
Baked beans	5.3g per 130g can
FRUIT & VEGETABLES	
Apple (medium size)	3g
Apricot (2 medium size)	3g
Apricot, dried	2.5g per 5 halves
Banana (medium size)	3g
Kiwi fruit (medium size)	3g
Orange (medium size)	2.5g
Pear (medium size)	4g
Beans, green	4g per cup
Broccoli	6g per cup
Cabbage	4.5g per cup
Carrots	5g per cup
Cauliflower	4g per cup
Corn	4g per cob
Peas, green	11g per cup
Potato, with skin	2g per medium size
Pumpkin	2.5g per cup
Spinach	9g per cup
Tomato (medium size)	1.4g

Bulking up (gaining weight)

In attempting to gain weight, you should be sure to emphasise proper nutrition and physical training programs that can increase gains in muscle mass, reduce gains in body fat and allow an achievement of optimal or maximum performance. The principles of effective weight gain are stated below:

1. The goals of weight gain should be to maximise gains in muscle mass while minimising body fat levels. This can only be achieved with a well planned diet and training program.

2. Changes in diet should be matched with changes in training programs.

3. The intake of macronutrients should be carefully planned so that the diet is low in fat and adequate in energy, carbohydrates and protein.

4. Commercial weight gain products are not recommended as they are relatively high in fat (30%), as well as being expensive. Simple carbohydrates can be used to increase the amount of energy in your diet. They provide lots of energy without the bulk. Skim milk drinks can be used to increase energy with extra skim milk powder and flavours added to them. Liquid meal supplements are another way to boost energy intake.

5. Weight gains should be relatively slow, about **0.5 to 1 kg/week.** This rate will result in less fat being gained and concentrate the gains on muscle mass. If gaining relatively large weight gains over a long period (> 6 months) weight

gain should be even slower, **0.25-0.5 kg/week**, to insure all gains is in lean body mass.

6. All recommended weight charts are designed for the general population, so body builders should monitor their weight every 1-2 weeks using skin fold measurements.

7. To gain 0.5 kg/week add an extra 2200 kJ/day on your current energy intake.

Energy Requirements

There is no set figure to place on the energy requirements of a body builder due to the huge individual differences in physique and training programs. Within this booklet is recommended intakes for each macronutrient so these requirements can be added to get a rough estimate of energy needs.

If weight is monitored weekly to fortnightly using scales and skinfold measurements it is easier to estimate energy requirements. Is your fat level has increased you may need to decrease the amount of energy and/or fat intake. On the other hand if you are losing more weight or fat than desired you may need to increase your energy intake whilst considering desired macronutrient distribution..

CARBOHYDRATES

Carbohydrates are the preferred fuel for the human body. They are especially important during aerobic endurance activities such as running, cycling, swimming etc and in anaerobic activities such as weight training that involve high volumes (eg repeated weight sets). After carbohydrate foods are eaten they are broken down into glucose (a type of sugar) and stored in the muscle and liver as glycogen, or used as energy and excess carbohydrate is converted to fat. It is the glycogen that fuels the muscles during exercise. The energy from carbohydrate can be released within exercising muscles up to three times as fast as fat. However, carbohydrate stores in the body are limited, so it is important to replace the glycogen stores after exercising. Insufficient intake of carbohydrate foods causes weight loss (from loss of muscle, fluid and fat), tiredness and early onset of fatigue when training.

Carbohydrates are usually classified as two categories, the first being simple carbohydrates(sugars) and the other complex carbohydrates (starches).

Simple carbohydrates. Simple carbohydrates include all sugars such as fructose, lactose, glucose, sucrose, maltose, and galactose. Many sugars occur naturally in foods. Fruit contains fructose, milk has lactose and honey has both fructose and glucose.

Simple carbohydrates enter the blood stream quickly as there is less digestion involved and therefore provide an immediate energy source. Glucose is the simplest unit of sugar. Foods containing simple carbohydrates include fruit juice, soft drinks (unless artificially sweetened), jams, biscuits, lollies, sports drinks etc.

Complex carbohydrates. Complex carbohydrates are made of a large number of simple carbohydrates linked together. Complex carbohydrates take longer to digest and absorb than simple carbohydrates. Complex carbohydrates are eventually broken down into glucose. Foods containing complex carbohydrates include bread, pasta, rice, potatoes, corn, cereals and grains.

Carbohydrates have a protein-sparing effect in the body. This mean that if your diet has enough carbohydrate then muscle will not be broken down to make energy. Furthermore, a diet high in carbohydrates is usually low in fat. It is usually what you add to carbohydrate foods such as butter or margarine to bread, creamy sauces to pasta, frying potato to make chips, that make them fattening .

DAILY CARBOHYDRATE REQUIREMENT

In any training phase for body building carbohydrate should contribute **50-65% of total energy intake**. This means daily carbohydrate intake should range from **6 to 11 g/kg of body weight.** Carbohydrate intake beyond this range does not provide any additional benefits and is usually converted to fat.

Muscle glycogen is replenished at a rate of only 5% per hour. Total replenishment of the body's carbohydrate store takes a minimum of 20 hours provided adequate carbohydrate is consumed. The main dietary factors which influence the rate of muscle glycogen resynthesis are:

- ☆ The rate in which carbohydrate is consumed.
- ☆ The type of carbohydrate consumed.
- ☆ The timing of carbohydrate consumption after exercise.

The rate of glycogen resynthesis is faster during the first two hours after intense exercise, therefore, sufficient carbohydrate should be consumed either as a solid food or as a drink as soon as possible after exercise. During the first four hours after exercise, sportspeople should consume at least 50 grams of carbohydrate as soon after exercise as possible and they should eat at least an additional 50 grams every 2 hours until the next large meal is eaten. Since appetite is usually reduced after intense training, bulky foods may be difficult to eat so liquid meal supplements and sports drinks may come in handy.

The most important factor for glycogen resynthesis during the 4-24 hour period after exercise is the total amount of carbohydrate consumed. Refer to the carbo counter on the following page for a list of high fibre foods which may be consumed during this period. Some good food choices include 1.5 cups of pasta, 1 cup of rice, a large potato or 3 bread rolls. Each of these provides approximately 50g of carbohydrate.

CARBO COUNTER

FOOD	GRAMS PER SERVE
BREAD	
White bread	13g per slice
Mixed grain bread	12g per slice
Wholemeal bread	11 per slice
Rye bread (dark)	15g per slice
Raisin bread	17g per pocket
English muffin	30g each
Wholemeal lebanese bread	57g per pocket
Bread roll	30g each
Crumpet	17g each
CEREALS	
All-Bran	28g per cup
Bran Flakes	23g per cup
Fibre-Plus	22.4g per cup
Weet-Bix/Vita-Brits	19g per 2 biscuits
Rolled oats (porridge)	22g per cup
Corn Flakes	25g per cup
Muesli (untoasted)	33g per 1/2 cup
RICE & PASTA	
Egg noodles (cooked)	51g per cup
White pasta (cooked)	49g per cup
Wholemeal pasta	49g per cup
Brown rice (cooked)	57g per cup
White rice (cooked)	53g per cup
LEGUMES	
Red kidney beans	36g per 100g
Lentils (boiled)	26g per cup
Baked beans	16g per cup
FRUIT	
Apple (medium size)	18g
Apricot (2 medium size)	7g
Banana (medium size)	30g
Kiwi fruit (medium size)	8g
Orange (medium size)	9g
Pear (medium size)	25g
Sultanas	9g per tbsp
VEGETABLES	
Corn	20g per cup
Potato, with skin	16g per medium
Average vegetables	<7g per cup

TIPS TO INCREASE CARBOHYDRATE

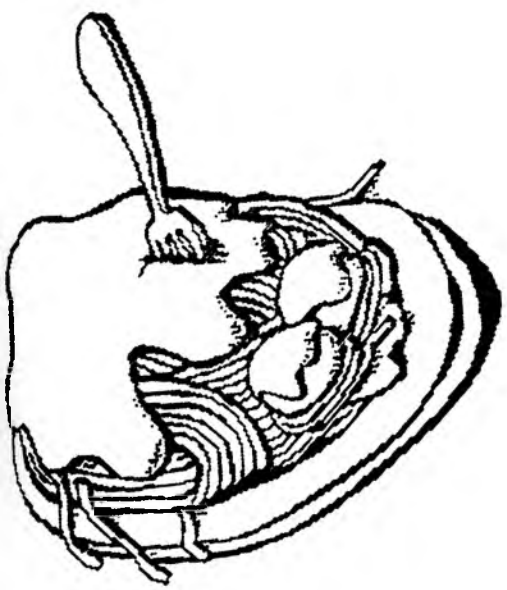
☆ **Eat carbohydrates at every meal** ie cereal and toast for breakfast, rice crackers or sandwiches for snacks, salad rolls for lunch and pasta rice or potatoes for dinner.

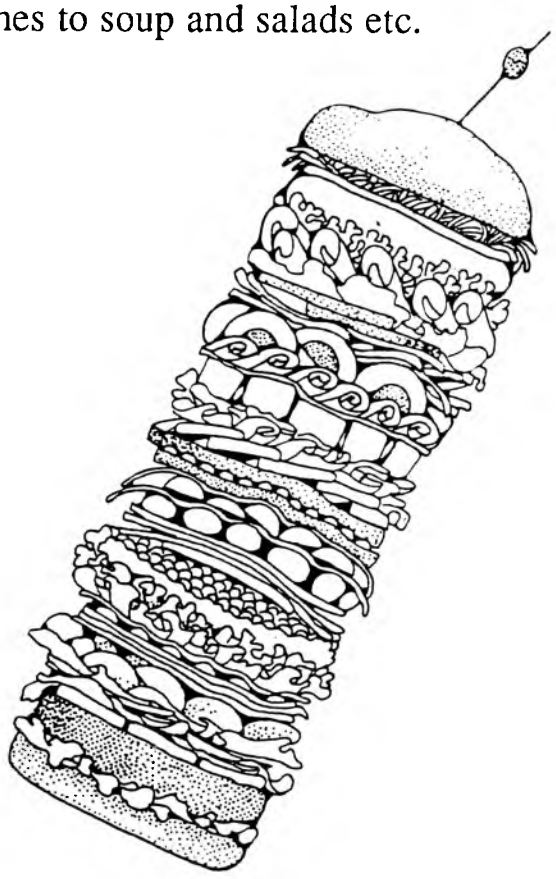
☆ **Make sure your plate is mainly carbohydrate foods.** Protein foods should only fill up 1/3 of your plate with carbohydrates and vegetables making up the other 2/3.

☆ Take **high carbohydrate snacks** to work with you ie dried fruit, sandwiches, muffins, potato salad, liquid meal supplements eg sustagen.

☆ **Add legumes to favourite dishes** ie add kidney beans to casseroles, lentils to stir fries, a variety of legumes to soup and salads etc.

☆ Eat a bread roll with dinner.





CARBO LOADING

Carbohydrate loading is practiced by body builders before a competition to increase muscle size and definition. There are a number of strategies used to carbohydrate load. Some of these strategies are more easily tolerated than other strategies.

Carbohydrate loading is achieved following several steps, the first step involves muscle glycogen stores being used up by long, exhaustive exercise, followed by 2-3 days of low-carbohydrate and low kilojoule diet. The second step involves stores being replenished by eating a high-carbohydrate diet and only doing a small amount of light exercise. This type of process will increase muscle glycogen stores 20%-40% or more above normal. Stage one of this process can cause several undesirable side effects, including physical and mental fatigue, depression, and irritability.

Due to the side effects of the previous method outlined, another method of carbohydrate loading which is recommended involves a 40-50% (by energy) carbohydrate diet which can be used along with a 6-day training taper. During the last three days of the training taper a 70% carbohydrate diet is used.

Glycogen is stored in muscle along with water, which body builders believe will cause some weight gain and the feeling of muscle stiffness and hardness.

PROTEIN

Although there are many nutritional factors that can affect strength training, protein is the single nutrient most often associated with strength improvement. Protein makes up about 12-15% of our body weight. Protein is important for:

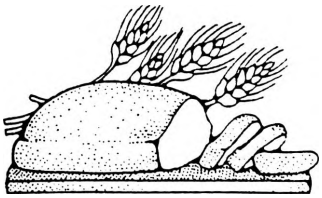
- growth and repair of cells and organs
- production of enzymes
- production of haemoglobin (which carries oxygen in the blood)
- production of antibodies
- production of hormones such as insulin and testosterone

Proteins are made up of amino acids. Eight of the twenty three amino acids cannot be made by the body and must be provided in food. These essential amino acids are isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. The remaining amino acids are called non essential amino acids as they can be made in the body at a rate appropriate for growth and repair of body tissues. For the body to use the amino acids, all amino acids must be present at one time. Foods which contain proteins with all eight essential amino acids are called **complete protein sources**. Such foods include meat, fish, poultry and eggs. Foods which contain proteins which do not contain all eight essential amino acid sources are called **incomplete protein sources.** Foods from this group include grains (eg bread, cereals, rice, pasta), legumes (eg baked beans, lentils, dried beans), nuts and seeds (eg peanuts, walnuts, tahini), and dairy products (eg milk, cheese, yoghurt). Vegetarian dishes are a great way to introduce both protein and carbohydrate into your diet. Legumes are a much cheaper alternative to meat and have

virtually no fat. See below for a guide to make complete proteins from incomplete proteins.

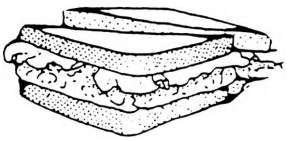
How to make a complete protein

Incomplete protein + **Incomplete Protein** = **Good quality protein**

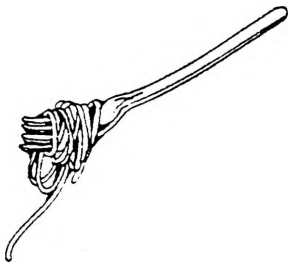


Grains
eg bread, cereals, rice, pasta

Legumes
eg baked beans, lentils, dried beans

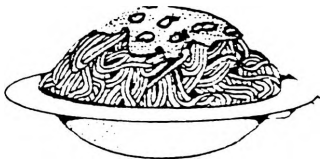


* baked beans on toast
* bean tacos
* rice, vegetables and bean casserole



Grains
eg bread, cereals, rice, pasta

Nuts & Seeds
eg peanuts, walnuts, tahini



* peanut butter on toast
* pasta with pinenuts
* pita bread with tahini

Adding **complete proteins** such as milk, dairy products or eggs to **incomplete proteins** of course makes protein combining very easy

Incomplete Protein + **Complete Protein** = **Excellent quality protein**

Grains
eg bread, cereals, rice, pasta

Milk & Dairy Foods
eg milk, cheese, yoghurt, eggs

* cereal with milk
* cheese on toast
* rice pudding

How much protein is needed?

Protein requirements for body builders are greater than those of the average Australian. Specific needs depend on a number of factors including:

	Effect on protein requirement
➠ exercise (type, intensity and volume)	⇑ with increased intensity and volume
➠ length of training period	⇑ with increased duration
➠ carbohydrate intake	⇑ if carbohydrate intake is inadequate
➠ energy intake	⇑ if energy intake is inadequate
➠ environmental conditions	
➠ quality of protein ingested	⇑ with incomplete protein intake
➠ steroid use	⇑
➠ age	⇓ with increasing age
➠ gender	⇑ males than females
➠ length of time involve in body building	⇑ in novices (training < 3 years)

Recommended daily intake of protein ranges from **1.0-2.3 g/kg/day** depending on the factors mentioned above. Protein should contribute 10-15% of total daily energy. **One gram of protein provides 17 kJ (4 cals)**

Increased dietary protein alone will not lead to increased muscle mass and strength. Without the proper strength training stimulus, excess dietary amino acids will be converted to fat and stored. Very high levels of protein can cause irreversible damage to the kidneys which may eventually lead to death.

To calculate your daily protein requirement do the following calculation:

☆ **Body weight = _____ kg**

☆ **Requirement = 1.0g-2.3g/kg body weight**

1.5g/kg of body weight is recommended for experienced body builders

2g is recommended for novice body builders (< 3 years training)

2.3g is advised for individuals using steroids

Daily requirement (g)= _____ (kg) x _____(g/kg body weight)

body weight requirement

To calculate the amount of energy you get each day from protein do the following calculation.

Amount of protein consumed (over 24 hours) _____ grams

Energy from protein = _____ x 17 kJ = _____kJ per day

amount of protein

(grams)

To calculate percent of protein from total energy intake do the following calculation:

☆ Total energy intake per day = _____ kJ

☆ Total daily energy from protein = _____ kJ

% total energy intake from protein = Energy from protein(.....) kJ

divided by Total energy intake(.....) kJ

Protein Counter

FOOD	GRAMS PER 100 GRAMS
MEAT	
Beef/Lamb/ Pork/Veal (cooked)	33g per 100g
Beef steak (lean & cooked)	28g per 100g
Lamb chop (cooked)	24g per 100g
Sausage (grilled)	12g per thick sausage
Bacon (lean. grilled)	9g per rasher
Chicken (baked, without skin)	28g per 100g
Hamburger mince (cooked)	27g per 100g
Brain (cooked)	13g per 100g
Kidney (cooked)	27g per 100g
Heart (baked)	32g per 100g
Tongue (cooked)	21g per 100g
Liver, lambs fry (grilled)	24g per 100g
SEAFOOD	
Fish (steamed)	23g per 100g
Salmon (canned)	23g per 100g
Tuna (canned)	23g per 100g
Prawns (cooked)	24g per 100g
LEGUMES	
Red kidney beans	13g per cup
Lentils (boiled)	10g per cup
Baked beans	13g per cup
Soy milk	9g per cup
DAIRY PRODUCTS	
Milk (full cream)	9g per cup
Milk (reduced fat)	12g per cup
Milk (low fat)	10g per cup
Milk (powdered)	10g per hydrated cup
Cheese (cheddar)	4g per slice
Cheese (low fat)	5g per slice
Cottage cheese	23g per 1/2 cup
Yoghurt (fruit, regular)	8.6g per 200g tub
Yoghurt (low fat)	5g per 200g
Icecream	2g per av serve

Protein Counter (continued)

FOOD	GRAMS PER 100 GRAMS
EGGS	
Egg white (boiled)	6g per 50g
Egg white (raw)	6g per 50 g
Egg yolk (raw)	8g per 50g
Egg (whole, boiled)	6.5g per egg
CEREALS	
Pasta (spinach, cooked)	4g per 100g
White pasta (cooked)	4g per 100g
Wholemeal pasta	6g per 100g
Brown rice (cooked)	3g per 100g
White rice (cooked)	2.3g per 100g
White bread	2.4g per slice
Wholemeal bread	3g per slice
Breakfast cereal	4g per serve
MISCELLANEOUS	
Meat pie	15g
Pizza (thin base)	18g per 2 slices
Hamburger (in bun)	18g
Peanut butter	7g per tbsp

TIPS TO INCREASE PROTEIN INTAKE

☆ **Include high quality protein at each meal** eg milk on cereal for breakfast, tuna/salmon/low fat cheese/baked beans/low fat meat on sandwiches, rice or pasta with lean meat for dinner

☆ **Have a high protein/ high carbohydrate snack after training** eg a smoothie made with skim milk, low fat fruit yoghurt and fresh fruit.

☆ **Choose low fat milks and yoghurts** as they usually have more protein than do the higher fat varieties.

☆ **Introduce more vegetarian protein sources into your diet** because you will benefit from both the carbohydrate and the protein.

☆ For **snacks** have low fat yoghurt with fruit or low fat cheese on sandwiches.

☆ **Add extra skim milk powder to your milk.** This is a low fat and more economical way to increase protein without using commercial powders or drinks.

☆ **Select lean cuts of meat** as they will have more protein per serve than the fatty alternatives.

☆ **Eat red meat at least three times** a day because an active person needs more iron.

Fat

The functions of fat within the body include:

- ☆ a source of energy
- ☆ transporters of fat soluble vitamins (vitamins A, D, E, K)
- ☆ synthesis of cholesterol
- ☆ production of associated steroid hormones eg testosterone

Fat delays gastric emptying, which means food high in fat is digested slower than low fat foods. Because of this meals high in fat tend to fill you up quicker so it is hard to eat enough carbohydrate.

Fat is very energy dense. This means that one gram of fat has over twice as many kilojoules or calories as protein and carbohydrate so it is easy to overdo energy needs when eating fatty foods.

Fat = 37 kJ/gram (9 calories per gram)
Carbohydrate = 16 kJ/gram (4 calories per gram)
Protein = 17 kJ/gram (4 calories per gram)

High fat intakes are associated with obesity, over weight, diabetes, high cholesterol, high blood pressure and heart disease.

Types of fat

Fats are described according to the chemical structure of their fatty acids as being saturated, monounsaturated or polyunsaturated. Most foods contain a mixture of a few types of fat.

Saturated fat - increases blood cholesterol. This type of fat is mainly found in animal foods eg butter, lard, meat and eggs but is also found in certain tropical plants eg coconut oil and palm oil.

Monounsaturated fat - has a neutral effect on blood cholesterol ie do not increase or decrease it. Monounsaturated fat is found in foods such as avocado, some nuts and canola oil.

Polyunsaturated fat - decreases blood cholesterol. It is found in foods including safflower oil, sunflower oil and corn oil.

How much fat is needed?

Fat should only account for less than **30% of our total daily energy intake**. This is about **50-90 grams** of fat daily. This amount includes all obvious fats such as butter, margarine, cooking oil and cream as well as fats hidden in foods. See the fat counter to calculate how much fat you have a day.

The types of fat should be present in our diet as a 1:1:1 ratio ie if you ate 60 grams of fat during one day 20 grams of that should come from saturated fat, 20 grams from monounsaturated fat and the remaining 20 grams from polyunsaturated fat.

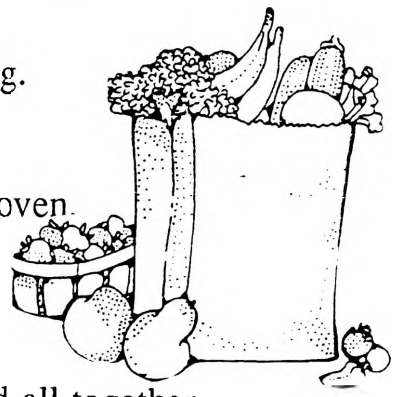
FAT COUNTER

FOOD	GRAMS FAT (per serve)
MEAT	
Bacon (with fat)	14g per rasher
Bacon (lean)	3g per rasher
Beef rump steak (with fat)	26g per 150g
Beef rump steak (lean)	8g per 120g
Beef mince (regular)	15g per 150g
Beef mince (diet/lean)	6g per 120g
Lamb shoulder	32g per 150g
Lamb shoulder (lean)	8g per 120g
Lamb cutlet	36g per 3 cutlets
Lamb cutlet (lean)	17g per 3 cutlets
Chicken breast (with skin)	12g per 140g
Chicken breast (skinless)	4g per 110g
Fish (fried)	18g per 150g
Fish (grilled)	5g per 150g
Tuna in oil	2g per tbsp
Tuna in brine	<1g per tbsp
Salami	12g per slice
Devon	5g per slice
LEGUMES	
Red kidney beans	1g per cup
Lentils (boiled)	0.5g per cup
Baked beans	2g per cup
Soy milk	9g per cup
DAIRY PRODUCTS	
Milk (full cream)	10g per cup
Milk (reduced fat)	2.5g per cup
Milk (low fat)	0.5g per cup
Milk (powdered, skim)	trace
Cheese (cheddar)	10g per 30g
Cheese (low fat)	3g per slice
Cottage cheese	23g per 1/2 cup
Yoghurt (fruit, regular)	4.2g per 200g tub
Yoghurt (low fat)	0.2g per 200g
Icecream	2g per av serve

FAT COUNTER
(continued)

FOOD	GRAM PER SERVE
EGGS	
Egg white (boiled)	0g per 50g
Egg white (raw)	0g per 50 g
Egg yolk (raw)	8g per 50g
Egg (whole, boiled)	11g per 100g
CEREALS	
Pasta (spinach, cooked)	1g per 100g
White pasta (cooked)	1g per 100g
Wholemeal pasta	1g per 100g
Brown rice (cooked)	1g per 100g
White rice (cooked)	0.2g per 100g
White bread	2.4g per slice
Wholemeal bread	3g per slice
Breakfast cereal	4g per serve
MISCELLANEOUS	
Meat pie	15g
Pizza (thin base)	18g per 2 slices
Hamburger (in bun)	18g
Peanut butter	7g per tbsp

Tips for reducing fat in your diet.



- Grill or barbecue meat, fish and poultry instead of frying.
- Cut all fat off meat before cooking.
- Bake meat on a rack to drain off fat when baking in the oven.
- Buy lean meat.
- Use non-stick pans when frying.
- Use cooking oil, margarine and butter sparingly or avoid all together.
- Do not eat skin of chicken or crackling of pork.
- Avoid all fried foods.
- Limit nuts, cakes, pastries and biscuits.
- Use "fat reduced" or "low fat" dairy products.
- Choose products with less than 10g fat/100g.
- Compare products by looking at their fat content.
- Have tomato based sauces or lean meat sauces on pasta rather than creamy sauces.
- Dress salads with oil-free dressing.
- Modify favourite recipes to reduce fat content.
- When browning or stir frying substitute a little water or soup stock for fat or use a non-stick pan.
- Season with herbs and spices rather than sauces, margarine or butter.
- Use low fat yoghurt rather than sour cream or mayonnaise.
- Use low fat cottage cheese or ricotta cheese instead of cream cheese.
- Replace some meat with legumes (eg lentils, kidney beans).