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Nutritional Status and Body Composition of New Zealand Jockeys

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Abstract

A requirement of the horse racing industry is for jockeys to achieve and maintain a low body weight. This potentially impacts on their food and fluid intake which may in turn influence both their short and long term health.

The purpose of this study was to determine the nutritional status, eating behaviours and body composition of jockeys working in the New Zealand Racing Industry.

Twenty jockeys, 9 senior (4 males, 5 females) and 11 apprentice (2 males, 9 females) were recruited. Questionnaires were used to provide demographic data, information on eating habits, smoking, and attempted practices in ‘making weight’. The Eating Attitudes Test-26 (EAT-26) was used to determine the presence of disturbed eating patterns. Jockeys completed 7-day weighed food records and Dual Energy X-ray Absorptiometry (DEXA) was used to determine bone mineral density (BMD) and body composition. Several indices were measured to determine iron status.

Mean age of senior and apprentice jockeys was 28.7 ± 5.0 yrs and 20.5 ± 3.8 yrs respectively. There was a significant ($p < .05$) weight difference between male and female jockeys (52.8 ± 2.4 kg vs 49.3 ± 3.4 kg) however there was no difference between their body mass index of 20.1 ± 1.5 kg/m^2 and 20.2 ± 1.5 kg/m^2 . Sixty-seven percent of jockeys used a variety of methods to ‘make weight’, including; diuretics, saunas, hot baths, exercise, and the restriction of food and fluids.

Twenty percent of jockeys had scores above the ‘cut off’ of 20 for the EAT suggesting some level of disordered eating. There was no significant difference ($p > .05$) between the mean scores for male and female jockeys.

Mean energy intake for male jockeys was 6769 ± 1339 kJ and for females 6213 ± 1797 kJ per day and the percentage of energy from carbohydrates (CHO) for all jockeys was 45.5 ± 7.9 . Energy and CHO intakes were below the recommendations for both the athletic and non-athletic populations. Male and female jockeys did not meet the RDI for a number of micronutrients.

Forty-four percent of jockeys were classified as osteopenic (2 males, 6 females). A number of factors may have contributed to this outcome, namely; reduced calcium intake, delayed menarche (14.5 yrs) in female jockeys, alcohol intake and smoking. There was a significant ($p < .05$) difference in the BMD of the distal wrist measurements compared with the measurements at the other three sites; lumbar

spine, total body and femoral neck. Mechanical stress placed on the wrist while riding may have increased the BMD of that area.

Percentage of body fat of male and female jockeys was 11.7 ± 2.9 and 23.6 ± 3.8 and for female jockeys this was greater than the recommendations for these athletes.

Iron status was normal in all jockeys.

The New Zealand Racing Conference has imposed weight restrictions on jockeys in the horse racing industry. As a consequence of this a number of jockeys compromise their nutritional status which may influence their sporting performance and both their short and long term health.

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Contents

1	Introduction	1
2	Literature Review	
2.1	The Early Days	3
2.2	Contemporary Practice	4
2.3	Benefits of Optimal Nutrition	
2.3.1	Macronutrients	5
2.3.2	Micronutrients	9
2.3.3	Supplementation	12
2.4	Body Weight Management	
2.4.1	Making Weight Practices	13
2.4.2	Body Composition	16
2.4.3	The Apprentice Years	17
2.4.4	Rules of Racing	17
2.4.5	Changing Times	19
2.5	Consequences of Making Weight	20
2.6	Eating Disorders	22
3	Methods	25
4	Results	
4.1	Anthropometry	28
4.2	Questionnaire- General	28
4.3	Questionnaire- EAT	30
4.4	Questionnaire- Menstrual Status	31
4.5	Activity/Exercise	31
4.6	Dietary Analysis	31
4.7	Bone Mineral Density	36
4.8	Body Composition	37
4.9	Iron Status	38
5	Discussion	39
6	Conclusion	52
	References	55

Appendices

1	Literature Review Databases	67
2	Consent Form	69
3 A	Questionnaire- General	71
3 B	Questionnaire- EAT	77
3 C	Questionnaire- Menstrual Status	79
4 A	Weighed Food Record Sheets	81
4 B	Instruction Sheet	83
4 C	Training/Activity/Making Weight	85
5	DEXA	87
6	Results of Questionnaire	89

List of Tables

Table 2.1	Anthropometric Comparison Between Jockeys and New Zealand Population Norms (Mean)	..... 15
Table 4.1	Age and Athropometric Measurements of Jockeys	.... 28
Table 4.2	Attempted Practices to 'Make Weight' (%)	.... 29
Table 4.3	Current Practices of Attempting to 'Make Weight' (%)	.... 30
Table 4.4	Eating Attitudes Test (EAT)	.... 31
Table 4.5	Macronutrient Analysis of 7-Day Weighed Food Records	.... 33
Table 4.6	Micronutrient Analysis of 7-Day Weighed Food Records	.... 34
Table 4.7	Mean T-scores of Bone Mineral Density at Selected Sites	.... 37
Table 4.8	Percentage of Body Fat for All Jockeys	.... 37
Table 4.9	Iron Status Measurements for Jockeys	.... 38

1 Introduction

Horse racing is a major industry in New Zealand and has played a significant role in the culture of New Zealanders. Racing takes place throughout the year as there is no specific racing ‘season’. The industry employs thousands of workers and generates millions of dollars to the economy (1). There are a number of significant players that contribute to the world of racing and none more so than the professional jockey (2). The typical jockey is small in stature and light in weight and the laws governing weight regulations are laid down by the ruling racing body- ‘*New Zealand Racing Conference*’ (3). Weight control and disciplining the body are learnt early in the apprentices’ careers (4). They become very conscious and concerned about their food intake, and eating and drinking continues to be a strong focus throughout their professional lives (5, 6). This is promoted by the immediate environment where the apprentice jockey lives and works, and also by the wider horse racing community that reinforces or protects the apprentice’s small size. Apprentice jockeys quickly learn that their lightweight size is an important and necessary attribute to their success as a jockey (4). If they cannot control their weight it is the finish of their careers (7).

There are very few jockeys who can avoid the constant war against weight and jockeys have been known to use a number of practices in order to ‘*make weight*’ (2, 8). ‘*Making weight*’ is a practice that jockeys use to achieve a certain weight in order to ride a particular horse at a specified weight determined by New Zealand Racing Conference Handicapper. The allowed weight not only includes the jockey but the saddle, stirrup (irons and leathers), girth and rubbers (towel or sponge) (3).

Attempts to ‘*make weight*’ often involve rapid weight loss methods and there are a number of studies that have shown the detrimental effects of such practices amongst athletes, particularly those competing in weight category sports, for example, wrestling and weight-lifting (9, 10). Possible adverse consequences include; impairment of performance, compromised physical and mental health, and impediment of normal growth and development (11).

This literature review will consider the current reported dietary practices of jockeys and determine if these do in fact influence their health and body composition. Because of the dearth of information reported in the literature on the dietary practices of jockeys both nationally and internationally it is necessary to consider athletes in other sports who also experience difficulties in making weight or where weight is considered of primary importance. This literature review also covers the early days of racing from around the world, with the main focus on the life of jockeys. This is important as it provides a comparison with contemporary jockeys and not surprisingly, a number of issues that jockeys have to contend with today were very similar to their earlier peers. Some of the information that has been sourced for this historical perspective have come from non-academic researchers and therefore at times the accuracy and the detail of events tend to be lacking. However even though this is the case, it is important to acknowledge that these writers have contributed significantly to the early history of horse racing and provided some very pertinent information to this researcher. A number of different databases have been used for this literature review (appendix 1).

2 Literature Review

2.1 *The Early Days*

The first horses arrived in New Zealand in 1814 at a place called Rangihoua in the Bay of Islands. These horses were landed by Rev. Samuel Marsden and they were to be used by the missionaries in their work (12). Other horses also arrived over the next few years and it has been recorded that the earliest race meetings were organised by the military garrisons or by the settlers celebrating the anniversaries of their districts. However no data is available that clearly states the actual dates of these early races. The first thoroughbred horse arrived in New Zealand in 1840 and this was the beginning of racing as we know of today (2).

The earliest jockeys in New Zealand had a difficult life with little or no standing in the community. This was aptly illustrated by the Melbourne Wire: “Richard Bennison, a jockey, aged fourteen, while riding William Tell in his training, was thrown and killed. The horse is luckily uninjured”. It was reported that even in those days his prime problem was his weight and his ability to keep it down. Jockeys who were unsuccessful in achieving this became shepherds, fencers or general farmhands while others who left for the city became coachmen or livery attendants (12).

In Britain the apprentices were recruited at an early age as trainers preferred them young as it provided them with a steady stream of lightweight jockeys. However there was some concern that the lightweight jockeys were not as strong as their heavier peers and that this may have placed them at greater risk for causing accidents during races. In 1860 Lord Redesdale proposed that Parliament legislate that the minimum weight for jockeys be seven stone for all races. This Bill was withdrawn after the Jockey Club themselves set a minimum of 5 st. 7 lb (later raised to seven stone in the 1920’s). Most jockeys had to waste in order to achieve the lighter weights for the racing season. Some had ‘put on’ a significant amount of weight during the winter months and had to shed a stone, many jockeys two stone and some even more (7). The basic methods employed in those days were sweating and diet.

Tramping across country dressed in heavy clothes was a popular option, others chose the Turkish bath however it was reported that this tended to 'sap' their strength. As nutritional knowledge was not available in the nineteenth century jockeys virtually starved themselves. Other methods were also used: 'George Barrett did eat well but after his meals he stuck his fingers down his throat'. Even in those times purgative medicines were used- 'Archer's standard fare was warm castor oil, an occasional strip of dry toast, and half a glass of champagne or half a cup of tea with a drop of gin in it'. Due to the stresses of their working lives many jockeys consumed alcohol and it was the curse of the old school of jockeys. Unfortunately it ruined many careers (7).

During the racing season jockeys were unable to enjoy life to the full. They were fearful that overstepping the mark would be reflected in the scales. Therefore self discipline was an important ingredient for the jockey. Jockeys who struggled with their weight placed great strain on their bodies and with continued attempts to starve off, weakened their constitutions and became susceptible to illness. In fact for jockeys tuberculosis was almost an occupational disease (7).

2.2 Contemporary Practice

The apprentice jockey's life is a busy one. Generally the jockey awakens at 4.30am (although this does depend on the trainers training schedule) and works until 5.00pm. A two hour lunch break in the afternoon is an opportunity to rest and catch up on some sleep. Daily duties include; mucking out boxes, riding track work, feeding, grooming the horses and learning the necessary skills to ride a race horse. When the trainer believes the apprentice is a competent enough rider, the trainer will organise their first trial run. Trials are held weekly and are an opportunity for horses to gain simulated race day experience. Betting does not occur at trial meetings. Once the apprentice has shown competence at trials the trainer will then organise their first official race course ride (4). Jockeys who show talent and who become proficient at riding, will ride regularly at race day meetings. A top apprentice will race 2-4 times per week, the same as a senior jockey. The apprenticeship lasts for four years and the jockeys are not eligible to become licensed until 20 years of age.

Senior jockeys also lead busy lives. Their day usually begins early in the morning with 3-4 hours track work and after this they may attend either trial or race day meetings. Track work is normally done 5-6 days per week. Trial meetings are held in their local area, and they probably attend one trial meeting on average per week. A jockey can ride anywhere between 2 to 22 horses at a trial meeting over varying distances. Most jockeys will ride in between 2-4 race meetings per week. Their first race may start at 11.00am and finish at 5.50pm in the evening. Some jockeys may have 1 ride while others may ride 7-8 horses at a particular race day meeting. They may be asked to ride in races anywhere in the country, however jockeys in the Waikato area will generally only race in the North Island. A small number of jockeys on occasions, will travel overseas to ride in race day meetings. Travel can therefore be a major component of the jockey's lifestyle. Most jockeys will have one day off per week, generally on Sundays, however in the Auckland/Waikato racing area, 18 race days were scheduled on Sundays for the 1997 season (13).

2.3 Benefits of Optimal Nutrition

It is now widely accepted that nutrition plays a pivotal role in any sporting performance (14). Advice to athletes needs to be individualised and each sport has its own specific dietary requirements (15). Athletes are known as a group of highly motivated and competitive individuals. Often they are on the lookout for a competitive 'edge' and this may lead some athletes to follow extreme forms of dietary practices. This may also include the use of nutritional supplements that athletes often think will enhance their sporting performance. Various forms of dietary extremism may be harmful to an athlete's performance, have undesirable side effects and also influence their long term health status (14).

2.3.1 Macronutrients

Research has clearly demonstrated that carbohydrates (CHO) play a key role in exercise performance. Since the mid-1930's it has been known that dietary carbohydrates enhance performance during endurance exercise (16). Consuming CHO foods results in the storage of muscle and liver glycogen (17). The quantity of muscle glycogen stored can be influenced by several factors: status of training, prior

exercise and the CHO content of the diet. Severe fatigue through exercise has been correlated with the depletion of muscle glycogen stores. The rate of depletion is also dependant on a number of factors, namely; exercise intensity, exercise mode, environmental temperature, pre-exercise diet and physical conditioning (18). It has been recommended that the CHO requirement for an athlete as a percentage of energy is between 55-70 % (19). In a study on jockeys by Labadarios et al., the mean percentage of carbohydrate to total energy intake was 43.4 % calculated from seven-day food records and 43.2% calculated from diet histories, well below the recommended levels (8). Athletes who compete in endurance events or who are in heavy training should aim for 65-70 % of energy from CHO (20, 21). Guidelines have also been set for CHO requirements based on a athlete's body weight and their duration and intensity of training (15). For example; athletes who train between 60-120 minutes per day, consisting of intense or lengthy medium intensity exercise have a carbohydrate requirement of between 6-8 grams per kilogram of body weight (15).

Protein requirements for optimal athletic performance has been debated in the literature for over 100 years (22). However there is now clearer evidence that athletes do have increased requirements above the current recommended daily allowance (RDA)- 0.8 g/kg body weight (23). There are a number of mechanisms that reflect these increased requirements, namely;

- a) protein contributes to the fuel requirements of the exercise
- b) protein provides the raw materials in conjunction with resistance training to increase muscle bulk
- c) extra protein is necessary to assist in the repair of any exercise induced muscle damage (14, 23)

In general the protein requirements for an athlete is between 12-15 % of total energy intake (19, 20). Labadarios et al., calculated the mean percentage of protein to total daily energy intake of jockeys from seven-day food records and diet histories to be both 15.2 % respectively (8).

Another method of calculating protein requirements is by using x grams of protein per kilogram of body weight to determine an individuals needs, for example; strength athletes probably require about 1.4-1.8 g/kg/day and endurance athletes about 1.2-1.4 g/kg/day (23). Most New Zealanders are renown for having a large protein intake. Results from the 1989 Life in New Zealand Survey show that the median protein intake for adult males between the ages of 25-44 years is 94 grams per day (24). This is 170 % greater than the recommended dietary intake (RDI) of 55 grams (25). For adult women between the ages of 25-44 years their median protein intake is 60 grams per day, which is 130 % greater than the RDI (24, 25). Most New Zealand athletes do not need to intentionally increase their protein intake as their normal intake is sufficient to meet the extra demands placed on them by their sport.

For an athlete fat should be restricted to less than 30 % of total energy (19, 20). Not only will this allow for a high CHO intake but it may also provide greater protection against coronary heart disease and reduce the risks of other diseases associated with an excessive fat intake (19, 26, 27). In a study considering the food intake of jockeys the percentage of fat to total daily energy intake was calculated to be between 34-35 % (8). However like all nutrients fat is extremely important and beneficial in appropriate quantities. Fat is not only a good source of energy but it also provides the important essential fatty acids and fat soluble vitamins (17).

There has been recent debate suggesting that an increased fat intake may improve endurance performance by increasing free fatty acids utilisation which in turn spares the oxidation of carbohydrates (28, 29). Muoio et al., suggests that a higher fat diet may increase intramuscular triglycerides levels which may provide an advantage to endurance athletes (30). Although there is insufficient data and conflicting results in the literature to draw any firm conclusions, continuing research into the role of medium-chain triglycerides in exercise will continue this ongoing debate (31, 32).

Fluid intake and replacement is extremely important for optimal sporting performance. Water body deficits and electrolyte imbalance can adversely affect cellular and systemic function. Dehydration due to fluid losses through sweating can result in alterations to circulatory, thermoregulatory and metabolic functions (10).

It has been shown that even a very small amount of dehydration, ie; 1 % of body weight, can elevate heart rate during exercise and limit heat transfer to the body's surface (11). When dehydration approaches a loss of 10 % body weight this then becomes life threatening (9). It is therefore extremely important that athletes are adequately hydrated before and during the event and the American College of Sports Medicine (ACSM) have provided the following practical guidelines for this area:

- 1) It is important to consume adequate fluids during the 24-h period before an event
- 2) It is recommended that athletes consume approximately 500 mls of fluid 2 hrs before exercise
- 3) During exercise athletes are encouraged to drink fluid at a rate that closely matches fluid loss through sweating (11)

It is also important that athletes ensure that they are fully hydrated after exercise especially as it is extremely difficult to replace all fluid losses through sweating during exercise. A supply of palatable drinks should be available and accessible following exercise. Sweetened drinks tend to be preferred (33).

There are no studies that have specifically considered the fluid intake or hydration status of jockeys. However, there are a number of studies that have shown that the weight loss methods used by jockeys 36 hours before a race and the actual amount of rapid weight lost, must result in some degree of dehydration (8, 34, 35, 36, 37). In the Auckland Sleepyhead Derby race held in December 1997, a jockey was stood down from this race as the official doctor at the course assessed that the jockey was unfit to ride due to dehydration. The jockey concerned was extremely upset, "They say I could cause a fall. What a lot of nonsense. The doctors say I'm dehydrated. Every jockey in that Jockeys' Room is dehydrated" (38). Obviously jockeys themselves are well aware that certain weight loss methods result in some dehydration. There is certainly no time during races for a jockey to consume fluids and if weight is an ongoing issue there is probably little fluid drank during a race day, until the last ride has finished.

2.3.2 Micronutrients

An athlete's iron status is crucial for optimal sporting performance because of its vital role in oxygen transport around the body and with aerobic metabolism (9). Iron deficiency appears to be a common nutritional problem among athletes. Some of the possible causes include:

- mechanical haemolysis
- inadequate dietary intake
- sweat losses
- increased losses due to menstruation
- haematuria
- gastrointestinal losses

(19, 39)

There are three stages in the development of iron deficiency, namely;

- iron depletion (low serum ferritin)
- iron deficiency (low serum ferritin, low serum iron, raised total iron binding capacity)
- iron deficiency anaemia (low serum ferritin, low serum iron, raised total iron binding capacity, low haemoglobin)

(40)

There is some evidence that iron depletion and deficiency may produce adverse affects on work performance (14). However evidence is quite clear that iron deficiency anaemia negatively affects athletic performance (20). A pseudoanaemia called '*Sports Anaemia*' is also seen in athletes, and even though iron status measurements are low there is little cause for concern as this is a direct result of an

increase in plasma volume due to training effects, and hence no treatment is required (41, 42).

There are no studies that have considered the iron status of jockeys. It is hypothesised by this researcher that this type of sporting activity is a combination of weight and non-weight bearing exercise. Sports that are primarily weight bearing, can cause greater iron losses due to mechanical haemolysis. An example of this is in distance runners, who are at greater risk for iron deficient states (43, 44). As the type of activity of jockeys is probably a combination of weight and non-weight bearing exercise, haemolysis would seem to be a less likely cause of iron deficiency and hence it is reasonable to suggest that a compromise in iron status could be due to:

- 1) inadequate dietary iron intake
- 2) losses due to menstruation

Calcium has a number of important functions in the human body, namely;

- coagulation of blood
- formation of bone and teeth
- muscular contraction
- maintenance of normal excitability of nerve and muscle (45)

Calcium has an important part to play in the prevention and treatment of osteoporosis. Adequate calcium intake will contribute to optimal skeletal size and calcium supplementation is used to treat people with osteoporosis to arrest further bone loss, however it will not increase bone mass (46, 47). It is estimated that nutrition and exercise contribute about 20 percent of a person's bone mass (48). In a study by Myburgh et al., athletes with stress fractures were more likely to have a lower bone density and lower calcium intake than those athletes with no history of bone injury. Mean calcium intake for the injured subjects was only 87 % of the

recommended daily allowance (RDA). This study also found that athletes who had calcium intakes above 120 percent of the RDA had a decreased risk of stress fractures (49).

There are a number of occupational injuries that jockeys sustain over their career and the commonest injury reported is fractures with over 60 % of jockeys reporting a fracture during their career (50). There are also a number of serious injuries to the head, neck and spine (51). This is probably not surprising as professional horse racing has been described as a hazardous enterprise (52). In New Zealand, horse riding has a high incidence of sports injuries (53). Research by Peres has showed that for apprentice jockeys bone density values were below normative values (54). One could postulate that the incidence of fractures is caused by the hazardous nature of the sport or by the reduced bone density of jockeys or a combination of both.

There is an increasing incidence of athletic amenorrhoea (absence of regular menstrual cycle) in the female athletic population, particularly with gymnasts, ballet dancers and distance runners (55, 56). There is concern that the consequence of menstrual dysfunction, namely; diminished bone mass will result in an increased risk of osteoporosis later in life (56). Research also suggests that runners with athletic amenorrhoea have an increased risk for stress fractures (57, 58, 59). In a recent study by Kirchner et al., gymnasts had greater menstrual irregularity compared to non-athlete matched controls, however their bone mineral density was significantly higher. However only two gymnasts could be classified as amenorrheic (60). There are a number of studies that tend to indicate that diet plays a key role in amenorrhoea. Nutritional issues that are implicated in athletic amenorrhoea are:

- low energy intake
- vegetarian diets
- low fat intake
- low calcium intake
- excessive fibre intake (55, 61)

Recommended calcium intake for this condition is 1500 mg per day and other important nutrition issues must also be addressed (19). This is significantly greater than the recommended dietary intake of 800 mg per day for adult New Zealanders (25).

2.3.3 Supplementation

Vitamin and mineral supplements are widely used by athletes. In a review of 15 sports by Sobal and Marquart they found 46 % of athletes were using supplements. Athletes who compete at the highest levels tend to use more supplements and women use more supplements than males (62). There is very little research on the supplement use of jockeys. Apted who investigated the lifestyle of 9 jockeys, recorded that 6 of those interviewed felt vitamin supplements were unnecessary. It is unclear from the study whether the other 3 jockeys were actually taking supplements (35). The only other reference to supplement use by jockeys in the literature is in an article by Hovdey, whereby one of the greatest riders in the world, "lavished his body with the best in vitamin and mineral supplements" (6). Supplement use among athletes tends to be higher than the general population as a telephone survey in the United States revealed that 39.9 % of adults consumed one or more supplements. Again supplement use was more prevalent among women than men (63). It is important to note that there are differences in reported results for dietary supplement use for both athletes and the general population and that these tend to be the result of methodological differences in collecting information (64).

Ergogenic (work enhancing) aids are also used by athletes as these are thought by athletes to improve their performance. There is very little scientific evidence that proves the efficacy of most of the commonly sold ergogenic aids, however there are a small number that may be beneficial to particular athletes in specific sporting events (14, 19).

In a review of the literature Greenhaff has concluded that by ingesting creatine, performance can be improved during repeated bouts of high intensity exercise (65). However recent research does not support the hypothesis that creatine supplementation enhances performance of high intensity short duration exercise (66, 67, 68). Further research is needed to resolve conflicting findings (66). Caffeine is

also known as a ergogenic aid and a review of the literature indicates that caffeine ingestion prior to exercise enhances performance during short term intense exercise and prolonged endurance exercise (69). In a study by Trice and Haymes they found that trained subjects when cycling intermittently at high levels of intensity and who consumed caffeine (5 mg/kg body weight) 1 hour prior to exercise, were able to increase their time to exhaustion by 29 percent (70). In another study by Cole et al., caffeine ingestion resulted in an increased work output at a given exertion level of 9 on the Borg Rating of Perceived Exertion scale. These results indicate that the ergogenic effect of ingesting caffeine on performance affects both substrate availability and the neural perception of effort (71). Other reviewers are cautionary as to the ergogenic effect of caffeine and that individual response to caffeine is variable. The International Olympic Committee (IOC) has caffeine on the list of controlled substances and the maximum amount allowed in urine is set at 12 µg/ml (14). There is reasonable evidence to suggest that by ingesting bicarbonate salts before high intensity exercise, that the adverse effects of acid accumulation is reduced with a corresponding improvement in performance. However results in the literature tend to be variable (72). There is no reference in the literature to the use of ergogenic aids by jockeys to improve athletic performance.

2.4 Body Weight Management

2.4.1 Making Weight Practices

As already discussed, nutrition is extremely important if athletes wish to optimise their sporting performance and their health. However because jockeys have difficulty in ‘making weight’, a number of them impose severe dietary restrictions on themselves in order to make a specified weight requirement (34). Occasionally there is the odd jockey who is a natural lightweight (7, 73, 74). Techniques to achieve weight loss include; severe restriction of food and fluid intake, exercise, fasting, use of saunas, hot baths, laxatives, diuretics, plastic running suits and purging (also known as flipping) (8, 34, 35, 36, 75, 76, 77). In a study of 93 senior jockeys in South Africa it was found that:

- * 77 % used dieting (short-term reduction/cessation of food/fluid intake)

- * 70 % used saunas
- * 80 % exercised (48 % also wore 'sweat clothes')
- * 27 % used hot baths
- * 70 % used diuretics
- * 27 % laxatives
- * 48 % appetite suppressants (8)

Each individual jockey experiments to determine what technique best suits them and a number of different methods may be used by a particular jockey (8, 35). The champion New Zealand jockey Grenville Hughes even built a sweatbox at the end of his garage so he and his jockey pals could shed a few pounds (37). In a recent case report by Bishop and Deans, an ex-professional jockey was referred to the Hospital Dental Services by his general dental practitioner because of substantial 'tooth surface loss' (TSL). Through questioning, the jockey admitted that during his twenty odd years of horse racing, he used regurgitation to control his weight. As a result of this practice the acid in the regurgitation had caused the TSL. This jockey also stated that this practice was common amongst his colleagues (78).

It has also been reported that a number of jockeys use smoking as a means to control their weight and in one study 58 % of jockeys used this as a weight control method (8, 35). Smoking may offer a distinct advantage to jockeys as studies indicate that smokers tend to weigh less than non-smokers and that smoking may increase resting metabolic rate (79, 80). It has also been suggested that nicotine has an appetite suppressing influence on women (81). However smoking is extremely detrimental to a person's health as it increases the risk of heart disease, stroke and cancer (82). It is hypothesised by this researcher that for a jockey who smokes it would be extremely difficult to give up not only because of the addictive nature of the habit but because cessation of smoking generally results in weight gain (83, 84, 85, 86).

In a study by Labadarios et al., 66 % of the jockeys were unable to maintain a constant body weight and 64 % had increasing problems maintaining an appropriate

body weight for a particular race. Their weight was a continuous problem for them even though their average body weight was only 52.9 kg and only 5 out of the 93 jockeys studied were above their ideal weight for age and height. For the majority of those jockeys weekly weight loss was a constant battle. Some (58 %) regularly lost up to 2 kg for a race meeting, others (33 %) lost between 2- 4 kg and a very small number (3 %) lost 4-6 kg per week. A limitation of this study was that only male senior jockeys were recruited (8). It has also been suggested that increasing weight may be a face saving device for jockeys who see their future in racing has ended (7).

From the previous study it is interesting to compare height, weight and body mass index (BMI) in relation to the New Zealand norms for anthropometric data. (Table 1). The average age for the jockeys 27.8 years (range: 19-55). Comparison with the N.Z. data (collected 1989) will be made with males between the age range 20-29 years.

Table 2.1 Anthropometric Comparison Between Jockeys and New Zealand Populations Norms (Mean)

	JOCKEYS (8)	NZ DATA (87, 88)
Weight (kg)	52.9	75.9
Height (cm)	160.9	176.6
BMI (kg/m^2) *	20.4	24.3

* BMI- weight (kg)/height (m^2)

Table 1 shows that jockeys are lighter and shorter than men of a similar age. However their BMI is significantly lower which implies they are proportional lighter for their height compared to the general population. In a second study 3 jockeys out of the nine subjects had a Body Mass Index (BMI) less than 20, which is considered underweight for an individual (35, 25).

It has been estimated that 95 % of jockeys have a weight problem (6).

2.4.2 Body Composition

For an athlete not only can body weight be an important consideration but body composition should also be an important component of body weight management (19). Guidelines have been established for the percentage of body fat for athletes, namely:

Males →	5-15 %	
Female →	12-20 %	(19, 89)

The American College of Sports Medicine have tried to establish clear guidelines as to the appropriate body composition of wrestlers. This has been the result of the continued ongoing concern of the rapid weight loss practices of these athletes (89). Measurements such as body fat percentages or total sum of skinfold measurements provides Sports Scientists with data to assist athletes determine a safe and ideal body weight. Weight loss should also primarily be fat loss rather than fat-free mass (15, 90). Being over-fat typically adversely effects athletic performance (90). It is generally recommended that increased fat-free mass is desirable for athletes that require power, strength and muscular endurance. However determining the ideal body composition of an athlete is sport specific (91). Wilmore and Costill have attempted to establish recommended guidelines for percent body fat for jockeys, namely;

Males →	6-12 %
Female →	10-16 %

The values quoted by Wilmore and Costill for various sports in this particular reference, are generally representative of elite athletes in those sports (91).

There are a number of studies that have considered the body composition of athletes where weight is a primary focus, but these lack consistency. In one study by Cohen et al., the mean percentage of body fat for male ballet dancers was 7.82 (range: 5.7-

10.4) and for the women dancers the mean was 12.9 % (range: 9.7-15.0) (92). However, Hergenroeder et al., found male ballet dancers to have a mean percentage of body fat of 14.5 and female dancers of 20.1 %. Amongst male wrestlers body fat has been reported at 9.8 % (93). In a study involving 93 male jockeys, with a mean age of 27.8 years, the average body fat was 11 %. Twenty-eight percent had body fat less than 10 % and 5 % greater than 15 % body fat. This was calculated by measuring the skinfold fat thickness at four body sites. However the equation used to determine this was not stated in the study (8). There are a number of techniques for assessing body composition. Each with inherent errors and limitations and this may be one factor that contributes to the variability of results (91, 94).

2.4.3 The Apprentice Years

Currently nearly 50 % of apprentice jockeys in New Zealand are women and New Zealand has emerged as a world leader in accepting women as equals in the racing industry (95). It has been suggested that women have an advantage over male jockeys in maintaining a certain weight due to a natural lower muscle mass than men and that gender socialisation gives them greater control over their bodies (17, 34). In New Zealand women are lighter than men for all age categories (87). However a number of apprentice jockeys are dogged by weight problems and may be forced to leave their apprenticeship due to rising weight (4, 5, 96). ‘Pushing down the scales too far ended more careers than anything else’ (7).

2.4.4 Rules of Racing

The New Zealand Rules of Racing clearly state the Weight Categories relating to different types of races held in New Zealand and how they apply to both Apprentice and Senior jockeys. Apprentice jockeys are given allowances and this is determined by the number of winners ridden by the jockey. For example if an apprentice has had less than 5 wins in his/her career their allowance is 4.5 kg. This means than they are able to ride 4.5 kg lighter than a senior jockey on a particular horse and a weight advantage increases their likelihood of winning.

Allowances is covered under Rule 842:

In all Flat Races in which Apprentice Jockeys only are eligible to ride every Apprentice Jockey who has ridden not more than 80 winners shall be entitled to claim an allowance which shall be determined according to the number of winners ridden by that Apprentice Jockey and computed as follows:

- (a) 0 to and including 5 wins- 4.5 kg
- (b) 6 to and including 19 wins- 3.0 kg
- (c) 20 to and including 39 wins- 2.0 kg
- (d) 40 to and including 59 wins- 1.5 kg
- (e) 60 to and including 80 wins- 1.0 kg

The rules also cover ‘weighing out’ (the jockey being weighed prior to the race) and ‘weighing in’ (the jockey being weighed after the race). An example of this is rule 851: *Weighing Out*

Rule 851-1

If the rider, in being weighed out, exceeds by 0.5 or more the weight required by the conditions of the race to be carried by his mount, the amount of such excess shall be deemed overweight and shall either be removed and the rider again weighed or such overweight shall be declared to the Clerk of Scales who shall cause the same to be exhibited at the place appointed for the purpose.

No rider shall be weighed out who is carrying a total overweight of more than 1 kg unless the permission of a Stipendiary Steward or the chairman of the Judicial Committee to such overweight has first been obtained. (3)

There are also penalties that may be incurred if a jockey does not make a certain weight for a particular race. If the jockey cannot make the stipulated weight he/she may lose the mount and/or if this has occurred on a number of occasions the jockey

may be fined (the fine could be anything between \$100- \$250). The amount of the fine depends on a number of factors and it is determined by the Judicial Committee appointed for that particular race day meeting. The New Zealand Racing Conference does not provide guidelines as to the level of fines in relation to certain indiscretions and this has lead to a number of inconsistencies which has caused concern amongst jockeys (97).

As a result of this a great deal of pressure is placed on jockeys to maintain low weights as their weight will determine the number of rides that can be offered to them and in turn will potentially influence their livelihood and career (7, 98, 99).

In recent years there has been a growing concern by The New Zealand Racing Conference of the abuse of diuretics and other drugs. Talented jockey Matthew Enright paid the price for abusing diuretics and eventually his health suffered to an extent that it ended his career. He experienced ‘aching kidneys, severe cramps, an erratic heart beat and dizzy spells during races’ (3, 100). Even though the Racing Conference has taken a strong stand against the abuse of diuretics their use is permitted in certain circumstances. This was outlined in a letter sent in November, 1995, to all licensed jockeys, apprentice jockeys and amateur riders: ‘With regard to Diuretics, the use of such will only become an issue if medical advice suggests that the use of diuretics by a rider is a safety concern. You are advised to use diuretics only as prescribed by your Doctor’ (101).

2.4.5 Changing Times

With the difficulties that jockeys experience in managing their weight there has at times been a push to have their weights increased. In 1988 the Jockeys Guild in the United States of America submitted a recommendation to the Association of International Racing Commissioners to raise the bottom end of the scale of weights by three pounds. The recommendation was not unanimous and the response from one of the jockeys was passionate: ‘can you believe that’- ‘Let those sonofabitches who voted against it go out and ride when they’re weak and hungry a few times’ (6). The request would seem reasonable especially as research tends to indicate that both the athletic and the general population are getting both taller and bigger. In 1976 Wilmore et al found that professional football players were now both taller, heavier

and had higher absolute body fat compared to reported values for the 1940-41 era of professional football player (102, 103). In New Zealand we too appear to be getting heavier and taller if a comparison is made with the National Diet Survey 1977 and the Life in New Zealand Survey 1989 (87, 104). In fact it has been established that there is an increasing prevalence of obesity in New Zealand. Between 1982 and 1993/4 the prevalence of overweight and obese people increased from 52.8 % to 64.2 % in men and from 36.5 % to 44.9 % in women (105).

2.5 Consequences of Making Weight

In 1967 the American Medical Association Committee on the medical aspects of sports produced guidelines for wrestling and weight control. They were concerned with some of the practices of 'making weight' and the adverse consequences of these practices, namely; performance impairment and in extreme cases the wrestlers health could be seriously affected (106). Even with the plethora of research articles on 'making weight' the number of wrestlers using unsafe practices for weight loss has not diminished (89, 107).

The seriousness of making weight has been highlighted by the death of a jockey who died from a fatal arrhythmia while on diuretics and after spending 2 hours in a sauna for reducing weight. However it appears that saunas are generally safe if bathing does not go to the extremes (108).

Fluid deprivation and restricted food intake lead to the loss of electrolytes and water, loss of glycogen and lean tissue, and a small amount of fat (89, 109, 110, 111). Wrestlers who have been 'weight cutting' (rapid weight loss) have between 30 minutes and 20 hours to replenish food and fluid intake from the time of weigh in until competition. This time is inadequate to re-establish fluid homeostasis, replace lean tissue and replenish muscle glycogen (89). In a recent study by Tarnopolsky et al., the researchers found that although weight loss methods used by wrestlers resulted in large losses in muscle glycogen that these were largely reversed during the 17-hour repletion phase when the wrestlers were allowed to eat or drink ad libitum before the tournament. In this particular study there were potential problems with the study design and these results would probably be different if the subjects

had less time during the repletion phase (111). Although wrestlers are very similar to jockeys in that they ‘make weight’ the requirements of the sport are quite different. Jockeys have no opportunity to consume food/fluid before their race as their weight must be the same before and after the race. Often they have restricted their food and fluid intake 24-36 hours before the race meeting and they will continue to do this until they have ridden their last ride. They must endure the physical demands of horse riding in a semi-starved and/or dehydrated state (34, 112, 113).

There are a number of other possible consequences of rapid weight loss which include; impairment of growth and development, alteration of hormonal status, pancreatitis, compromised protein nutritional status, impaired academic performance, reduced immune function and pulmonary emboli (11).

Not only are there physiological consequences of making weight but there are also psychological factors as well. Wrestlers who make weight have experienced negative feelings when trying to lose weight, tend to have increased anxiety levels and are more angry (107). Jockeys experience bad moods, may feel depressed and less confident due to the practices of making weight (6, 51).

In the case of wrestlers it appears that weight loss adversely affects performance based primarily on aerobic metabolism, however the majority of studies show no change in anaerobic performance (114). However research on the effects of anaerobic performance tends to be conflicting and in part can be attributed to methodological differences (115, 116, 117). This researcher speculates that jockeys who race on the flat tend to rely on mainly anaerobic energy systems as their races can last anywhere between 48 seconds for a 800 metre race to 3 minute 20 seconds for the longest race of 3200 metres. There is possibly some validation to this speculation in the literature. Trowbridge et al., considered the physical demands of riding in National Hunt Races and found the mean blood lactate levels, sampled within 5-8 minutes of completing the race, to be 7.1 mmol/L (range: 3.5-15.0 mmol/L), well above base line levels ranging between 0.7-2.1 mmol/L (113). This would indicate a switch to some level of anaerobic metabolism (118). However in the study by Trowbridge et al., it is important to note that National Hunt racing

combines both galloping and jumping over hurdles or fences, water jumps and open ditches (113). There is no research in the literature considering the physical demands of jockeys racing on the flat. To infer that a jockeys performance may not be impaired because of research relating to wrestlers is at best dubious, particularly as wrestlers are able to partially restore their nutritional status prior to competition.

If an athlete loses weight for their specific sport and regains that weight during or in the off-season it is classified as weight cycling. In a review of the literature on weight cycling in amateur wrestlers, it was speculated that this may lead to a decrease in metabolic rate and an increase in fat disposition. This may explain the difficulties athletes experience in losing weight for subsequent competitions (114). However it appears that wrestlers who experience a decrease in resting metabolic rate with weight loss, that this is probably a transient phenomenon (114). Weight cycling may also alter renal function and cause renal ischaemia (119, 120). A number of jockeys experience weight cycling (8).

Sometimes the pressure to make weight is too much. A brilliant jockey in England by the name of Fred Archer committed suicide in 1886 at the age of 29. It has been written that Fred's fasting and purging contributed to his suicidal despair (7, 121).

2.6 Eating Disorders

Athletes may be at greater risk for an eating disorder partly because of the emphasis placed on body weight and partly because of their often obsessive and compulsive personalities. They are a highly self-motivated and success-oriented group of individuals (14, 122). Symptoms of eating disorders are more common among women athletes compared to women non-athletes and women athletes are more likely to have an eating disorder than male athletes (123, 124). The National Collegiate Athletic Association (NCAA) surveyed their member institutions and of the number of reported eating disorders 93 % were female (123). Athletes participating in endurance, aesthetic and weight control sports have a higher prevalence of eating disorders compared to those participating in technical, ball-game, and power sports or non-athletes (123, 124, 125).

It has been shown that the methods such as those used by jockeys for weight control resemble those seen in individuals suffering from anorexia and bulimia nervosa (126). However, in this study by King it is important to note that none of the jockeys displayed an intense fear of becoming fat or a disturbance of body image which is characteristic of people with an eating disorder (126, 127). Before diagnosis of either anorexia or bulimia nervosa can be made several specific criteria must be met, as outlined in the Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association (DSM-IV) (128). Only 1 jockey admitted to self-induced vomiting, however other research suggests that this practice is reasonably common amongst jockeys (78). In King's study no case of an eating disorder was found however there was anecdotal evidence from three stables that suggested some trainee jockeys did not complete their apprenticeship due to an eating disorder (126). There were also limitations to King's findings as they were based on a very small number of subjects, the subjects were selected on the basis of ease of access and all interviews were conducted out of the racing season. However his results were particularly interesting as the subjects chosen were male jockeys and it is known that anorexia nervosa is primarily a disorder of females with a gender ratio of approximately 10:1 and for bulimia nervosa the ratio is 10-20:1 (127).

Other athletes such as wrestlers who also '*Make Weight*' are at risk for sports-induced eating disorders. In a study involving 713 high school wrestlers in Wisconsin, Oppliger et al., used a survey to determine the extent of bulimic behaviours. Twelve wrestlers (1.7 %) answered positively to the five areas of diagnostic criteria consistent with the diagnosis of bulimia nervosa- DSM-III. Another 52 (7.3 %) met four of the diagnostic criteria (129).

Gottfried et al., considered male athletes in sports where the rules dictate that a low body weight must be reached and if there was an increase in the prevalence of eating disorders. A total of 84 athletes (59 rowers, 25 wrestlers) of the lower weight categories completed an anonymous questionnaire. The eating attitudes inventory (EDI) was used to assess psychological characteristics relevant to anorexia and bulimia nervosa. Fifty-two percent of the athletes reported bingeing and 11 % of the athletes show pathologic EDI profiles suggesting the presence of subclinical eating disorders. It was concluded that there was an increased prevalence of subclinical

eating disorders in low weight male athletes and that these athletes should be considered a high-risk population for eating disorders (130).

Wrestlers are similar to jockeys in that the methods used to control their body weight are not related to image or to improving performance. If a wrestler does not make the required weight he/she does not compete, similarly, the jockey does not ride and does not receive any financial reward. Wrestling with specific weight categories place particular demands on wrestlers, however it is extremely difficult to differentiate between the characteristic behaviours used to make weight and actual eating disorders (123).

3 Methods

Subjects

Jockeys were recruited from both the Waikato District Apprentice School and from names of apprentice ($n = 19$) and senior ($n = 24$) jockeys listed in the New Zealand Racing Calendar (monthly publication). Only jockeys racing on the flat and residing in the Waikato District were selected for the study. All senior jockeys were licensed jockeys. A number of apprentice jockeys were recruited while the researcher visited the Apprentice School while all other jockeys were recruited by telephone. Overall, twenty jockeys working in the horse racing industry were selected. Of these 9 were senior jockeys (4 males, 5 females) and 11 apprentice jockeys (2 males, 9 females). Jockeys signed consent forms agreeing to participate in the study (appendix 2).

Study Design

This study was both quantitative and descriptive in design.

Questionnaire

All jockeys who agreed to participate in the study were visited by the researcher. Each jockey completed a written questionnaire and this was used to provide demographic data and information on eating habits, smoking and ‘making weight’ (appendix 3A). Abnormal weight and eating concerns were assessed by using the Eating Attitudes Test-26 (EAT-26) (appendix 3B) an abbreviated version of the original 40 question test (EAT-40) (131, 132). The EAT is an objective and self-reported measure of the symptoms of anorexia nervosa (131). A ‘cut-off’ score of 20 or above, is used to indicate the presence of disturbed eating patterns. EAT is suitable as a screening instrument in non-clinical settings (131). Female jockeys completed a third questionnaire on their menstrual status (appendix 3C). Secondary amenorrhea is defined as an absence of menses for 3 months or cycling at intervals longer than 90 days and irregular periods is defined as menses occurring greater than 35 days but less than 90 days.

Dietary Assessment

Each jockey completed 7-day weighed food records (appendix 4A). Detailed instructions were given to each jockey on how to weigh and record food/fluids consumed during the day (appendix 4B). The researcher explained and demonstrated the use of the Salter electronic (Selectronic Plus 5500) kitchen scales, which included a tare function, to ease the weighing of a number of foods together.

On the same form space was provided where each jockey also recorded his/her training/activity levels for that particular day and any methods they used in order to make weight (appendix 4C). The food record sheets were analysed using Diet-1 software program (Crop & Food Research, Palmerston North). Nutrients analysed were both macro and micronutrients, and comparisons made with the Recommended Dietary Intakes (RDI's) for adult New Zealanders and for the athletic population (14, 133). Nutrient analyses presented here are based on intake from food sources only. Nutrient intake from vitamin/mineral and other supplements have been excluded from the analysis. Supplement intake was recorded on the questionnaire.

Bone Mineral Density

Bone mineral density (BMD) was determined by Dual Energy X-ray Absorptiometry (DEXA; Norland model TXR-26/391A051) (appendix 5). BMD was measured at four sites, namely; femoral neck, total body, lumbar spine and non-dominant distal wrist. Diagnostic guidelines that have been established by the World Health Organisation (WHO) were used in this study. Osteopenia is defined as a bone density between 1 and 2.5 standard deviations below the mean (ie; a T-score between -1 and -2.5) and osteoporosis as a bone density greater than 2.5 standard deviations below the mean (ie; T-score < -2.5) (134).

Body Composition

Percentage body fat was also determined by DEXA on the total body scan (appendix 5). These results were compared to both the athletic and non-athletic population (91, 135).

Iron Status

A number of biochemical measurements were used to evaluate iron status, namely; serum ferritin, serum iron, total iron binding capacity and haemoglobin. Measurements were determined by automated biochemical analysis using a Boehringer Mannheim/Hitachi 717/911 analyser. All laboratory work was performed by Medlab Hamilton, which also provided age and sex matched normal control values.

Statistical Analysis

Chi-square and t-tests were used to compare weight of smokers, EAT scores, and dietary analysis results with senior and apprentice jockeys, and male and female jockeys. ANOVA and t-tests were used to compare T-scores of the BMD at the four selected sites. A number of correlations were computed to examine selected relationships of importance. Results from the EAT scores were analysed using SPSS computer software package (version 6.1) and all other results were analysed using Microsoft Excel (Microsoft Office '97) programme.

The statistical significance level for this study was set at $p < .05$. Data are presented as means \pm standard deviation (s.d.).

Ethical Approval

The study was approved by the Waikato Ethics Committee and by the Human Ethics Committee of Massey University, Palmerston North.

4 Results

4.1 Anthropometry

The ages and physical characteristics of the jockeys are presented in Table 4.1. The mean age for senior jockeys was 28.7 ± 5.0 years and for apprentice jockeys 20.5 ± 3.8 years. The mean height for male jockeys was 162.3 ± 4.4 cm compared to that of female jockeys of 156.2 ± 4.0 cm. There was a significant ($p < .05$) weight difference between male and female jockeys however there was no difference between their body mass index (BMI). Comparing jockeys anthropometric data with that of population data from New Zealand (20-29 yrs), male jockeys' height and weight are both less than the 5th percentile, while for females their measurements are both less than the 10th percentile (87, 88). Comparing BMI's, male jockeys and female jockeys are near the 5th and 25th percentile, respectively (87, 88).

Table 4.1 Age and Anthropometric Measurements of Jockeys

Jockeys	Age (yr) mean \pm s.d.	Height (cm) mean \pm s.d.	Weight (kg) mean \pm s.d.	BMI (kg/m ²) mean \pm s.d.
Senior n = 9	28.7 ± 5.0	158.7 ± 5.0	51.3 ± 3.7	20.4 ± 1.6
Apprentice n = 11	20.5 ± 3.8	157.5 ± 5.1	49.6 ± 3.3	20.0 ± 1.3
Male n = 6	23.5 ± 4.3	162.3 ± 4.4	52.8 ± 2.4	20.1 ± 1.5
Female n = 14	24.5 ± 6.7	156.2 ± 4.0	49.3 ± 3.4	20.2 ± 1.5

4.2 Questionnaire- General

All the jockeys except one (Maori) classified themselves as New Zealand Europeans. Most of the jockeys (74 %) had an education level between the 4th and 5th form levels. Three of the jockeys achieved 6th form Certificates and 2 had attended university. The majority of jockeys (90 %) prepared and cooked their own food at some stage during their working weeks. Eighty-five percent of jockeys reported that what you eat and drink makes a difference to your sporting performance, however

only 45 % had received dietary information or advice in the past. This advice had been given by parents (33 %), by other jockeys (33 %), nutritionists (22 %), Jenny Craig (11 %), Weight Watchers (11 %) and 1 jockey had sought the assistance from a Dietitian. Practically all of the jockeys (90 %) consumed meat with 2 of the jockeys stating that they were lacto-ovo vegetarian, however one of these did occasionally eat fish and chicken. Seventy-five percent of jockeys drank alcohol and of these 60 % drank at least on 1 day or more per week. Dietary supplement use was common amongst the jockeys, with 50 % taking supplements either daily or weekly.

Fifty percent of jockeys smoked, averaging 13 cigarettes per day. Of those who smoked, 50 % did so in order to help them control their weight. The average weight of the smokers was 51.2 ± 4.0 kg and that of the non-smokers 49.7 ± 3.2 kg. There was no statistical difference between these groups ($p > .05$).

Eighteen jockeys described both their attempted and current methods of 'making weight' (Table 4.2 & 4.3). Two jockeys were excluded from this analysis as their current methods were unknown. Seventy-eight percent of those who responded said that they had attempted one or more methods at some stage in their careers (Table 4.2). Even 67 % of apprentices had attempted a number of methods. The least tried method was laxatives, however 50 % of males had still experimented with this option. The 22 % who did not report using any method were all female (1 senior and 3 apprentice jockeys).

Table 4.2 Attempted Practices to 'Make Weight' (%)

Jockeys	Fasted	Diuretics	Laxatives	Saunas	Hot Baths	Restricted Food	Restricted Fluids	Exercised	Other
All Jockeys n = 18	61	50	28	67	61	78	67	56	11
Senior n = 9	67	56	44	67	78	89	67	56	11
Apprentice n = 9	56	44	11	67	44	67	67	56	11
Male n = 6	100	83	50	100	83	100	83	100	33
Female n = 12	42	29	17	50	50	67	58	33	0

In terms of current practice only 67 % reported using one or more methods to ‘make weight’ (Table 4.3). Again the 33 % who did not report using any methods were all female (3 senior and 3 apprentice jockeys). Sixty-one percent and 28 % respectively, reported having used fasting and laxatives as a method to ‘make weight’ at some stage but neither method was currently being used. Overall the restriction of food and fluids, and the use of saunas were the most popular methods employed to achieve weight goals.

Table 4.3 Current Practices of Attempting to ‘Make Weight’ (%)

Jockeys	Fasted	Diuretics	Laxatives	Saunas	Hot Baths	Restricted Food	Restricted Fluids	Exercised	Other
All Jockeys n = 18	0	17	0	56	28	67	56	22	22
Senior n = 9	0	33	0	44	33	67	56	11	22
Apprentice n = 9	0	0	0	67	22	67	56	33	22
Male n = 6	0	33	0	83	50	100	100	50	50
Female n = 12	0	8	0	42	17	50	33	8	8

4.3 Questionnaire- EAT

The mean score of the EAT for all jockeys was 13.5 ± 9.3 (Table 4.4). Overall 20 % of jockeys (2 senior-male and female, 2 apprentice females) had scores of 20 or greater. There were two scores of 18 and one other of 19, from senior jockeys. The mean score for male jockeys was 16.0 ± 7.3 (range: 7-28) and for female jockeys 12.4 ± 10.3 (range: 1-35). There was no significant difference ($p > .05$) between the means for male and female jockeys, or for the number of senior and apprentice jockeys scoring greater than 20. A positive correlation ($r = .39$) was found between BMI and EAT total, however this was not significant ($p > .05$).

Table 4.4

Eating Attitudes Test (EAT)

Jockeys	EAT Scores mean \pm s.d.
All Jockeys n = 20	13.5 \pm 9.3
Senior n = 9	13.9 \pm 9.5
Apprentice n = 11	13.2 \pm 9.9
Male n = 6	16.0 \pm 7.3
Female n = 14	12.4 \pm 10.3

4.4 Questionnaire- Menstrual Status

The average age of menarche for all female jockeys was 14.5 ± 1.9 years (range: 11-19). There was no difference between the age of menarche for senior or apprentice jockeys. Age of menarche was delayed compared to a sample of New Zealand girls (12.9 years) (136). Thirty-six percent of female jockeys had menstrual abnormalities and of these; two jockeys had secondary amenorrhea, 2 irregular cycles and 1 had an extremely variable menstrual pattern.

Full results of the questionnaire are in appendix 6.

4.5 Activity/Exercise

All jockeys worked six days per week and this included a variety of horse related activities, namely; stable work, track and race day racing. Only 3 jockeys (15 %) participated in any other form of exercise outside of their normal work activities and this included; running and using an easy rider, tap and Irish dancing, using a rebounder, gym work and roller blading.

4.6 Dietary Analysis

The results of the nutrient analysis from the 7-day weighed food records are presented in Tables 4.5 and 4.6. One male jockey was classified as an outlier

because his energy intake was 85 % above the mean intake for all jockeys. Therefore his results were not included in the analysis.

Macronutrients:

Energy

The mean energy intake for all jockeys was 6359 ± 1671 kJ (range: 2485- 9195) per day (Table 4.5). The mean intake for males was 6769 ± 1339 kJ per day and for females 6213 ± 1797 kJ per day. The mean intake for both male and female jockeys was significantly lower than the RDI calculated by using the Schofield equation ¹ and a moderate activity level (male- 11,200 kJ, female- 8700 kJ) (133). There is little difference between the energy intake of both senior and apprentice jockeys, and no significant difference ($p > .05$) between male and female jockeys. The mean lowest energy intake for all jockeys was 3432 ± 1600 kJ (range: 0-5937) per day. Male jockeys mean lowest energy intake was 3371 ± 828 kJ per day, whereas for female jockeys the mean intake was 3454 ± 1826 kJ per day. Although males had a similar mean intake, their s.d. was smaller. The mean highest daily energy intake for all jockeys was $10,180 \pm 2894$ kJ with a wide range of between 5729-15,495 kJ. Apprentice jockeys had the highest mean intake followed by male jockeys.

Sixty-four percent of jockeys were riding in race day meetings during the study. Twenty-seven percent of these (three apprentice) jockeys significantly reduced their food intake on the day before a race day meeting. One female jockey reduced her intake to 1344 kJ compared with her weekly mean energy intake of 5308 kJ. One male jockey reduced his energy intake down to 2269 kJ and 2448 kJ respectively, on two occasions before race days, whereas his weekly mean energy intake was 8390 kJ. The third jockey (male) also severely reduced his food intake. On one occasion his energy intake was 4761 kJ compared with his weekly mean energy intake of 8016 kJ. He raced on two consecutive days and on the first day his intake was 3869 kJ and on the second day of racing his intake rose to 14,651 kJ. His last race ride finished at 4.15 pm and the bulk of his food/fluid intake occurred after 4.30 pm.

Carbohydrate

The mean daily carbohydrate (CHO) intake of male jockeys was 179 ± 56 g (116-236) and for females 174 ± 50 g (range: 66-272). Dividing these quantities by the

¹ Males (18-30 yrs): $0.063\text{wt} + 2.896 \times 1.8$ (activity factor)
Females (18-30 yrs): $0.062\text{wt} + 2.036 \times 1.7$ (activity factor)

Table 4.5 Macronutrient Analysis of 7-Day Weighed Food Records

Nutrients	All Jockeys n = 19 mean \pm s.d.	Senior n = 8 mean \pm s.d.	Apprentice n = 11 mean \pm s.d.	Male n = 14 mean \pm s.d.	Female n = 5 mean \pm s.d.
Mean E Intake (kJ) <i>Range</i>	6359 \pm 1671 2485- 9195	6214 \pm 998 4383- 7364	6465 \pm 2074 2485- 9195	6769 \pm 1339 5404- 8390	6213 \pm 1797 2485- 9195
Low E Intake (kJ) <i>Range</i>	3432 \pm 1600 0- 5937	4059 \pm 909 3131- 5688	2977 \pm 1868 0- 5937	3371 \pm 828 3131- 4453	3454 \pm 1826 0- 5937
High E Intake (kJ) <i>Range</i>	10180 \pm 2894 5729- 15495	8822 \pm 1383 5729- 10253	11167 \pm 3346 6239- 15495	10691 \pm 2619 8493- 14651	9997 \pm 3058 5729- 15495
Fat (g)	58.0 \pm 20.0	54.0 \pm 16.0	61.0 \pm 23.0	54.0 \pm 23.0	59.0 \pm 20.0
CHO (g)	175.0 \pm 50.0	168.0 \pm 37.0	181.0 \pm 59.0	179.0 \pm 56.0	174 \pm 50.0
Protein (g)	50.0 \pm 15.0	56.0 \pm 13.0	46.0 \pm 15.0	58.0 \pm 12.0	47.0 \pm 16.0
% Energy- Fat <i>Range</i>	34.5 \pm 7.2 17- 44	33.5 \pm 8.4 17- 44	36.0 \pm 6.3 26- 44	31.0 \pm 10.8 17- 44	36.0 \pm 5.2 30- 44
% Energy- CHO <i>Range</i>	45.5 \pm 7.9 32- 63	45.0 \pm 9.1 32- 62	46.5 \pm 7.2 37- 63	43.0 \pm 11.9 32- 62	46.5 \pm 6.3 38- 63
% Energy- Protein <i>Range</i>	14.0 \pm 3.5 9- 22	14.0 \pm 3.3 12- 22	12.5 \pm 3.0 9- 19	15.0 \pm 4.5 11- 22	13.5 \pm 3.0 9- 19
% Energy- ETOH <i>Range</i>	6.0 \pm 8.8 0- 29	7.5 \pm 10.5 0- 29	5.0 \pm 7.8 0- 22	11.0 \pm 12.1 0- 29	4.0 \pm 7.1 0- 22
% E Fatty Acids- Sat	17.5	15.8	18.4	15.2	18.0
% E Fatty Acids- Mono	11.9	11.6	11.9	10.9	11.9
% E Fatty Acids- Poly	5.2	5.3	5.0	4.7	5.4
Dietary fibre (g)	12.6 \pm 6.5	12.2 \pm 8.6	12.8 \pm 5.0	14.1 \pm 10.9	12.1 \pm 4.6

Note. E = Energy; S D = standard deviation; CHO = carbohydrate; ETOH = alcohol; Sat = saturated; Mono = monounsaturated; Poly = polyunsaturated

Table 4.6 Micronutrient Analysis of 7-Day Weighed Food Records

Nutrients	All Jockeys n = 19 mean \pm s.d.	Senior n = 8 mean \pm s.d.	Apprentice n = 11 mean \pm s.d.	Male n = 5 mean \pm s.d.	Female n = 14 mean \pm s.d.	RDI's	
						Male	Female
Vitamin A (μ g)	519 \pm 225	485 \pm 217	544 \pm 238	531 \pm 243	515 \pm 228	750	750
Thiamin (mg)	1.03 \pm 0.94	0.82 \pm 0.33	1.18 \pm 1.2	0.91 \pm 0.42	1.07 \pm 1.08	1.1	0.8
Riboflavin (mg)	0.97 \pm 0.32	0.99 \pm 0.21	0.96 \pm 0.4	1.11 \pm 0.26	0.92 \pm 0.34	1.7	1.2
Niacin (mg)	8.9 \pm 2.7	9.4 \pm 1.5	8.58 \pm 3.38	10.6 \pm 2.73	8.29 \pm 2.53	19	13
Vitamin B6 (mg)	0.95 \pm 0.44	0.91 \pm 0.22	0.97 \pm 0.57	1.06 \pm 0.3	0.90 \pm 0.49	1.3-1.9	0.9-1.4
Folate (μ g)	135 \pm 53	133 \pm 39.3	137 \pm 62.8	146 \pm 60	132 \pm 52	200	200
Vitamin B12 (μ g)	2.36 \pm 1.07	2.66 \pm 0.97	2.14 \pm 1.13	2.9 \pm 0.9	2.15 \pm 1.07	2.0	2.0
Vitamin C (mg)	49.8 \pm 30.6	55 \pm 33.6	46.1 \pm 29.4	57.8 \pm 39.2	47 \pm 28.2	40	30
Vitamin E (mg)	4.89 \pm 2.39	4.57 \pm 1.99	5.13 \pm 2.7	4.65 \pm 2.54	4.98 \pm 2.43	10	7.0
Zinc (mg)	6.44 \pm 2.15	6.97 \pm 1.86	6.1 \pm 2.4	7.13 \pm 1.61	6.2 \pm 2.32	12	12
Iron (mg)	7.2 \pm 2.5	7.6 \pm 2.3	6.9 \pm 2.8	8.1 \pm 2.9	6.9 \pm 2.4	7	12-16
Magnesium (mg)	189 \pm 78	197 \pm 103	184 \pm 59	234 \pm 120	174 \pm 55	320	270
Calcium (mg)	449 \pm 158	432 \pm 171	462 \pm 155	466 \pm 221	444 \pm 139	800	800
Phosphorus (mg)	827 \pm 249	849 \pm 186	811 \pm 294	930 \pm 185	791 \pm 264	1000	1000
Selenium (μ g)	33.4 \pm 19.3	39.2 \pm 24.5	29.3 \pm 14.3	48.8 \pm 26.6	28 \pm 13.2	85	70
Sodium (mmol)	83 \pm 31.5	80.8 \pm 35.8	84.6 \pm 29.7	81.1 \pm 34.7	83.7 \pm 31.6	40-100	40-100
Potassium (mmol)	46.8 \pm 14.8	51.4 \pm 9.9	43.5 \pm 17.2	56.4 \pm 7.9	43.4 \pm 15.4	50-140	50-140

mean weight for both male and female jockeys determines the amount of CHO per kg of body weight (male-3.4 g /kg, female- 3.5 g /kg). This is well below the recommendations for athletes (15). The percentage of energy from CHO for all jockeys was 45.5 ± 7.9 , well below the recommendation of greater than 55 % for athletes and between 50-55 % for the general population (14, 26).

Protein

The mean daily protein intake for males and females were; 58.0 ± 12 g (range: 44-74) and 47.0 ± 16 g (range: 18-75) respectively. These means are both above the RDI recommendations, however 2 males were below their recommended intake of 55 grams per day and 7 female jockeys were below the recommended intake of 45 grams per day (133). Their average intake of protein per kg of body weight was calculated as; males- 1.1 g and females-0.95 g. This is within the recommended range for adult NZers, however it is borderline for female jockeys (14, 26). The mean percentage of energy from protein for all jockeys was 14 ± 3.5 , which is within the ideal range for athletes of 12-15 % (14).

Fat

The percentage of energy from fat for all jockeys was 34.5 ± 7.2 , which is above the recommendation for athletes and currently just outside the target figure recommended by the Nutrition Taskforce for NZers by the year 2000 of 30-33 % from fat (14, 26). Males have a lower percentage of fat compared to that of females. The mean percentage of saturated fat of total energy intake for all jockeys was 17.5, which is greater than the recommendation of no more than 12 % from saturated and trans fatty acids by the Nutrition Taskforce for NZers by the year 2000 (26). Diet 1 nutrient software program does not have the capacity to analyse trans fatty acids. The mean percentage of monounsaturated fatty acids for all jockeys was 11.9 which is within the recommendation for NZers. The mean percentage of polyunsaturated fatty acids for all jockeys was 5.2, which is just below the recommendation of 6-10 % for NZers (26).

Alcohol

The mean percentage of energy from alcohol for all jockeys was 6.0 ± 8.8 (range: 0-29). Five of the jockeys (3 males, 2 females) exceeded the daily recommended intake of 30 g for males and 20g of alcohol for females (26).

Dietary Fibre

The mean dietary fibre intake for all jockeys was 12.6 ± 6.5 g (range: 4.4-32.6) per day compared with the recommended intake for NZers of between 25-30 g per day (26).

Fluids

In considering the fluid intake of jockeys, all fluids consumed including both nutrient and non-nutrient sources, as well as alcohol, were included in the analysis. The mean daily fluid intake for male and female jockeys was 1638 ± 818 mls (493-2474) and 905 ± 381 mls (range: 161-1525) respectively. Sixty-three percent of jockeys consumed coffee with a mean intake of 2.8 ± 1.5 cups per day and 37 % of jockeys consumed more than 10 grams of alcohol daily. Four jockeys did not consume any fluids on 1 or more days during the week and two male apprentice jockeys decreased their fluid intake prior to race days.

Micronutrients:

Jockeys did not meet the RDI's for a number of micronutrients (Table 4.6). These included for male jockeys; vitamin A (71 % of the RDI), thiamin (83 %), riboflavin (65 %), niacin (56 %), vitamin B6 (82 %), folate (73 %), vitamin E (47 %), zinc (59 %), magnesium (73 %), calcium (58 %), phosphorus (93 %) and selenium (57 %). For female jockeys; vitamin A (69 % of the RDI), riboflavin (77 %), niacin (64 %), folate (66 %), vitamin E (71 %), zinc (52 %), iron (58 %), magnesium (64 %), calcium (56 %), phosphorous (79 %), selenium (40 %) and potassium (87 %). In general micronutrient guidelines for athletes are the same as for the non-athlete population (15).

4.7 Bone Mineral Density

Of the 18 jockeys who underwent a DEXA scan, 44 % (2 males and 6 females) were classified as osteopenic. Forty percent of the men and 46 % of the women were classified as osteopenic. (For this study osteopenic subjects were identified as having T-scores < -1 at a minimum of two sites).

Table 4.7 Mean T-scores of Bone Mineral Density at Selected Sites.

	Lumbar Spine mean \pm s.d.	Total Body mean \pm s.d.	Distal Wrist mean \pm s.d.	Femoral Neck mean \pm s.d.
All Jockeys n = 16	-0.36 \pm 1.0	-1.80 \pm 0.76	0.26 \pm .099	-0.54 \pm 1.10

n = 16 (2 of the jockeys measurements were not used as they did not have a full compliment of BMD results for each site)

The number of apprentice jockeys classified as osteopenic was 60 % compared to that of the senior jockeys of only 25 %. Of the 4 females who had menstrual abnormalities, none of them were classified as osteopenic. ANOVA revealed that there was a significant difference in the means of the four body sites (Table 4.7). T-tests showed that there were significant ($p < .05$) differences between the wrist measurements and each of the other 3 sites.

4.8 Body Composition

The mean percentage body fat for male jockeys was 11.7 ± 2.9 and for females 23.6 ± 3.8 (Table 4.8).

Table 4.8 Percentage of Body Fat for All Jockeys

Jockeys	Body Fat (%)
Senior n = 8	19.0 ± 5.7
Apprentice n = 10	21.3 ± 7.2
Male n = 5	11.7 ± 2.9
Female n = 13	23.6 ± 3.8

The males were within the recommended guidelines for percent body fat for jockeys (6-12 %), however the female jockeys were outside the range of 10-16 % (91). Only one female jockey (14.6 %) fell within this range. There was a significant difference ($p < .05$) between male and female jockeys in their percentage of body fat as expected. Mean percentage of body fat for senior and apprentice male jockeys was

10.7 and 12.3 respectively, and for senior and apprentice females, 23.9 and 23.0 respectively.

4.9 Iron Status

Mean values for blood chemistry results are shown in Table 4.9. Only 1 female apprentice jockey, had 1 measurement that was outside the normal range for the hematologic variables. There was no sign of iron depletion or deficiency. Recorded values were compared to the median of the laboratory range. Males had a lower percentage of serum ferritin compared to females and females had a lower percentage of serum iron compared with males. Both males and females had similar percentages for serum iron binding capacity and haemoglobin measures.

Table 4.9

Iron Status Measurements for Jockeys

Jockeys		Iron Measurements			
		Serum Ferritin (ug/L) mean \pm s.d.	Serum Iron (umol/L) mean \pm s.d.	Serum Iron Binding Capacity (g/L) mean \pm s.d.	Haemoglobin (g/L) mean \pm s.d.
Males		56.8 ± 28.4 <i>30 *</i>	18.8 ± 7.7 <i>84</i>	55.3 ± 4.6 <i>91</i>	149.8 ± 4.6 <i>96</i>
Normal Ranges		25- 350		40- 80	
Females		58.9 ± 51.6 <i>44</i>	13.2 ± 3.4 <i>59</i>	57.5 ± 12.1 <i>95</i>	133.0 ± 7.1 <i>98</i>
Normal Ranges		15- 250		40-80	

* Numbers in italics represent a percentage calculated from the median.

5 Discussion

In this study the nutritional status, dietary behaviour and body composition were determined for both senior and apprentice jockeys working in the New Zealand Racing Industry. There has been some evidence that jockeys use a number of practices in order to ‘make weight’ and research from other sports where these practices are also used suggest that these methods may be detrimental to health (34, 35, 89). Little research has been undertaken to consider the nutritional status of jockeys and only one study of male jockeys ($n = 93$) in South Africa by Labadarios et al., provides data using comparable validated methodology (8). No research is available on female jockeys. Because of the dearth of information on jockeys comparisons with other sports have been made where ‘making weight’ is also an issue or where body weight is of primary importance.

Both male and female jockeys in this study are shorter and lighter, and have a lower BMI than the 25th percentile norms for the New Zealand population (87, 88). When comparing the study results with the Metropolitan Life Insurance height and weight tables (using the jockeys’ mean heights and the table’s small frame size) the male jockeys mean weight (52.8 ± 2.4 kg) was significantly outside the recommended range (60.8-63.5 kg). Making the same comparison for females their mean weight (49.3 ± 3.4 kg) fell just outside at the lower end of the recommended range (49.8-55.7 kg) (137).

The mean BMI for male and female jockeys was 20.1 kg/m^2 and 20.2 kg/m^2 respectively, which is at the lower end of the recommended BMI for adult NZers of $20-25 \text{ kg/m}^2$. Forty percent (4 males and 4 females) of the jockeys had a BMI less than 20.0 kg/m^2 which is considered as underweight (25). In a study of male jockeys by Labadarios et al., the average weight of jockeys in South Africa was 52.9 kg and the mean BMI of 20.4 kg/m^2 (8). These findings closely resemble the results for males in this study (Table 4.1).

The results in the current study are consistent with the weight categories determined by the New Zealand Racing Conference (3). The most commonly used minimum and maximum weights in flat racing are 51.0 kg and the 57.0 kg respectively. However for an important race day meeting such as the Auckland Cup Race Day, the feature race will have a minimum of 47.0 kg (97). A low body weight is a specific requirement of this sport.

Eighty-five percent of jockeys acknowledged the importance of food and drink to their sporting performance however less than half (45 %) had received nutritional information or advice in the past. Most of the help they received was from a person not qualified in sports nutrition.

Analysis of food records revealed that there was some under reporting of the methods to 'make weight'. Of the six female jockeys who reported using no methods, 4 of these jockeys had energy fluctuations that were consistent with food restriction. For example, the mean low energy intake of the 4 jockeys was 4269 kJ (range: 2931-5203) and the mean high energy intake 12,354 kJ (range: 9187-15,225).

In South Africa 80 % of male jockeys studied used one or more methods to combat their 'weight problem'. For example; 77 % used dieting, 70 % saunas and 80 % exercise (8). In the current study 67 % of jockeys reported using one or more methods to 'make weight'. Methods used included; saunas (56 %), hot baths (28 %), restricting food (67 %) and restricting fluids (56 %). Only 22 % of the jockeys in the current study occasionally used exercise to help control their weight. A number of jockeys stated that they do not participate in any exercise outside of their work activities, because they believe exercise increases muscle mass, which will result in weight gain. In a study by King et al., 100 % of male jockeys used exercise for weight reduction (126).

Labadarios et al., reported that 70 % of jockeys used diuretics in order to 'make weight', 27 % used laxatives and 48 % appetite suppressants (8). King et al., also reported that English male jockeys used diuretics (60 %), laxatives (70 %), and appetite suppressants (20 %) as methods of weight control (126). In the current

study 17 % of jockeys used diuretics and no jockeys reported using laxatives. Only one jockey used appetite suppressants when ‘making weight’.

Overall, in the current study there was a reduction in the number of methods used to ‘make weight’ compared with attempted methods, which is consistent with other studies that have found that jockeys experiment until they determine the best method(s) for themselves, in order to ‘make weight’ (8, 35).

Fifty percent of the jockeys in the current study smoked compared to 75 % in the South African study (8). Of those who smoked in the current study, 50 % did so specifically as a means to help weight control, whereas 58 % of South African smokers also did this for the same reason (8).

On comparing these studies it appears than males have greater difficulty in ‘making weight’ than female jockeys. This could be explained by the fact that females are naturally shorter and lighter, and that gender socialisation has given them greater concern with their appearance, and hence they are more used to controlling their body weight (24, 34, 87, 137).

Overall, 20 % of jockeys had EAT scores above the cut-off of 20. The mean EAT scores for male and female jockeys was 16.0 ± 7.3 and 12.4 ± 10.3 respectively. The mean score for males in this study was greater than the mean score of 14.9 (range: 0-45) in a study of male jockeys in England (126). In the current study it was surprising that there was no significant difference between the EAT mean scores of male and female jockeys, particularly as females are at greater risk for an eating disorder and demonstrate greater restrictive behaviour towards food in the general and athletic population (123, 124, 127, 138, 139). Results indicate that male jockeys have a similar risk to female jockeys in developing disordered eating. It could be hypothesised that this is due to the focus on weight which begins when the young apprentice first enters the stable and is reinforced by the wider horse racing community (4). This continues throughout the jockey’s career and is reinforced when a jockey is weighed before and after every race; he/she may step on the scales up to 18 times on a race day. There are probably few other work environments where weight is such a central focus.

There is some evidence that there may be a link between eating problems and amenorrhea (140, 141). In a study of 55 adult ballet dancers by Brooks-Gunn et al., 59 % of amenorrhoeics reported anorexia nervosa and prolonged amenorrhea was significantly related to dieting as measured by a short version of the EAT-26 scale (140). In the current study 2 female jockeys (14 %) were classified as having secondary amenorrhea and of these 2 jockeys, 1 had an EAT score above 20. However, it is difficult to draw any significance from these results as the study sample ($n = 14$) is too small.

A positive correlation was also found between EAT scores and BMI. A possible explanation for this correlation is that weight gain may place jockeys at greater risk for an eating disorder or restrictive eating behaviour, because of the extra focus and attention that is needed in order for them to obtain a desired weight.

The limitation of the EAT is that it relies on accurate self-reporting and individuals with disordered eating may find self-reporting eating habits rather threatening and therefore under-reporting is a potential problem (125, 132). The EAT is useful in identifying individuals with disturbed eating or restrictive behaviour but it is not a tool for diagnosing people with an eating disorder (131). Such diagnosis is made using the criteria outlined in the DSM-IV (128). Like wrestling, it is probably extremely difficult to differentiate between the accepted and common practices used by jockeys to 'make weight' and a clinically diagnosed eating disorder (123).

The mean energy intake of all jockeys was 6359 ± 1671 kJ per day. There was no significant ($p > .05$) difference between the mean daily energy intake of both male (6769 ± 1339 kJ) and female (6213 ± 1797 kJ) jockeys. This is unusual as most males have a higher energy intake than females in both the athletic and non-athletic populations (134, 142). In the most recent survey (1989) of the nutrient intake for NZers the mean daily energy intake for females (25-44 years) was 7300 kJ and for males (19-24 years) 10,700 kJ (24). Energy intake for male jockeys were significantly lower than this and also lower than the mean energy intake of 9250 kJ (calculated from 7-day food records and diet histories) of male South African jockeys (8).

For individuals, energy expenditure is a combination of three factors; resting metabolic rate, thermic effect of food and of activity. Resting metabolic rate contributes about 60-75 % to total expenditure and is closely related to total lean body mass (91). The mean total lean body mass (LBM) for male jockeys ($45,581 \pm 1061$ grams) was significantly ($p < .05$) greater than that for female jockeys ($35,217 \pm 2356$ grams). Therefore it would be presumed that male jockeys should consume more food than female jockeys, particularly as they have a higher LBM and theoretically they need to consume more food in order to maintain the same weight. However this was not found in this study. It could be postulated that the two other factors of energy expenditure, namely; thermic effect of food and exercise influenced these results. Discrepancy may also be due to the possible under reporting of food and fluid intake by the male jockeys.

Comparing the energy intake of female jockeys to that of another sport where weight is of primary importance, namely ballet dancers, the females in this study had a lower energy intake (6213 kJ) than their dancing counterparts (7027 kJ and 7311 kJ) (92, 143). In a third study of ballet dancers the energy intake of the current study was in fact greater than the 5704 kJ recorded by the dancers (144). The variation in these results may partly be attributed to the methods being used in the dietary assessment of the subjects (145, 146). In the study where the calculated mean energy intake was 5704 kJ, the dancers only recorded their food intake for a period of three days which may not be as representative of their normal food intake as the 6/7 day recordings being used in the other studies. In the current study the female jockeys weighed and recorded their food and fluid intake for 7-days; weighing of food is generally considered the best available method for self-recorded nutritional assessments (145). However subjects may change their usual food intake to simplify the measuring or weighing process and there is also the potential problem of misreading the weighing scale and/or recording errors (147). It is generally agreed that absolute reproducibility and validity is not achieved by any dietary assessment methods (145).

The recommended minimum energy intake for both males and females is 6400-7600 kJ and 5000 kJ respectively (15). In the current study, the mean energy intake of 3

male and 3 female jockeys were below these recommendations. An energy intake less than these minimum guidelines may result in metabolic conservation and/or make meeting nutritional goals almost impossible (15). Overall the reported energy intake of jockeys was inadequate.

There were wide energy intake fluctuations for both male and female jockeys. The mean low energy intake for male jockeys was 3371 ± 828 kJ (range: 3131-4453) and the high 10691 ± 2619 kJ (range: 8493-14651). For female jockeys the mean low was 3454 ± 1826 kJ (range: 0-5937) and mean high energy intake 9997 ± 3058 kJ (range: 5729-15,495). It appears that the fluctuation of energy intake was greater for female jockeys. Across all jockeys these fluctuations were primarily due to the practices of 'making weight' and were possibly also used as a means of overall weight control. Energy fluctuations may imply a lack of nutritional knowledge and reflect difficulties that jockeys are having making appropriate food choices consistently.

The mean percentage of energy from CHO was 45.5 ± 7.9 for all jockeys. This is below the recommendations of greater than 55 % for athletes (14). The results in this study were very similar to the percentage of energy from CHO (43.4 %) in a study of male South African jockeys (8). The number of grams of CHO per kilogram of body weight for male and female jockeys was 3.4 and 3.5 respectively. This is below the 5-6 grams per kg of body weight recommended for general sports activity of up to 60 minutes of training per day (or unlimited low-intensity training) (15). Both apprentice and senior jockeys would spend on average much more than 60 minutes per day on horse related activities which would include both aerobic and anaerobic exercise. It is hypothesised that the intake of CHO may not overtly influence the performance of jockeys due to the short duration of races (48 seconds to 3 minutes 20 seconds approximately) in which jockeys probably rely primarily on anaerobic metabolism. However with the amount of time spent by jockeys on horse related activities during their working week, a low CHO intake could affect their training/recovery and their performance levels when completing these activities.

The mean percentage of energy from protein was 14.0 ± 3.5 for all jockeys. This is within the ideal range of 12-15 % for athletes (14). Male South African jockeys were

just outside this range (15.2 %) (8). Fifty percent of female jockeys were not consuming the RDI of 45 grams per day (range: 18-44) (133). This is of some concern as athletes have increased protein requirements above the RDI (14). The average intake of protein per kg of body weight for female jockeys was 0.95 grams. The protein requirements for jockeys has yet to be researched however the protein requirements for athletes involved in general sports activity is 1 gram per kg of body weight (15). These results suggest that female jockeys are not meeting their protein requirements. Three female jockeys have an energy intake below 5000 kJ and protein needs are increased when energy intake is inadequate (14).

The mean percentage of energy from fat for male and female jockeys was 31.0 ± 10.8 and 36.0 ± 5.2 respectively. South African male jockeys had a higher percentage of energy from fat of 34.3 (8). Ideally athletes should aim for a fat intake of less than 30 % of the overall energy intake (14). The mean percentage of energy from fat for all jockeys was 34.5 ± 7.2 which is less than the figure of 37.8 % for NZers greater than 15 years of age (24). The higher than recommended fat intake of jockeys probably has contributed to their lower CHO intake and is also disadvantageous if individuals are trying to achieve weight loss (148, 149).

Mean daily dietary fibre intake of all jockeys was 12.6 ± 6.5 g per day which is similar to the intake of male South African jockeys (14 g) (8). This is significantly lower than the recommended guidelines of 25-30 g per day and a low intake of dietary fibre increases the risk of coronary heart disease and colon cancer (26). The mean dietary fibre intake for NZers greater than 15 years of age is 21.0 g (24).

The New Zealand Food and Nutrition Guidelines suggest that individuals drink one to two litres of liquid every day, or greater amounts if undertaking exercise (26). The mean daily intake for male and female jockeys was 1638 mls and 905 mls respectively. Of the 7 jockeys who consumed more than 10 grams of alcohol daily, 4 (3 male, 1 female) of these (57 %) also stated that they restricted their fluid intake in order to 'make weight'. Alcohol is a diuretic so these jockeys in particular, may be at greater risk of dehydration (15). Fifty-six percent of jockeys use saunas to 'make weight' and 28 % use hot baths for the same purpose, therefore increasing the risk of dehydration. Dehydration has been clearly shown to decrease an athlete's performance

(11). No research has considered the sweat losses of jockeys however due to the short duration of races it is probable that only very small amounts of fluid are lost through sweating while racing. Although this is the case it is doubtful whether in fact jockeys, particularly female jockeys are meeting their fluid requirements when considering their weekly work schedule and some of the practices they use to 'make weight'.

Both male and female jockeys did not meet the RDI's for a number of micronutrients, namely;

males- vitamin A, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin E, zinc, magnesium, calcium, phosphorus, selenium
females- vitamin A, riboflavin, niacin, folate, vitamin E, zinc, iron, magnesium, calcium, phosphorous, selenium, potassium.

RDI's for thiamin, riboflavin, niacin, and vitamin B6 were calculated on the RDI energy requirements (133). If this calculation is also used in the current study, it means that male jockeys now meet the RDI for thiamin and riboflavin and that female jockeys meet the RDI for riboflavin. Overall these results are consistent with other studies of athletes with low energy intakes who also run the risk of low vitamin and mineral intakes (14). Although the micronutrient intakes are sub-optimal it may not reflect the jockeys actual intake as 50 % of the jockeys were taking supplements either daily or weekly, and this was excluded from the nutrient analysis. The accuracy of recording their food and fluid intake and the limitation of the Diet-1 data base may also have influenced these results.

Recommended Dietary Intakes are levels of essential nutrients that should meet the nutritional needs of 97.5 % all healthy people in the population (40). Even though individuals are below the RDI's it does not mean that they are deficient for that specific nutrient. However, RDI's do provide data that can be used as an assessment tool for determining if an individual is at risk for a nutritional deficiency, but identifying an individual with a deficiency can only be determined if biochemical and clinical investigations are also carried out (147).

Overall 44 % of jockeys were classified as osteopenic, 2 males and 6 females. Similar percentages of males (40 %) and females (46 %) were osteopenic. This is interesting as bone loss is normally associated with an aging population and primarily thought to be a problem affecting females (150). Other studies have reported both young male and adult jockeys having BMD levels lower than normative values (54, 151). Nicholas et al, reported that athletes have greater BMD than non-athletes (152). It was also reported by Dook et al., that non-impact loading sports such as swimming, have intermediate levels of BMD that did not differ from non-sporting controls (153).

Adult peak bone mass is determined by genetic and environmental factors (nutrition/exercise) and it is speculated that genetics contribute to about 80 % in bone mass development and the environment 20 % (48). It is believed that an inadequate calcium intake throughout life is a risk factor for osteoporosis, however the amount of calcium required is controversial (134). The National Institute of Health Consensus Development Conference on optimal calcium intake is now recommending a calcium intake of 1000 mg/day for males 25-65 years and 1000 mg/day for females between 25-50 years (154). These are significantly greater than the current RDI's of 800 mg for adult males and females (133). The 1993 Consensus Conference of the Osteoporosis Society of Canada, is also recommending increased calcium requirements above the RDI (155). In the current study the mean daily calcium intake for all jockeys was 449 ± 158 mg (range: 213-812) which is only 56 % of the RDI while the mean intake of those jockeys who were osteopenic was 485 mg (range: 308-775) per day. There appears to be no clear link between the lower levels of calcium intake and osteopenia in this study. In a study by Kirchner et al., female college gymnasts had significantly higher BMD than their controls, even though their daily calcium intake was only 85 % of the RDI (683 ± 58 mg) (60).

Excessive alcohol consumption and cigarette smoking increase the risk for osteoporosis (134). In the current study, of the 4 jockeys who consumed alcohol greater than the current recommendations and who had a bone scan, 3 (75 %) were osteopenic. Of the jockeys who are osteopenic thirty-eight percent smoke.

Sixty percent of apprentice and only 25 % of senior jockeys were osteopenic. The mean age of apprentice and senior jockeys was 20.5 and 28.7 years respectively. As peak bone mass is achieved by late adolescence or early adulthood, the difference between apprentice and senior jockeys cannot be explained by age (156, 157). Nor can the difference be attributed to current levels of calcium intake because senior jockeys consumed on average less (436 mg/day) than that of apprentice jockeys (501 mg/day). However there are some differences between both groups. Fifty percent of apprentice jockeys who are osteopenic smoke, and drink alcohol above the recommended guidelines for males and females. None of the senior jockeys who are osteopenic smoke and none drink alcohol above the recommended guidelines. Other possible explanations for the differences between the two groups may be attributed to past behaviours not reviewed in this study. Both exercise and nutrition plays a role in maximising peak bone mass. It is postulated that senior jockeys may of had a history of greater exercise than apprentices. Possibly their calcium intake may also have been higher at a time when it was critical for the development of peak bone mass.

In a study by Finkelstein et al., they discovered that males who had a history of constitutionally delayed puberty had osteopenia in adult life. They postulated that the timing of sexual maturity may influence peak bone density (158). There is some evidence that a delay in puberty in young male jockeys results in a decrease in bone mineralisation (54). This line of investigation was not considered in the current study of male jockeys. There are also studies that have considered the BMD of females in relation to early and late menarche (159, 160). Ito et al., found that early menarche showed a positive correlation with a high BMD and suggested that it was important to prevent risk factors that disturb the beginning of menstruation in girls (159). Keay et al., also found a significant negative relationship between BMD at the lumber spine and age at menarche (160). The mean age of menarche for female jockeys in the current study was 14.5 ± 1.9 years which is considered delayed compared to expected norms (12.9 years) (136). In a study by Warren et al., their results suggested a link between a delay in menarche and an increased risk of fractures. The risk of fractures increases with the rise in menarche (161).

Myburgh et al., reported that 25 athletes with stress fractures are more likely to have lower bone density than other athletes with similar training habits (49). Sixty percent of jockeys report suffering a fracture during their careers (50). Medical reports reviewed by Oberlin, suggest a relationship between BMD and fractures for adult jockeys ($n = 10$) (151). This would need to be confirmed with further research and a larger number of subjects.

Both male and female jockeys have been diagnosed as osteopenic in this study. It is difficult to identify the exact cause (s) of why such a high percentage of jockeys meet the criteria for osteopenia, however it could be that a combination of factors contributed to this outcome. Possible factors include; a reduced calcium intake, the role of alcohol and smoking, a delay in puberty for both male and female jockeys and perhaps the activity of jockeys being predominantly non-weight bearing.

An interesting aspect of the BMD results was the significant difference ($p < .05$) between the wrist measurements and the other three body sites. In the mechanics of riding a horse, the jockey must maintain a strong hold of the reins in order to control his/her mount. The wrist plays a pivotal role in this process. In a study by Tsuji et al., the midradial BMD of the dominant arm of tennis players was greater compared to the non-dominant arm. It is presumed that the physical stress on that arm had a direct effect on increasing midradial BMD (162). In the current study it is hypothesised that the mechanical stress placed on the wrist of the jockey while riding a horse has increased the BMD of that area.

Percent body fat for males was significantly lower than that of females and this is what would be expected for most athletes and the general population (91, 118, 135). Male jockeys were within the recommended range of percentage of body fat for jockeys, and similar to the 11 % body fat of South African jockeys, however, the mean percentage of body fat for a talent squad of male jockeys in Australia was 7.4 % (range: 5.2-9.8 %) (8, 90, 91). The variation could be attributed to methodological differences in determining body fat, as at the South Australian Sports Institute, percentage of body fat is measured by skinfolds and calculated using the Withers and Siri equations (90). By contrast female jockeys were outside the recommended range (10-16 %) and in fact their levels were similar to that expected for the general

population (22-25 %) (118, 135). Other sports such as ballet and gymnastics where body weight is important, researchers have reported mean percent body fat levels of female athletes of 16.9 and 17.0 respectively, certainly lower than the current study (60, 144). The mean percent body fat for female jockeys is about 7-8 % greater than the recommended guidelines for female jockeys (91). This in effect means that female jockeys can potentially decrease their body fat further, without compromising their health status. Principle methods to decrease body fat are to achieve an energy deficit (primarily by decreasing dietary fat intake) and through appropriate resistance and endurance training (14, 91). Female jockeys' percentage of energy from fat is currently 36.0 ± 5.2 which is above the recommendation of 30 % for athletes (14). Fifty percent of female jockeys are currently having difficulty in 'making weight' and there are methods available to them to achieve realistic and permanent weight loss.

Blood chemistry results of both male and female jockeys showed no signs of iron depletion or iron deficiency (Table 4.9). There is little difference between the measurements for male and female jockeys, however male jockeys had a lower percentage of serum ferritin calculated from the median compared with female jockeys. Therefore the males may be at greater risk for iron depletion. It is somewhat surprising that no female jockeys had a compromised iron status as the mean dietary intake of iron was only 6.9 ± 2.4 mg or 58 % of the RDI (12-16 mg) (133). While their intake was low the sources of their iron were generally high in more readily absorbable haem iron (17). Excluding the two female jockeys who classified themselves as lacto-ovo vegetarian, the other female jockeys consumed red meat on average 4.2 times per week. It is also very difficult to assess dietary intake relative to biochemical status as bioavailability of iron is affected by many dietary factors (40).

The dietary iron intake of the female jockeys in this study was less than that of female runners (11.0 mg) and inactive female controls (10.4 mg) in a study by Pate et al., (43). In these 2 groups 50 % of runners and 22 % of controls were iron depleted (43). Although female jockeys had a low dietary intake as measured by their weighed food records, it is not a true picture of their actual intake. Fifty percent of female jockeys used a supplement either daily or weekly. Eighty-six percent of these

jockeys took supplements that included iron. The intake from supplements was not quantified in this study. Females may also be at greater risk for compromised iron status due to menstruation (19).

Possible reasons why no jockeys showed signs of iron depletion or deficiency are; most of the jockeys consumed red meat regularly which provides haem iron, vitamin C intake was above the RDI and vitamin C facilitates non-haem iron absorption, and supplementation may also have contributed to an increased iron intake (40).

These results may also indicate that the type of activity undertaken by jockeys is primarily non-weight bearing exercise rather than weight bearing. The incidence of iron deficient states, has been shown to be increased when people participate in weight bearing exercise (40, 44, 163).

Overall, the results of this study indicate that the current nutritional practices of jockeys may have implications for their short and long term health. A number of these results were similar to that reported by Labadarios et al., where validated methodology was also used (8). Further research is needed in this area with a greater number of subjects, both male and female, to verify the current results and to determine the impact that food and nutrition has on the sporting performance and health status of jockeys.

6 Conclusion

Jockeys racing in New Zealand must obtain a lower than the average body weight compared to the general population. Specific weight guidelines for jockeys have been established and are carefully regulated by the New Zealand Racing Conference (3). As a consequence of this both male and female jockeys use a number of methods in order to 'make weight'. This appears to have impacted on their nutritional status, as jockeys do not meet their energy or carbohydrate requirements or their requirements for a number of micronutrients. The difficulty of 'making weight' is possibly also reflected in the results of the EAT, where 20 % of the jockeys displayed signs of disordered eating.

A significant finding from this study was that 44 % of jockeys were classified as osteopenic. There appears to be no single factor contributing to these results but that a combination of factors may be involved, one of which includes a low intake of calcium.

This study revealed interesting findings. However, because the sample size was small ($n = 20$) and the number of males in the study only 6, it is necessary to validate these results with further research and a larger sample size.

Overall, inadequate research has been carried out on this group of athletes. To determine their exact nutritional requirements it is necessary to determine the physiological requirements of their sport. Possible areas of research include using a more objective method to determine their actual energy requirement, such as the doubly labelled water technique (91). It would also be important to determine the primary energy systems that jockeys use while horse racing, ie; aerobic verses anaerobic metabolism.

Although there was disordered eating among a small number of jockeys in the study, identification of an eating disorder can only be determined by the criteria set down in the DSM by the American Psychiatric Association (128). This diagnostic criteria could possibly be used in future research in conjunction with the EAT, if jockeys score highly on the EAT scale.

There were a high percentage of jockeys who were classified as osteopenic. This is of concern as race riding is a hazardous sport and 60 % of jockeys report a fracture during their career (50, 52). This is an area for further research to examine the impact on both their short and long term health. However, if other studies confirm these results, a screening and treatment program could be developed for jockeys who are at high risk of fractures.

As has been discussed previously wrestlers are also athletes that use a variety of methods to 'make weight'. The Wisconsin Interscholastic Athletic Association implemented a program to curtail rapid weight loss among high-school wrestlers (164). The project included an estimate of body fatness to determine an individual's minimum weight, a limit on weekly weight loss and an education program to inform wrestlers on how to diet effectively (ie, safe and healthy methods) (164). This project has received widespread endorsement and possibly offers the racing industry a model for developing guidelines for jockeys.

It is important that if a jockey seeks professional help from a Dietitian/Nutritionist, that the professional understands the culture and the specific nutritional requirements of the sport. This type of available information could be similar to the general and specific recommendations that have already been established for dancers (165). Recommendations would also include appropriate and safe practices in 'making weight'. However a significant amount of research needs to take place first to establish the exact nutritional requirements of the sport. It is envisaged that minimum weights for jockeys would be determined by the individual's percent body fat calculated by skinfold measurements or by the sum of skinfold measurements that are currently being used for a number of other sports (15). This field technique for assessing body composition is more accessible and less costly than laboratory techniques such as DEXA, however it does require a person skilled in using skinfold calipers (91, 162). It has also been suggested that an effective nutrition education program for athletes needs to be practically orientated (166).

There are a number of obvious signs indicating that jockeys need a greater understanding of the role of food and nutrition in their sporting performance.

Further research is necessary to provide the scientific data that would support any dietary recommendations. Research would also provide credibility to these dietary recommendations and it may also influence the racing industry to take a proactive approach in ensuring that jockeys understand the importance of nutrition, not only for sporting performance but for their short and long term health.

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Appendix 1 *Literature Review Databases*

Networked Databases

Medline	Health care, Medicine	1966-1997
Psyclit	Psychology, Psychiatry, Therapy	1974-1997
Current Contents	Arts, Environmental sciences, Humanities, Life sciences, Physical sciences, Social sciences	1995-1997

CD ROM Databases

Human Nutrition	Food science and nutrition	1982-1997
Index New Zealand	NZ journals and newspapers	1987-1997
SportDiscus	Sport science and management	1975-1996

Appendix 2 *Consent Form*

Consent Form

A Study of the Nutritional Status of Jockeys' Working in the New Zealand Racing Industry.

I have read and understood the Information Sheet and have had the details of the study clearly explained to me. All my questions about the study have been answered to my satisfaction.

I agree to take part in this study and understand that I also have the right to withdraw from the study at any time.

I will provide information to the researcher on the understanding that no material which could identify me will be used in any reports on this study.

I know who to contact if I have any questions regarding the study.

I agree to participate in this study under the conditions described in the Information Sheet.

Name:

Signature:

Date:

Appendix 3 A *Questionnaire- General*

Questionnaire

A Study of New Zealand Jockeys

This questionnaire is an opportunity for me to find out about your current food habits and your attitude towards food. Completed questionnaires are strictly confidential.

Please answer each question carefully.

Tick the box that best describes you.

1) Male

Female

2) Date of Birth: ____ / ____ / ____

3) Do you:

Live alone

Live with others

4) Which ethnic group (s) do you belong to?

NZ European/Pakeha

NZ Maori

Samoan

Cook Island Maori

Tongan

Fijian

Pacific Island Group (please state)

Asian

Chinese

Indian

Other Ethnic Group (please state)

) Are you an apprentice or senior jockey?

Apprentice

Senior

) How long have you been a jockey?

Number of years Number of months

) What is your highest school qualification?

Fourth form year

Fifth form year

NZ school certificate

NZ sixth form certificate

NZ higher school certificate

NZ university bursary or scholarship

Other (please state)

) Do you prepare or cook your own food?

Yes

No

If yes to the above question how often do you cook or prepare your own food?

1 day per week

2 days per week

3 days per week

4 days per week

5 days per week

6 days per week

Daily

If no to the previous question who does cook or prepare your food?

- Wife/Husband
- Partner
- Flatmate
- Mother
- Father
- Trainer
- Other (please state)

9) Do you think what you eat or drink makes a difference to your performance as a jockey?

- Yes
- No

10) Have you received dietary information or advice in the past?

- Yes
- No

If yes to the above who has given this information or advice to you?

- Trainer
- Jockeys
- Mother/Father (*please circle*)
- Husband/Wife
- Partner
- Doctor
- Naturopath
- Dietitian
- Nutritionist
- Other (please state)

11) Are you a smoker or a non smoker?

- Smoker
 Non smoker

Do you smoke to help you control your weight?

- Yes
 No

12)

Have you tried any of the following practices in order to 'make weight'?
(you may tick more than one of these)

- Fasted
 Taken diuretics
 Taken laxatives
 Used saunas
 Used hot baths
 Restricted the food you eat
 Restricted the amount you drink
 Exercised a lot
 Other (please state)

13) Do you drink alcohol?

- Yes
 No

If yes to the above question how often do you drink alcohol?

Please state days per week *or*
..... days per month

How much alcohol would you drink on each occasion?

Please state (eg: *x bottles, x glasses*)

14) Do you take any vitamin or mineral supplements?

- Yes
 No

If yes to the above please name what supplement (s) you take.

.....
.....
.....

How often do you take these supplements?

- Daily
 Weekly
 Monthly
 Other (please state)

15) Do you eat meat (this includes all red meat, chicken and fish)?

- Yes
 No

If no what type of vegetarian are you?

- Lacto ovo (eats dairy products and eggs)
 Lacto (eats dairy products but not eggs)
 Vegan (avoids all products that come from animals)

Appendix 3 B

Questionnaire- EAT

For each of the numbered statements please place an (x) under the column which best applies to you

	Always	Very Often	Often	Sometimes	Rarely	Never
1. I am terrified about being overweight.						
2. I avoid eating when I am hungry.						
3. I find myself preoccupied with food.						
4. I have gone on eating binges where I feel that I may not be able to stop.						
5. I cut my food into small pieces.						
6. I am aware of the calorie content of foods that I eat.						
7. I particularly avoid foods with a high carbohydrate content (e.g. bread, potatoes, rice, etc.).						
8. I feel that others would prefer if I ate more.						
9. I vomit after I have eaten.						
10. I feel extremely guilty after eating.						
11. I am preoccupied with a desire to be thinner.						
12. I think about burning up calories when I exercise.						
13. Other people think that I am too thin.						
14. I am preoccupied with the thought of having fat on my body.						
15. I take longer than others to eat my meal.						
16. I avoid foods with sugar in them.						
17. I eat diet foods.						
18. I feel that food controls my life.						
19. I display self control around food.						
20. I feel that others pressure me to eat.						
21. I give too much time and thought to food.						
22. I feel uncomfortable after eating sweets.						
23. I engage in dieting behaviour.						
24. I like my stomach to be empty.						
25. I enjoy trying rich new foods.						
26. I have the impulse to vomit after meals.						

Thank you

Appendix 3 C *Questionnaire- Menstrual Status*

Questionnaire

A Study of New Zealand Jockeys (Part Two)

For Women jockeys.

1) At what age did you have your first period?

Age

2) Do you have regular periods every month?

- Yes
 No

If no to the above when do you have your periods?

- Never
 Once every 2 months
 Once every 3 months
 Once every 4 months
 Other (please state)

Appendix 4 A *Weighed Food Record Sheets*

FOOD RECORDS

Day: 1

Date:

Appendix 4 B

Instruction Sheet

Instructions

7- Day Weighed Food Records

General:

- * Always have these records with you as it is important to write down what you eat and drink as soon as possible
- * Please start a new line for each new food/drink
- * Careful weighing of food/drink is really important

Column 1: Time

- * Always write down the time when you eat or drink. Include whether it is am or pm

Column 2: Description of Food and Drink

- * Please give as much information as necessary
- * You need to write down:
 - name, type and brand/product name of food/drink, eg; Huntley Palmers cream crackers, Moro bar
 - how the food was cooked, eg; grilled
 - if the food was coated, eg; fish coated in breadcrumbs
 - if any additional foods were used, eg; dressings, gravy

Column 3: Quantity (How Much)

- * Everything should be weighed on the digital scales (in grams)
eg; making sandwiches for lunch
 - weigh a slice of bread and write down the weight
 - press the zero button
 - add butter and write down the weight
 - press the zero button
 - add tomatoes and write down the weight
 - press the zero button
 - add cheese and write down the weight
eg; weighing a drink
 - place the glass on the scales
 - press the zero button
 - pour the drink into the glass and write down the weight
- * Sometimes food/drink come in containers such as boxes, packets, cans and tins. Use these weights to write down how much you have consumed, eg; 1 can of coke- 355 ml
- * Eating out- It is going to be impossible for you to take your scales everywhere you go, eg; if you are eating out in a restaurant. Therefore you need to use household measures to record your quantities, eg; 2 tablespoon of peas, 1 cup of mashed potatoes, 7 x 5 x 0.5 cm piece of steak.
However if you are visiting friends for dinner it may still be OK for you to weigh your food there- in this situation you could take your scales. If you are having takeaways and are returning home to eat them you can weigh them when you arrive home.

Column 4: Leftovers (How Much)

- * All leftovers need to be weighed and these written down

Appendix 4 C *Training/Activity/Making Weight*

Training/Activity

Making Weight

Appendix 5

DEXA

Dual energy X-ray absorptiometry (DXA) is a method of quantifying bone mineral and body composition. DXA uses an x-ray generator of high stability to produce photons over a broad spectrum of energy levels.

Bone is differentiated from soft tissue based on the attenuation of the low and high energy photons; therefore, bone mineral, percentage body fat and other calculations can be performed.

The XR-series bone densitometer consists of two major components:

- 1) a scanner unit capable of positioning the x-ray beam over any part of the patients body
- 2) a control/analysis computer system which allows the operator to control the scanning process, analyse and store the resulting data and print reports of the results

BMD results are compared to both North American and Australian reference values.

From: *XR-Series X-Ray Bone Densitometer Operator's Guide*, Norland Corporation, USA, 1993.

Appendix 6

Results of Questionnaire

Subjects	Ethnic Group	School Qualification	Prepare/Cooking Food	Food/Drink and Performance
Apprentice (M)				
913 814	NZ European	SC	Yes	No
040 661	NZ European	6th Form Cert	Yes	Yes
Apprentice (F)				
509 730	NZ European	SC	Yes	Yes
279 078	NZ European	5th Form	Yes	Yes
815 605	NZ European	University	Yes	Yes
276 114	NZ European	5th Form	Yes	Yes
676 414	NZ European	4th Form	No	Yes
123 391	NZ European	4th Form	Yes	Yes
113 051	NZ European	SC	Yes	Yes
389 493	NZ European	South African	Yes	Yes
241 778	NZ European	4th Form	No	Yes
Senior (M)				
561 030	NZ European	4th Form	Yes	Yes
074 441	Maori	4th Form	Yes	Yes
359 766	NZ European	6th Form Cert	Yes	No
837 285	NZ European	4th Form	Yes	Yes
Senior (F)				
802 158	NZ European	5th Form	Yes	Yes
848 515	NZ European	5th Form	Yes	Yes
856 872	NZ European	6th Form Cert	Yes	Yes
934 311	NZ European	SC	Yes	No
572 167	NZ European	University	Yes	Yes

Dietary Information/Advice	Source of Dietary Information/Advice	Smoker	Do you Smoke to Help Control Your Weight	Number of Cigarettes per Day
Yes	Mother/Father			
Yes	Jockeys/Staff Cook	✓	Yes	6
Yes	Mother/Father	✓	No	3
No		✓	Yes	12
Yes	Trainer/Jockeys Mother/Father			
No		✓	No	7
No				
No				
No		✓	No	5
Yes	Jockeys/Reading Books			
Yes	Dietitian	✓	No	25
Yes	Nutritionist	✓	No	10
No		✓	Yes	10
No		✓	Yes	30
Yes	Weight Watchers	✓	Yes	20
No				
Yes	Nutritionist Jenny Craig			-
No				
No				
No				

Alcohol Consumption	Supplement Use	Consumption of Meat
2/7	Weekly	✓
3/7	Weekly	✓
3/7	Weekly	Lacto-ovo
3/mnth	No	✓
1/7	Daily	✓
No	No	✓
No	No	✓
2/mnth	No	✓
2/mnth	Daily	✓
No	No	Lacto-ovo
2/7	No	✓
1/7	No	✓
No	Weekly	✓
5/7	No	✓
5/7	No	✓
2/7	Daily	✓
6/7	Weekly	✓
1/7	Daily	✓
7/7	Daily	✓
No	No	✓