HEALTH AND TECHNOLOGY IN ROWING:

A HEALTHIER PROCESS OF MAKING WEIGHT FOR THE LIGHTWEIGHT ROWER

An Interactive Qualifying Project

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Abstract

The process of making weight in the sport of lightweight rowing was evaluated for female, college – aged athletes. A group of 11 female athletes participating in a United States National lightweight development camp for rowing was observed for a period of 2 months. Health issues affecting the athletes were discovered through responses from the subjects as well as observations. Mental health and disordered eating were found to be the largest problems with this group of rowers. Recommendations were made in hopes of making the process of making weight healthier for the lightweight athlete. Coaches need to intervene when an athlete should not be rowing lightweight because of body size or type, or due to health issues that may arise.

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1. Introduction

Rowing is a sport that relies on equipment. Technology has changed many aspects of the oars that rowers use, the boats they row, and even the clothes they wear. All of the changes in design, material, and construction in some way affects the rower using the equipment.

All of the changes in equipment are in hopes of making the crew faster. This has an affect on the rower in a number of ways. For instance a faster boat will want for a faster crew. Thus the level of competition increases as the speed of the boats increases. Athletes are pushed harder by themselves as well as others to be faster through the water.

The weight class denoted "lightweight" in rowing is seen as a very competitive sport. The athletes that compete as lightweights not only have to perform their best but they also have to be at a certain weight to compete. This added pressure might lead to unhealthy practices of weight loss in order to compete.

This IQP investigates the methods that athletes are using to make weight and comparing them to healthy practices. The question arises concerning how to make the process of making weight healthier for the rowers involved. Recommendations will be made directed towards coaches as well as rowing associations concerning the health of female lightweight rowers.

There has been research into the affects of making weight, methods of making weight, physiological responses to training, possible health problems, and problems with over training. This project will use the research that others have done and make recommendations to rowing associations and coaches to possibly make the process of making weight healthier for the lightweight rower.

The athletes should be informed of all the risks and benefits of their decision to row lightweight. Weight loss can be a complicated process and the athletes that decide to compete as lightweights should have adequate knowledge of the process. Informed athletes will be less likely to resort to drastic or unhealthy measures to get down to weight for competition.

2. Background

Background information was gathered to create a base of knowledge to work with. Rowing, as well as any sport, has its own terminology. The introduction to rowing gives an overview of rowing as a sport, some terminology used, and other relevant information related to this project. The background information on nutrition was gathered to establish a base of knowledge of what is involved with the health of the subjects.

2.1 Introduction to Rowing

Rowing is a sport with a lot of history. Rowing started as a means of transportation in early times dating back to the Vikings. However, the sport of rowing started to develop in the early 1800's. In 1829 the first race between Oxford and Cambridge Universities took place on the Thames River in England. Ten years later in 1839 the first Henley Royal Regatta was held in England. Shortly after that rowing appeared in the United States. The first Harvard – Yale race was held in 1852. Rowing in the United States gained popularity quickly. Around the 1870's women began picking up the sport in the United States. There was an abundance of opposition to women coming into the boathouses originally reserved for men. Eventually the pioneers of women's rowing formed the US National Women's Rowing Association, which in 1982 merged with the US National Association for Amateur Oarsmen to form the US Rowing Association.[1]

There are two main types of rowers, sweep rowers and scullers. Sweep rowers hold one oar with both hands while scullers hold two oars, one in each hand. Sweep rowers come in 2s (pairs), 4s (fours), and 8s (eights). Scullers can row alone (a single scull), with one other person (double scull), or with three other people (quadruple sculls). Some sculling boats have what is referred to as a toe. The toe is attached to a rudder that steers the boat, it is controlled by rower in the stern-most seat (stroke seat) of the boat. Single sculls do not have a toe. Sweep boats are steered by an athlete that is not rowing called a coxswain. Pairs and fours may or may not have a coxswain but all eight boats are coxed.

Rowing races are measured in meters. The fall season races are 6000 meters in length. The spring and summer season races are 2000-meter races. More information about rowing can be seen in Appendix 1.

Fédération Internationale des Sociétés d'Aviron" (FISA) in French, or the English equivalent International Federation of Rowing Associations is the governing body of rowing so to speak. FISA is the oldest international sports federation in the Olympic movement. Representatives from around Europe established FISA on June 25, 1892. FISA was established to create guidelines and regulations for the sport of rowing. All of the weight class regulations were imposed by FISA as well as many other rules and guidelines.[7]

The apparatus used for indoor rowing is called a rowing ergometer. In the sport this apparatus is often referred to as an “erg”. Rowing on an erg is called “erging”. Ergs are used for practice off the water. Rowing on an erg is very similar to rowing in a boat and thus is good for training and conditioning. A diagram of a rowing ergometer can be seen in Figure 1.

2.2 Nutrition

Peak nutrition varies from person to person. Each person needs a different amount of calories, vitamins, and minerals. The amount of calories a person needs is the amount of energy their body needs for normal everyday function. Vitamins and minerals are essential to a person's health and well-being.

The Recommended Dietary Allowance (RDA) for vitamins and minerals were first set during World War I in the United States. The United States government delegated the Food and Nutrition Board of the National Academy of Sciences to devise nutritional guidelines that could be used uniformly for all the armed forces. After the war, the applications of the RDAs were expanded to include use by hospitals, boarding schools and nursing care facilities.[9]

The daily amounts of vitamins and minerals set forth in the RDAs were formulated using much statistical data, using the average healthy person as a model. Thus there is little bearing when taken in consideration for each individual. The RDAs don't take into account many things like sickness and disease or genetics.[9]

There are many different RDAs for the wide range of age groups chosen; these vary from pregnant women, infants, and people over 55 years old. To simplify this problem and create uniformity for food labeling purposes, the Food and Drug Administration (FDA) established the USRDA. According to the USRDA, calories plus ten nutrients must be included on food labels. These nutrients are protein, carbohydrates, fats, vitamin A, vitamin C, thiamin, riboflavin, niacin, calcium, and iron. The FDA took the highest value of the 1986 RDAs for each nutrient and used a percentile as a reference point. RDA figures for people over four years old (excluding pregnant and lactating women) were chosen. People today will know the USRDA by a different name. Today it is no longer called the USRDA, it is referred to as the Reference Daily Intake or RDI.[9]

Foods have been broken down into three main components, carbohydrate, fat, and protein. Everybody needs a balance of each nutrient, however, finding that balance can be complicated. Each of these components has a calorie equivalent assigned to them. Carbohydrates and proteins have been found to contain four calories per gram of nutrient. Fats have nine calories per gram. There are many different views on the correct balance of these three substances.

"The Food Guide Pyramid was configured in 1992 by the United States Department of Agriculture (USDA) in collaboration with the Department of Health and Human Services (HHS)."[9] The Food Guide Pyramid was formulated to help people make healthy choices when it came to eating and nutrition. At the base of the pyramid is the Bread, Cereal, Rice, and Pasta Group from which the average person is supposed to consume 6 to 11 servings a day. Above this group are the Fruit Group and Vegetable Group. From the Fruit Group a person is supposed to consume 2 to 4 servings daily and from the Vegetable group, 3 to 5 servings daily. The next step above contains the Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts Group and the Milk, Yogurt, and Cheese Group. 2 to 3 servings are to be consumed from each of these groups per day. At the peak of the pyramid is the Fats, Oils, and Sweets Group. Foods from this group are to be used sparingly each day.[9] See Figure 2 for a picture of the Food Guide Pyramid.

There are a number of ways to calculate the number of calories a person needs each day, widely known as a person's daily caloric intake. Resting Metabolic Rate (RMR) is a number that represents the amount of calories a person's involuntary functions burn per day. Formulas for calculating calorie need can be seen in Appendix 2.

2.2.1 Water

Water is nearly the most important matter your body needs. It serves as an integral part of your tissues and as a medium in which nutrients and many biochemical components are conveyed from one part of the body to another. It also serves as the medium in which many biological reactions – the conversion of the food you eat into energy and bulk – take place. Water helps to remove toxins and acids that collect in your tissues during the normal metabolic process or during physical exertion like exercise.[9]

Under normal conditions, the average adult loses roughly two and a half quarts of water a day, mostly in urine but also in sweat, feces, and through breathing. This loss must be replaced or we become dehydrated. One way our bodies protect us is through the signal that we're thirsty. We are also protected by a mechanism that causes the kidneys to begin conserving water – reabsorbing it back into the blood instead of excreting it – when there is deprivation.[21] Relying on thirst alone is not sufficient for replenishing and keeping optimum levels of water in the body. A person can become up to 60 percent dehydrated before the sensation of thirst is perceived. The body's thirst mechanism is not sensitive enough to maintain an optimum water level.[21]

The percentage of water in a person's body directly depends on the person's percentage of body fat. For instance a very obese person may have a percentage of water of 43, where a person who is very lean may have a percentage of water of 70. Water loss dictates the person's need for water intake. The ingestion of liquids is one of the best ways to regain the water lost throughout the day's activities. The most easily absorbed liquid, which also has the most water content, is plain water. Other drinks such as juices, sports drinks, sodas, and other drinks have water in them also. However the more ingredients in the beverage the longer it takes to be absorbed from the stomach. Another source of water is through food ingested. All of the food ingested throughout the day has some percentage of water. Some foods have more water than others. For instance fresh fruits and vegetables tend to have more water contained within them than uncooked breakfast cereals. Another source of water in the body is through metabolism. This is often referred to as metabolic water. Metabolic water is the water that is produced in the body as a result of energy production. Often overlooked, it totals approximately 10 ounces per day, depending on how many calories are burned.[15] One other water source within the water is glycogen-bound water. Glycogen-bound water is stored in the muscles along with glycogen. About 3 ounces of water are stored along with every 1 ounce of glycogen. Glycogen-bound water becomes important when the glycogen supply is in the process of being depleted for energy use. This occurs during training and endurance events lasting more than one hour and during periods of calorie restriction. During intensive endurance activities, about 16 fluid ounces of water may be released per hour. However, this water will be released only for as long as the glycogen to which it is bound remains stored in the body. Glycogen-bound water must be replenished when it is used. Altogether, approximately 3 to 4 pints of glycogen-bound water can be stored. For endurance athletes and athletes performing in day-long tournaments, glycogen-bound water is an important source of hydration during physical activity.[15]

Athletes and persons performing any physical activity need more water than someone who is sedentary. There are many factors that contribute to this. For example, the athlete tends to lose more water through sweat. They also need more water to aid in their body's recovery process after exercise. Some athletes need a much higher level of water than the average person. Researchers have found that the best way to determine the recommended daily water intake is to look at daily energy expenditure. As the temperature increases to over 70° F and the humidity above 70%, water loss will increase due to increased sweating. This will be amplified during exercise also.[15]

2.2.2 Sports Nutrition

Sports nutrition is thought to be a specialized form of nutrition geared towards athletes. There are many misconceptions that arise when the term sports nutrition is used. Sports nutrition is similar to nutrition for the average person with a few minor adjustments geared toward different activities and activity levels. When comparing the nutrient needs of athletes and sedentary individuals the same nutrients are needed but level of need may be different depending on the particular nutrient.[48]

Energy requirements are often different for athletes than for the average person. Several factors are known to influence energy requirements, including sex, body composition and size, age, and activity. Energy requirements are also influenced by muscular activity; the greater the activity the more energy required. Energy requirements decrease with age. Energy requirements are also influenced to a small degree by the specific dynamic action of foods. Specific dynamic action is the increase in metabolism that occurs after food ingestion. [48]

Timing of meals and snacks can play an important role in energy level and endurance for the athlete. For example studies have shown that consuming a high-glucose food or drink approximately thirty minutes to two hours before exercising stimulates a rise in the insulin level. This rise in insulin in turn promotes the uptake of glucose by cells throughout the body and may cause hypoglycemia (low blood sugar). The net result is decreased performance and early onset of fatigue.[15]

Glycogen is stored in your muscles and is referred to as muscle glycogen. During exercise glycogen is used by muscles for energy. After the stores of muscle glycogen have been exhausted the body starts to metabolize fat. This can be a good thing if one is trying to lose weight. However, for the athlete looking for optimum performance this can be counterproductive. At the point which the body starts utilizing fat stores the person will experience a drastic decrease in energy, this is often referred to as "hitting the wall". The body does not easily convert stored fat into energy; it expends a lot of energy converting the fat into energy to be used. Thus the athlete wants to have a good supply of muscle glycogen for peak performance. This means a sufficient diet that supplies the body with enough nutrients for proper energy storage.

Protein is essential to the athlete in many ways. Protein is needed for the growth, maintenance, and repair of cells, including muscle cells, and for the production of enzymes, hormones, and deoxyribonucleic acid (DNA).[15] Just as with carbohydrates proteins must be ingested in the correct balance. During certain exercise periods, such as prolonged weight lifting, without the correct energy storages the body will break down protein for energy. This can cause many problems for the athlete seeking optimum performance. When the body starts to utilize protein for energy this means that there is no longer protein for rebuilding muscles after strenuous exercise. This can cause a low in performance following training.[15]

Lipids are a necessary part of any person's diet. Athletes need to remember to include a certain amount of fat in their diets for proper functioning. Fats are needed in the body for absorption of fat-soluble vitamins, they provide protective padding for body structures and organs, they serve as components of all cell membranes and other cellular structures, and they supply building blocks for other molecules.[15] As far as athletes are concerned, the total amount of fat that should be consumed varies with the sport. In general, endurance athletes need to maintain higher levels of fat intake than power athletes. The specific level is directly related to the energetics of the sport. Most athletes should concentrate on reducing their total lipid intake as well as their saturated fat intake while at the same time increasing their essential fatty acid intake. An athlete's essential fatty acid intake should be at least 9000 or more milligrams per day of linoleic and alpha-linolenic acids. [15]

Calorie intake for the athlete is calculated in the same way as for the non-athlete. The amount of calories one needs per day depends on the amount of energy expended throughout the day. The athlete usually requires more calories than the average person due to exercise expending more energy. To determine the number of calories needed per day look to the formulas in Appendix 2.

Water intake is essential to the athlete due to the higher amount of water loss. The athlete needs to be more concerned with the amount of water their bodies are receiving each day due to the accelerated loss of water during exercise periods. A lack of water can lead to cramping in the muscles and a greater chance of fatigue. Substantial amounts of water loss may lead to more severe problems such as dehydration. [15]

3. Literature Review

Information contained in the literature review pertains to the health of the athlete. Information concerning responses to training was gathered to get a sense of how athletes' bodies respond to training loads. This information gives an idea of what healthy responses to training are. The section on overtraining gives useful information about limitations of training. Information contained under the section "Making weight" pertains to the affects of making weight both physically and mentally. Possible health problems were investigated to make aware the problems that athletes face.

All of this information pertains to the overall health of athletes. The process of making weight may be affected by or affect certain aspects of training. This information was gathered to create a large base of knowledge to draw from concerning the overall health of the lightweight rower.

3.1 Physiological Responses to Training

A study by Mahler and colleagues investigated the physiological changes in rowing performance during the training season in collegiate women rowers. "Selected cardio-respiratory variables associated with aerobic and anaerobic components of exercise capacity were measured at 3-month intervals, which corresponded with the seasonal emphasis in the training program. This approach enabled us to assist the coach and athletes in determining the physiologic benefits of training and to provide specific guidelines for conditioning."[31]

Peak power production was increased significantly (+18%) compared to the initial value. Maximal heart rate was unchanged throughout the training season. Over the entire testing period the aerobic capacity increased significantly (+14%). "With 6 days of training per week for 6 months, the female rowers had a 14% increase in maximal oxygen consumption (VO_{2max}) (l/min)."[31] Maximal CO_2 (VCO_2) consumption and maximal energy output increased significantly by the end of the rowing season compared with the start.[31] "The O_2 pulse increased significantly between the initial and final testing periods (+14%), while the ventilatory equivalent for O_2 showed no change over the 6-month interval."[31] Two different responses were observed for parameters relating to the anaerobic threshold during the training season. In general, these results appear to reflect the predominant type of training (aerobic vs. anaerobic) emphasized during the 6 months.

When women race competitively over a distance of 1,000 m, anaerobic metabolism represents approximately 45% of the total oxygen requirements. Accordingly, the ability to noninvasively measure the anaerobic threshold (AT) by ventilatory changes and the associated heart rate (HR) response can be especially useful for training purposes. By the end of the training season, the collegiate rowers had improved their VO_2 at the AT by 18% compared to the initial testing period. This increase occurred entirely during the later 3-month interval.[31]

3.1.1 Hormonal Changes

Hormonal changes occur when an athlete undergoes a training regime. The different systems of hormones within the body are effected by exercise differently. Some studies have been done concerning a few systems of hormones in female athletes.[19, 11, 17, 34, 33, 56, 36.]

"Athletic training, particularly when combined with weight loss, increases a woman's risk of anovulation, irregular menses, and amenorrhea."[46] A study by Snow et al. monitored the estrogen metabolism and menstrual function of two groups of elite female rowers. The two groups of oarswomen included five oarswomen (group A) who experienced no menstrual dysfunction during the training year and five oarswomen (group B) who experienced normal menses during the phase of low intensity training but disrupted menses during the phase of high intensity training.[46]

Group B oarswomen metabolized a significantly greater fraction of estrogen (E_2) by 2-hydroxylase oxidation than did group A oarswomen. The amount of E_2 metabolized by 2-hydroxylase oxidation among group B oarswomen was significantly greater than that in controls. In contrast, group A oarswomen did not differ significantly from the controls in the extent of 2-hydroxylase oxidation.[46] It was found that the higher the fractional body water (the leaner the subject), the greater the extent of 2-hydroxylase oxidation of estrogen.[46]

"Physical exercise, dependent on intensity and duration, may cause changes in the plasma levels of endogenous anabolic or catabolic steroid hormones."[19] During an altitude training camp Fischer et al. collected night urine from 36 German elite rowers in order to measure the excretion of urea, creatinine, 17-ketosteroids (17-KS), and 17-hydroxycorticosteroids (17-OHCS). The general find was that in males the ratio of 17-KS/17-OHCS increased with rowing specific and non-specific training regimes where a lactate level below 2 mmol/l was observed. Training at higher lactate levels caused a decrease in the ratio that may be interpreted as a shift in the production from endogenous androgenic steroid hormones to cortisol. No significant effects of single training variables were found in female rowers, which indicates major training influences on testosterone metabolism.[19]

One study looked at the effects of oral contraceptive (OC) use (OCU) and non-use (OCNU) on growth hormone (GH) responses to exercise. The GH responses were significantly higher during the OCU phase than the OCNU phase. Based on these findings, females on OC therapy may best able to adapt to the greatest training intensity during the OCU phase when total estrogen levels are at their highest and the subsequent GH responses to exercise maximal.[11]

Ovarian hormone response to intense exercise and body weight changes were studied for 12 female lightweight rowers. The lightweight rowers had significantly lower progesterone metabolite excretion rates during the competition season, reductions that were reversed during the off-season. Low oestrogen and progesterone metabolites were also more prevalent in the lightweight rowers who had to lose the most weight. This bodyweight loss was associated with the suppression of progesterone metabolite concentrations during the competition season.[33]

One study investigated the impact of intense training on endogenous estrogen and progesterone concentrations and bone mineral acquisition in adolescent rowers. This study demonstrated an osteogenic response to mechanical loading, with the rowers accruing greater bone mass than the controls at the lumbar spine. However, the exercise-induced osteogenic benefits were less when rowing training was associated with low estrogen and progesterone metabolite excretion.[34]

Another study looked at the effect of an exercise-training program on bone mineral density in novice oarsmen. Findings showed that after 7 months training the mean bone mineral density of the lumbar spine had increased significantly by 2.9% and the mean bone mineral content had increased by 4.2 %.[17]

Other studies have been done investigating the effect of training on the hormone systems of the body.[56, 36] These studies show that there is no clear cut answer as to the effect of exercise on the hormones of the body. There is a compound effect on the hormone systems and levels of hormones in the body from things such as other hormone levels, duration and intensity of training, and other outside influences.[17, 34, 33, 56, 36]

3.1.2 Heart and Blood

Studies have been done on the effect of athletic training on aspects of the heart and blood. Saito and colleagues conducted a study on the effects of training on left ventricular systolic and diastolic function in female college rowers. The results indicated that rowing training increases the left ventricular diastolic dimension and left ventricular mass index without impairment of left ventricular diastolic function. This allows the heart of the athlete to generate a larger stroke volume during exercise due to the increased end-diastolic volume and adequate diastolic filling of the left ventricle.[41] Telford and colleagues looked at whole blood viscosity (WBV) of elite rowers in relation to performance. This study showed that the better performances of elite rowers of relatively homogenous rowing fitness and maximal oxygen consumption corresponded with a lower resting WBV at both high and low shear rates, the relationship being stronger at high shear rates.[52] Clifford et al. investigated the response of arterial blood pressure to rowing in men. The increase in mean arterial pressure during rowing is similar to that reported in other types of dynamic exercise. However, a Valsalva-like maneuver that is performed at the catch of each stroke produces large pressure fluctuations superimposed on the normal pulse pressure. Accordingly, there is a large effective pulse pressure during rowing that varies according to the force exerted. This may explain the greater cardiac hypertrophy in rowers compared with other aerobic athletes.[16]

3.1.3 Working Capacity and Power Output

A study was done investigating dietary carbohydrate, muscle glycogen, and power output during rowing training. Dietary carbohydrate content has a positive correlation to muscle glycogen content. A high carbohydrate group and a moderate carbohydrate group were studied. Results of this study revealed that the high carbohydrate diet resulted in greater muscle glycogen levels and better time trial performance than did the moderate carbohydrate diet in rowers over 4 weeks of intense twice-daily training.[44]

Vermulst et al. analyzed the seasonal training volume and working capacity in elite female rowers. Their study showed that the seasonal training volume expressed in terms of time and rowed kilometers changes in such a way that an increase in training volume is found. There was no relationship between the performance parameters as measured on a rowing ergometer and daily training volume (in minutes and kilometers) could be found.[55]

3.1.4 Psychological Effects

It has been demonstrated that most individuals who participate in competitive athletics consistently display positive mental health profiles in comparison to population norms.[39] The results of the study by Raglin et al. are in agreement with previous investigations examining the effect of intense training on mood state. Freshman rowers exhibited significant elevations in global mood disturbance during the course of competitive training. Comparisons among the three groups, dropouts, unsuccessful adherers, and successful adherers, revealed a lack of significant differences in baseline mood state.[39] Findings from this study are consistent with the mental health model of athletic performance, which predicts that athletes with significant mood disturbance are less likely to be successful than athletes with positive mental health.

The conclusions of this study were such:

1. Baseline mood state does not differentiate among eventual dropouts, successful adherers, and unsuccessful adherers.
2. Successful adherers are characterized by an improvement in mood state following a training reduction, whereas unsuccessful adherers do not respond in a positive manner.
3. Self-motivation discriminates between adherers and dropouts, but it is not related to success among those who adhere to training.
4. Self-motivation is correlated significantly with rowing ergometer performance.[39]

3.1.5 Immune Function

Many components of the immune system exhibit change after prolonged, heavy exertion, indicating that the immune system is suppressed and stressed, albeit transiently, following prolonged endurance exercise.[37] In a study done comparing immune function between female elite rowers and non-athletes it was found that killer cell activity was substantially higher in the female rowers than in controls.[38] Another study looked at the immune response to two hours of rowing in elite female rowers. The patterns of change in blood natural killer cell counts and activity were slightly affected by carbohydrate ingestion, but these differences were small. This study found that minimal changes in blood hormonal and immune measures were found following two-hour bouts of training the athletes.[37]

3.1.6 Cardiovascular Response

There have been a number of studies investigating cardiovascular responses to rowing.[30, 12, 50, 40] One study looked at the lung elasticity of the rower during training and expiratory flow limitation during exercise.[12] One study looked at the hypothesis that locomotor-respiratory coupling (LRC), or entrainment of breathing, develops in the sport of rowing as a result of training. A majority of subjects exhibited a ratio of 2:1 of breaths per rowing stroke. The study concluded that LRC can develop after an 8-month training program in the sport of rowing, and was most evident at peak exercise intensity.[30]

In a study by Szal and Schoene is stated that imposed biomechanical motion of rowing may alter both respiratory mechanics and timing. The results of this study demonstrate that in both elite rowers and untrained controls simulated rowing results in a higher ventilatory response for sub maximal levels of exercise than cycling. The mechanoreceptors' response may be increased, leading to an increased respiratory drive and ventilatory result, especially in the extended position when breathing and rowing are synchronized.[50] A study by Rosiello et al. is in agreement with the results of these other studies. They demonstrate that the cardiovascular responses to rowing are different from upright cycle exercise.[40]

Both studies by Szal and Schoene and Mahler and colleagues state that biomechanical factors might contribute to or determine the pattern of breathing during rowing. At the catch the knees and hips are flexed while the body is in a cramped position. This position might possibly impair the normal downward excursion of the diaphragm because of an increase in abdominal pressure, which in turn might limit the lung capacity of the rower. During the drive the knees, hips, and back are extended. This movement would permit or even facilitate inspiration as the compressed body position and increased abdominal pressure are relieved.

3.2 Overtraining

One study by Kellmann and Gunther shows the importance of balancing training stress and recovery for an optimal performance development. "According to the bio-psychological stress model by Janke and Wollgramm, stress is an unspecified reaction-oriented syndrome that is characterized by a deviation from the biological homeostatic state of the organism. Stress is accompanied by emotional symptoms like anxiety and anger, elevated activation in the central and autonomous nervous system, humeral responses, changes in immune functions, and behavioral changes. Recovery encompasses active processes of reestablishing psychological and physical resources and states that allow the taxing of these resources again." Empirical evidence suggests that recovery is a sensitive process that can easily be disturbed or prevented. Optimal performance is only achievable if athletes are able to recover after competition and optimally balance training stress and adequate recovery. As a result of inadequate recovery (deficit and/or disturbances of recovery) psychological and physical consequences such as overtraining and burnout may occur.[26]

Staleness is an undesirable outcome of overtraining characterized by an inability to train at customary levels, and sometimes accompanied by symptoms like drowsiness, apathy, irritability, fatigue, anxiety, confusion, disturbances in sleep, and clinical depression. During overtraining, mood disturbances significantly increased and were accompanied by a profile reflecting diminished mental health in the study by Kellmann and Gunther. Mood improvements occur if the training volume is reduced.[26] It has been suggested that hormonal changes that occur do to overtraining result in performance incompetence and high fatigue ratings.[54] Morgan and colleagues recommend that the symptoms associated with overtraining and staleness should be monitored continuously during the course of athletic training so that training volumes can be adjusted as soon as negative symptoms begin to appear.[26]

3.3 Making Weight

Making weight is the term used for the process of losing or gaining weight to qualify for a specific weight class. In lightweight rowing the weight limit for the female rower is 59 kilograms (130 pounds). For national competitions FISA has set a crew average of 57 kilograms (125 pounds) as well.

3.3.1 Body composition and weight loss

Body weight (BW), ideal body weight (IBW), fat free mass (FFM), percentage body fat, total body fat, and body mass index (BMI) are some quantities that people compare when looking at fitness and the athlete. Several studies have been published using quantities such as these.[22, 28, 35, 20, 49, 45.]

Several methods for determining IBW have been published. Linear regression equations are the most widely used methods. The most accurate equations are corrected for gender and frame size. These equations take into consideration clothing, height, body frame, and gender.[22] Examples of these equations can be seen in Appendix 3.

In many weight limited sports, acute weight loss before competition is achieved by energy restriction, along with various dehydration techniques such as excessive exercise, plastic wraps, saunas, induced vomiting, laxatives, diuretics, and sweat runs. Despite the documentation of the detrimental impact that these weight loss techniques have on rowing performance, use of the techniques persists.[35]

A study by Koutedakis et al. showed a 6% and 7.4% reduction in BW following two-month and four-month periods of weight control respectively. Approximately 50% of the BW loss reflected FFM, which is higher than the 22%, suggested by Webster et al. to be an optimal figure. This is an important finding as many authorities suggest that exercise prevents FFM loss, at the expense of fat, during BW regulation regimens.[28]

Six to eight weeks of dietary restriction, carried out during normal physical training, was associated this significantly reduced respiratory anaerobic threshold (T_{vent}) compared with those at the beginning of this period. It has been suggested that BW loss of up to 1kg/week, for approximately four weeks, is safe weight-regulation regimen for athletes.[28] Though the subjects from the study by Koutedakis et al. were within these recommended limits, they demonstrated impaired test performance associated, for instance, with maximal muscular effort.[28]

In another study by Morris and Payne on body composition of lightweight rowers no changes were observed in FFM over a season of intensive rowing training. Examination of the lightweight rowers' body weight across the season revealed significant reductions at competition season to a seasonal low of 57.0 kg, equating to a 5.9% seasonal body weight decrease in the female rowers. Seasonal body weight reductions were attributed, in part, to dietary restrictions, and more specifically to significant reductions in total energy (kJ), absolute protein ($g\ d^{-1}$) and absolute fat consumption ($g\ d^{-1}$). Acute weight loss methods employed by the lightweight rowers to "make weight" incorporated a combination of several weight loss techniques including the implementation of training rows by 73% of the participants, fluid restrictions by 71%, sweat runs by 30%, sitting in the car in the sun by 30%, hot showers by 16.5%, sauna by 10%, and heater by 7%. In this study the rowers' FFM showed no change throughout the season.[35]

In those studies that have used a prolonged (>24 h) exercise and food/fluid restriction dehydration regimen resulting in greater than 5% reduction in body weight, common physiological responses include a decrease in physical working capacity and muscular strength, muscle glycogen content and maximal oxygen uptake, and non-significant changes in aerobic capacity, anaerobic capacity, and maximal heart rate.[14]

3.3.2 Diet disturbance

Athletes have been identified as a group at high risk for eating disorders. Existing studies generally find that athletes more frequently have problems than the general population or control groups and that sports characterized by specific weight requirements or appearance expectations (e.g., wrestling, gymnastics) have more problems than sports in which weight is less important (e.g., volleyball).[49, 10]

In a study done by Sykora and colleagues it was found that female rowers had significantly higher scores on the Eating Attitudes Test than male rowers. This reflects a higher occurrence of eating disturbances in females. This study found that females are more concerned about eating and weight than males and that females exhibit more maladaptive eating behaviors. In their sample of college rowers, 20% of females and 12.3% of males reported binge eating twice or more per week.

"It should be noted that the athletes' striking weight loss and aversion for food develop *consciously* and *voluntarily* as they do in anorexia nervosa in the absence of any organic disease. The maintained high level of energy expenditure in intense training activities in the absence of any significant food intake is remarkable and accentuates weight loss. Daily losses of a pound, or even more, are not uncommon. As in anorexia nervosa the involved athlete experiences and tolerates the consequent hunger pains. The starving athlete may have bizarre reactions to having eaten, and may go on eating binges at the end of a tournament or season. It must be pointed out that such gorging can be hazardous because of salt-induced water retention and cardiovascular overload."[43]

Incidence of subclinical eating disorders is increasing according to Beals and Manore. Subclinical eating disorders are forms of eating disorders that meet some but not all of the formal diagnostic criteria.[10] *Anorexia athletica* has been identified as a subclinical eating disorder. A subclinical disorder may eventually lead to development of a clinical eating disorder such as anorexia nervosa. "Severe energy restriction may cause an increase in energy conservation or energy efficiency, which may undermine further attempts at weight loss or weight maintenance. This in turn may cause the athlete to resort to more extreme dieting measures and, perhaps, eventually develop a clinical eating disorder. Moreover, the energy and nutrient deficiencies resulting from severe energy restriction may further decrease performance."[10]

Discussion with coaches suggests that lightweight teams are rare because of concerns with eating and dieting practices. One major university among those surveyed had terminated the lightweight team because of problems with dieting and eating disorders. Competitive college rowers appear to be susceptible to heightened pressures to diet in order to meet specific weight criteria.[49]

3.3.3 Chronic Energy Deficiency

In a study by Kukarni et al. it was found that chronic energy deficiency results in decreased linear growth and reduction in body size. The reduced stature and small body size of chronically energy-deficient (CED) subjects is also linked to poor productivity. "Prolonged energy restriction results in a reduction in the basal metabolic rate (BMR), which is attributed both to a reduction in body tissue and a reduction in oxygen consumption of the residual active tissue mass."[29]

In addition to decreasing performance, inadequate energy and/or micronutrient intake may adversely affect health status either directly, as a consequence of low body weight, or indirectly through the effects of behavioral, dietary, or exercise practices used to maintain a low body weight. Some potential consequences of chronic nutrient deficiency include chronic fatigue, increased susceptibility to infection, poor or delayed healing and recovery from injury, anemia, electrolyte imbalances and cardiovascular changes, endocrine abnormalities, and osteoperosis.[10] There is adequate evidence to suggest that chronic energy restriction can produce or exacerbate psychological disturbances.[10]

3.3.4 Fluids

One study done by a group in Australia examined the effect of a commonly used dehydration and rehydration practice on rowing performance and physiological function during high intensity rowing by elite lightweight rowers.[14] For this study it was hypothesized that dehydration, even if followed by partial rehydration, results in a significant reduction in performance due to altered metabolic processes during exercise. The subjects took significantly longer to complete the dehydration – rehydration trial (RT) than the euhydrated trial (ET). The increased time to complete the RT was not reflected in significant changes in peak O_2 uptake, peak maximal energy (VE_{peak}), and peak heart rate (HR_{peak}). During the RT the subjects used significantly less glycogen compared to that of the ET.

These data demonstrated that dehydration caused a significant decrease in the ability to sustain work at a high intensity. On average, it took approximately 22s longer to complete the RT compared with the ET. This increase in time to "cover the same distance" could be equated to losing a boat race by approximately 117 m in an eight-oared race or approximately 95 m in a pair-oared event over 2000 m.[14]

3.4 Possible Health Problems

A study conducted by Devereaux and Lachmann took a look at a variety of sports and sporting injuries. Of their findings rowing injuries constituted 8.3% of the total injuries within the study. The most common injuries occurring in rowing were Lumbar Strain and Wrist Tendonitis. "Wrist Tendonitis involved mainly the extensor tendons and of the total treated 83% were in oarsmen."[18] In this study Lumbar Strain caused 28% of the injuries seen in rowers.

3.4.1 Sports Hematuria

An article published in The Journal of Urology by Abarbanel and colleagues report on bleeding associated with sports activity and coin the term "sports hematuria" as a separate entity in the differential diagnosis of urinary tract bleeding. Sports hematuria is found to occur in non-contact as well as contact sports. "Alyea and Parish investigated athletes in a wide range of sporting professions, such as swimming, rowing, lacrosse, football and track. They observed that 60 to 80 % of the athletes had an abnormal amount of red blood cells in the urine specimen taken after exercise. It was evident that there was little difference in the percentage of athletes with red cells in the urine whether the sport was traumatic or non-traumatic in character. Swimming, lacrosse and track gave similar results (80%), and football and rowing were approximately equal (55%)."[8] This type of hematuria was found to not be gender specific.[8] Typical findings from different studies on the topic suggest that the mode of production of the bladder injury is the repeated impact of the flaccid posterior vesical wall against its base, which is a thicker, fixed and more rigid structure, since it comprises the trigone. See Figure 3 for a depiction of the site of impact. While each impact in itself is probably insignificant, with repetition the resultant effects may be evident.[8] "During intensive physical activity there is, at least temporarily, damage to the kidney. Recovery seems to be prompt but is it complete? This question remains open to further investigation, since there have been no data on the renal function of subjects who have retired or no longer compete in sports activities, regardless of whether they participated in contact or non-contact sports."[8]

3.4.2 Athletic Amenorrhea

Oligomenorrhea and Amenorrhea are more prevalent among athletes than among the general population.[42] Serum levels of several protein and steroid hormones rise acutely during exercise, and the long-term effects of such repetitive, transient alterations remain unknown.[42] Menstrual dysfunction can result from either hyperprolactinemia or hyperogenism, but regular exercise has not been shown to cause sustained elevations in resting concentrations of either prolactin or androgens. It remains to be shown how differences between amenorrheic and eumenorrheic athletes account for their different menstrual patterns and whether repetitive transient hormone alterations relate to long-term changes in athletes.[42]

Some other factors that may contribute to amenorrhea are weight loss, physical and emotional stress and dietary factors. Simple weight loss or thinness alone, even in the absence of exercise, may lead to amenorrhea.[42] While exercise tends to relieve stress and anxiety, it can promote stress and anxiety, too, particularly in goal-oriented obsessive – compulsive individuals.[42] Schwartz et al. have shown that amenorrheic runners associate more stress with their exercise than do eumenorrheic runners. It remains to be shown how psychological stress relates to exercise – associated amenorrhea, but such stress can lead to increased production of several "stress" hormones, including catecholamines, prolactin, endorphins, and cortisol.[42] Concerns about healthy living often lead regular exercisers to alter their dietary habits, and athletes have been shown to eat differently from nonathletes.[42]

Osteoporosis is an age-related disorder characterized by a decrease in bone mass and an increase in susceptibility to fractures.[51] As estrogen therapy has been shown to retard the loss of bone mineral content in postmenopausal and oophorectomized women, the low normal concentrations of estrogen in amenorrheic athletes may predispose this population to premature osteoporosis. Highly trained athletes seem to be losing bone mass. This is contrary to the idea that exercise has a positive effect on bone mass by actually increasing bone mass.[47]

The study done by Snyder et al. failed to show that elite lightweight oarswomen have decreased radial or vertebral bone mineral content. These results are in agreement with other studies done on amenorrheic runners. This study also did not show a decrease in vertebral bone mass among the athletes. "Prospective studies indicate that resistance exercise training can induce small, but significant, increases in bone mineral density (BMD). However, the increases do not appear to be greater than those that can be induced by relatively high intensity endurance – type exercise training."[27]

3.4.3 Sacroiliac Joint Dysfunction

Sacroiliac Joint Dysfunction (SIJD) is an important orthopaedic problem in rowers. SIJD has been defined as a state of altered mobility within a portion of the sacroiliac joint's range of motion, either unilaterally or bilaterally, which causes one or more changes in the structural relationships between the sacrum, the ilium, and one or both legs. Several studies have examined the general nature of low back pain in rowers. However, one possible source of low back pain that has not been studied in elite athletes, including rowers, is SIJD.[53]

SIJD is manifest as pelvic obliquity. Pelvic obliquity may cause an asymmetry between the anatomical landmarks of the distal aspect of the lower extremities resulting in a functional shortening of one leg. These deviations from the normal anatomical relationships cause abnormal force-loading mechanics within the structures of the pelvic and lumbar regions, which may result in low back pain.[53]

Results of the study done by Timm showed 54.1% of rowers tested were found to have SIJD.

3.4.4 Stress Fracture of the Rib

Stress fractures are a well-described consequence of athletic training. Athletes who make sudden changes or significant increases in their training programs are at risk for stress fractures.[25] Stress fractures occurring in ribs 5 through 9 were found to occur in elite level rowers both male and female. [24, 13, 25, 32]

It is suggested that actions of the serratus anterior and external oblique muscles on the rib cause stress fracture because of the repetitive bending forces cause by rowing.[24, 25, 32] "The serratus anterior is a broad muscle originating at the medial border of the scapula and inserting anterolaterally on ribs 1 through 9, where it becomes interdigitated with the origin of the external oblique muscle on ribs 5 through 9."[25] See Figure 4 for a depiction.

"The fractures were routinely mistaken for muscular strains because of the significant bulk of overlying muscular tissue in this anatomical area."[24] In a study by Holden and Jackson fractures of the lower ribs consistently presented pain along the spinal boarder of the scapula with pain radiating as far as the midaxillary line, depending on the exact fracture location. In the study by McKenzie pain was localized to the chest wall and did not radiate. "It was aggravated by a deep inspiration and by movements of the upper extremities and thorax that simulated the rowing stroke."[32] Pain in the lungs would be experienced upon expiration; air entry was normal. Tenderness was experienced in the right chest wall at the insertion of the serratus anterior muscle.[32]

3.5 Rowing Specific Publications

Publications devoted specifically to rowers and coaches are available to everyone. There are newsletters such as The Independent Rowing news that is published bi-weekly.

The organization USRowing publishes its own newsletter as well as having on online for members of the organization. The web site About.com has a popular web site devoted to rowing information (http://rowing.about.com/recreation/rowing/). There are also a number of websites and newsletters specific to the area in which a person is situated.

3.5.1 Making weight

A letter addressed to Lightweight Coaches concerning the athlete using unhealthy measures for making weight was published on the About.com's rowing website. "In an effort to address the concern of athletes taking extreme measures to 'make weight', a Lightweight Task Force was formed. The Task Force was established to discuss this issue and to make recommendations or suggestions for decreasing the occurrence of this problem. At the same time, during this process, the Task Force felt it was important to work with coaches and athletes to encourage safe practices for lightweight rowing.

A number of recommendations were made and are currently under consideration. One recommendation with a high priority was to 'inform' coaches and athletes of the dangers and problems associated with extreme weight loss measures."

The recommendations made in this letter are as follows:

~ The healthiest way to lose weight is slowly, with full hydration and good nutrition. This means systematically losing and then maintaining weight.

~ There are two major health risks involved in losing weight for athletic competition: dehydration and malnutrition. Dehydration is the most acute and the most dangerous.

~ Endurance athletes must be concerned with dehydration. In mild environments, body water losses more than -3% of body weight result in reduced VO2 max. In hot environments, small to moderate water losses (-2% to -4% of body weight) result in large reductions in VO2 max.

~ Exercising or competing while dehydrated causes the body to overheat. Heat cramps, heat stroke and heat exhaustion may set in.

~ Though you can largely rehydrate in 12 hours, it takes 24 hours for full rehydration.

~ When rapid weight loss techniques are used, primarily water and lean body mass is lost, not fat. The result is a decrease in muscle carbohydrate stores, or glycogen, and muscle water. This translates into decrements of temperature regulation, cardiovascular function, endurance, and possibly power when muscular contractions are sustained and repeated longer than 30 seconds.

~ The methods of rapid weight loss appear to affect athletic performance differently:

  - Water loss via diuretic use results in great reductions in cardiovascular endurance and in larger fluid loss from the circulation system than other forms of dehydration.
  - Strength athletes are likely to show impairment of performance if weight loss is accomplished by fluid restriction.
  - When rapid weight loss occurs via exercise and heat exposure, decreases in strength and power are even more likely to result.
  - Rapid weight loss may result in psychological changes that influence performance negatively.[4]

This letter touches upon all of the concerns that are noted throughout many different articles on making weight for lightweight rowing. Other sources the rower might seek information from typically contain the same information as this letter.

The rower can also view anecdotal articles containing information on making weight. Personal information on the whole process of making weight may be helpful to the athlete deciding on whether or not to row lightweight.[2] Information on some dangerous aspects such as dehydration[6], disordered eating, and other unhealthy activities can be obtained from such articles.[2, 5, 6] For instance one article written by Jen Renaud gives her account on rowing lightweight for a year. "Eating became almost painful as I counted every gram of fat I put into my body. Though I never purged, I struggled with binge eating."[2]

Articles like these both say the same thing about deciding to row as a lightweight. "Coaches and rowers alike need to carefully evaluate whether or not a rower is fit to go lightweight before a decision is made."[2] "If you aren't already under the specified lightweight limit at this point in the season, you should probably be asking yourself if it is actually healthy or physically possible for you to be a lightweight rower."[5]

Through my research I have found no studies like my own published. People have published letters and articles making suggestions on how to avoid unhealthy practices and situations in the sport of lightweight rowing. However, no studies have been done to make recommendations as to possibly making the process of making weight healthier for the lightweight rower.

4. Methods

A group of 11 female lightweight rowers was the research group used for the bulk of the gathered information. Participation in the study was on a voluntary basis. All 11 rowers were involved in a lightweight development camp for sculling that lasted for two months, from June 2000 to August 2000. All of the athletes were between the ages of 20 and 25 years. The weight of the athletes was 60.9 kg $\pm$ 2.21 (Mean $\pm$ SD).

The development camp routine consisted of two-hour practice sessions 11 times per week; two sessions per each weekday and one practice on Saturday. Each session was either water practice in a boat, land practice consisting of running, ergometer rowing, or weights workout, or any combination of water and land practice. Along with the demanding practice schedule for the camp each athlete had to deal with losing weight to compete in the weight class.

Along with questionnaires and discussions the group of female athletes was observed during the two-month period. The observation was limited to time spent at practice and time spent at races including traveling to and from races. The time spent at races included observations of preparation for weigh-in, actual weigh-in, and post weigh-in.

Two elite female rowers were interviewed to find more information on making weight. These athletes have competed and trained on the National and International level as lightweight rowers.

A group of 10 lightweight oarsmen was also observed during the racing period. Observations of pre and post weigh-in habits were taken. No questionnaires or discussions involved the male athletes.

Results were formed using the responses from the questionnaires and the information received through observations and discussions. The questionnaires were assessed using numerical values assigned to responses. The totals for each question were evaluated to get the response that occurred most frequently. The most frequently occurring answers are reported within the results. The information obtained through interviews was used to formulate recommendations and are not contained within the results.

4.1 Questionnaire

The use of a questionnaire was decided upon due to the amount of information provided from their utilization. The questionnaires consisted of multiple choice and short answer questions. The first two questionnaires administered consisted of 20 multiple-choice questions each. The third consisted of 12 questions overall, 8 multiple-choice and 4 short answer. The questionnaires were given at approximately 2 to 3 week intervals.

Each rower was asked to answer each question to the best of their ability. The first questionnaire sought background information about the rower, such as weight and goal weight, information on personal changes from dieting, such as mood changes, and what information about health and nutrition was known. The intent of the second questionnaire was to discover, more specifically, how much information the athlete had about nutrition and optimal health. The third questionnaire given sought to discover information on how the rower felt about the process of making weight. This questionnaire was seeking the opinion of the rower on making weight after having gone through it. Questionnaires given can be seen in Appendix 4.

4.2 Interview

Two experienced rowers that have made weight on a number of occasions were interviewed. This interview provides a different perspective on the process from the athletes given the questionnaires. The information sought from the interview was similar to the information sought from the other rowers; practices for making weight during training and on race day. Both these women have lost weight for the purpose of rowing in a lighter weight class. They have several experiences making weight under a few different coaches and in a few different environments.

4.3 Focus Groups

Focus Groups were used to gather information from a number of people on the process of making weight. The Focus Groups provided more detailed information than the questionnaires.

The Focus Groups that were used were from the same 11 athletes that were given the series of Questionnaires. A group of 3 to 4 athletes were taken at a time to discuss the topic of nutrition and making weight. The discussions included eating habits, types of food eaten, diets that they have tried or heard about, information they know, where they found this information, how informative coaches and rowing associations have been, information they have heard from other rowers, and any other topics that may come about. Every two weeks a group of athletes would discuss making weight for approximately 30 minutes. The athletes identified the topics of the day's discussion.

5. Results

The average weight needed to be lost to make weight for international races for the group of athletes this season was 4.22 kg ± 2.21. The time span for the weight loss was approximately 6 weeks from the date the first questionnaire was administered (June 6). The goal weight reflected the weight average placed on the boat by FISA regulations for international competitions; an athlete weight of 59 kg with a crew average of 56.7 kg.

Responses from the questionnaires show that the athletes have sufficient knowledge of health and nutrition; 8 athletes felt they know a lot about nutrition. 8 out of the 11 athletes were aware of possible long-term health risks from dropping weight. Actions they are taking now to make weight may contribute to health problems such as osteoporosis later in their life. Of those 8, 5 knew of possible immediate health risks from making weight. Problems such as amenorrhea may arise when too much body fat is lost. 3 athletes were not aware of any health problems from trying to row a lighter weight class.

Nutrition	# of subjects		
Response:	A lot	A little	None at all
Amount of knowledge	8	3	0
Information received from coaches	1	9	1
Information received from rowing associations	0	3	8

Out of the 11 subjects only 1 considered the long-term health effects to be a major factor in their decision to row lightweight and only one person considered the short-term health effects to be a major factor. 6 out of 11 considered the long-term health effects at all, while the remaining 4 did not. 6 out of the 11 athletes also considered the short-term health effects to be a factor in their decision, while 4 did not consider them at all. 3

athletes did not consider either long-term or short-term health effects as factors in their decision to row lightweight.

Health	#of subjects		
Response:	Yes	No	
Awareness of long-term health effects	8	3	
Awareness of short-term health effects	5	6	
Response:	A lot	A little	None at all
Impact of long-term health effects on decision to row lightweight	1	6	4
Impact of short-term health effects on decision to row lightweight	1	6	4

Of 5 different factors Competition was the biggest factor in their decision with 6 athletes ranking it as the biggest factor. 5 athletes ranked Height as being the largest factor, 2 athletes ranked Weight, and 1 athlete ranked Strength as the largest factor in their decision. 1 athlete ranked Height, Weight, Strength, and Competition all as being the largest factor in their decision to row lightweight; with Health not being considered. 4 of the athletes felt that Competition was the second most important factor. Weight was the third most important factor of the group.

Factors in decision to row lightweight		
	# of subjects	
Ranking:	1	2
Competition	6	4
Height	5	2
Weight	2	3
Strength	1	2

The information obtained about nutrition came mostly from individual research with 9 athletes ranking it the largest source of information. Coaches were the next largest source of information, with peers being the third largest source of information. Rowing associations were the smallest source of information with 7 of the athletes ranking it so. 6 athletes were presented with information before they asked for it. Of those 6 athletes 3 were presented with the information much before they were making the decision to row lightweight. 6 athletes did not receive any information on healthy living from their general practitioner. The remaining athletes felt that only a little information was given.

Sources of information			
Rank:	1	2	3
	Individual research	Coaches	Peers

9 of the 11 athletes felt that the information presented to them was clear. Only one person felt that information about nutrition was hard to find. However, this athlete reported taking less initiative than other athletes. A majority (8 out of 11) of the athletes felt that information given to them by their coaches was useful. Only one of the athletes felt that this information was not correct. Of the athletes who felt rowing associations gave any information at all reported mostly training information. Information on technique and training tips was the type of information given out by associations. The bulk of the information received from rowing associations was through newsletters. All but 1 athlete felt that the information retrieved through personal research was very similar to the information they may have received from coaches and rowing associations.

Only 4 athletes felt they utilized the information to better their health. The same 4 athletes felt that the information they were presented and collected has an impact on their decisions concerning their health. Only 2 of the athletes have seen a nutritionist. Both felt the nutritionist was easy to find, however, only one athlete felt it was helpful.

Overall the athletes felt there was a supportive environment for making weight. 7 athletes felt a strong sense of support from the other athletes. The remaining 4 felt it less strong but still supportive. Only one of the athletes felt that the coach was in no way supportive in the process of making weight. 5 athletes felt that the coach was very supportive and the remaining 5 felt the coach was only somewhat supportive.

Support	#of subjects		
Response:	Very Supportive	Somewhat supportive	Not Supportive
Support from athletes	7	4	0
Support from coach	5	5	1

Tension from other athletes was reported by 8 of the 11 athletes. Tensions could be cause by athletes talking about teammates, discussing how much food a certain person is eating or discussing the weight of a teammate for example. Tensions were felt near and around weigh-in times. Athletes perceived tensions from the group when large fluctuations (4 to 6 pounds) in weight were experienced. Tensions from the coach were reported by 4 of the athletes. Tensions from the coach may be caused by worry about one's weight. For instance an athlete may be worried as to how the coach will react to their weight at weigh-in. The athlete may be a few pounds heavy that day because of factors out of their control. Worry from the athlete may manifest into tension from the coach. Or the coach may be creating tension among the athletes through his or her actions.

Tensions	# of subjects	
Response:	Yes	No
Tensions from athletes	8	3
Tensions from coaches	4	7

Discussion of making weight occurred often. 4 athletes reported discussing making weight 2 to 3 times per day. 5 athletes reported discussing it once per day, and the remaining 2 athletes discussed the topic 2 to 3 times per week. At no time during the camp did the athletes discuss the topic of making weight less than 2 to 3 times per week.

Discussions of Making Weight	#of subjects
2 to 3 times per day	4
Once per day	5
2 to 3 times per week	2

The most difficult aspect of making weight seems to be specific to the individual. There was no major trend in the answer to the question of the most difficult aspect of making weight. The largest agreement in answer was water weight fluctuation reported by 3 of the athletes. The two athletes interview felt that there wasn't enough information provided on how to lose weight and how to reach your goal weight. There were responses from the group in agreement to this. Some athletes felt there should be more information provided on how to lose weight.

The largest problem in lightweight rowing once again seems to be more specific to the rower than general to the sport. Some responses to this question were weight averages imposed by FISA, "cutting weight" i.e. sweat runs, and people forcing their bodies to lose weight to row in the weight class. The two women interviewed felt that secrecy of teammates was a large problem the first season they rowed lightweight. They felt it caused unnecessary tension between teammates and an unhealthy environment.

Discussions with the athletes revealed the everyday practices in place to make weight. The amounts of calories were scrutinized over throughout the duration of the camp by most of the athletes. Food intake was cut back to create a negative calorie balance. Some athletes to help in creating a negative calorie balance increased exercise as well. Quality of food was closely watched by many of the athletes due to the diminished volume consumed. Foods such as nutritional bars were often eaten throughout the day as part of the diet. Some athletes followed popular diets for a period to try and make weight. For the most part the athletes simply cut back in calories and cut out "junk food" from their diets.

During discussions and observations a lot was revealed about the lightweight athlete. Behavior patterns of the athlete change as time nears competition and ultimately weigh-in. During one racing session a number of rowers became seemingly obsessed with their weight and the weight of their teammates. At one point the athletes would wake in the morning and weigh themselves first thing. After their normal morning routine they would weigh themselves again. Before morning practice some athletes would weigh themselves about 4 times before even leaving the hotel. This weigh-in habit occurred on two or three different scales with athletes going from one scale to the other to check if there was any discrepancy in weight. These habits occurred in the male athletes as well as the female athletes. Weight was seemingly the first thing on their minds in the morning and the last thing on their minds before going to sleep at night. This behavior seemed to be at times almost obsessive.

Food went hand in hand with weight. Around competition time some athletes became obsessive about the food they ate. They would take pains to count every calorie they ingested throughout the day. Some went so far as to take measures to curb hunger; behaviors such as eating hard candies to satisfy hunger without consuming a lot of calories or heavy foods were practiced. Foods like fruit were avoided because of the amount of water weight that could possibly be gained.

6. Discussion

The results of this study give an idea as to the complexity of the process of making weight. There are many issues that affect the athlete such as nutrition, mental health, and performance. Each athlete may have a different opinion or a different view on one particular aspect of lightweight rowing. It is difficult to generalize these opinions so they relate to the sport as a whole. However, there are trends that athletes fall into regardless of what their opinions.

Nutrition at this level of competition seems to be less a worry than at other levels. It seems that the athlete that competes at the development camp level has been exposed to the idea of health and nutrition. Whether they have done research of their own initiative to better their health and performance or received information on nutrition and health most athletes seem to have a solid base of knowledge. At this level performance is a large factor in the athlete's mind when it comes to decisions of any kind. There is enormous pressure placed on the athlete to perform at her best at all times. The athletes at this level seem to have realized that performance is largely affected by nutrition and thus try to practice good behaviors.

Weight loss is a different issue altogether. Weight loss is an issue that needs to be out in the open. If this issue is not addressed by either the coaches, the rowing associations, or some outside party it may potentially create a harmful situation for the athlete who does not have sufficient information. Weight loss is not something everyone knows how to accomplish. Some may go about losing weight harmfully. This may have serious effects on their health in the short-term as well as long-term. However, this also does not seem to be the largest problem in the sport. It seems that at this level of the sport most athletes have an idea as to how to lose weight safely over a given period of time. Most of the athletes seem to have the initiative to gather information for themselves whether or not the coach or anyone else has provided any. Weight fluctuations are one of the issues that the athletes are most concerned about. This issue should be addressed before or at the time the athletes show concern.

Mental health seems to be a possible problem in all sports that have weight classes. In the sport of lightweight rowing mental health should be seen as a possible serious problem for the athlete. The environment created in which athletes are competing at the same time as trying to make weight may be mentally harmful. Some athletes may not be able to handle the stresses placed on them to make weight. It seems that the athletes are capable of creating a lot of unnecessary tension between teammates when it comes to making weight. Talk of an athlete by other athletes causes a lot of tension within the team. This should be avoided as much as possible. It has the potential to create a hostile environment between team members. It has also been documented that athletes may resort to harmful measures to make weight rather than let teammates down. This may have a large effect on the mental health of the athlete. For example if an athlete resorts to extreme measures to make weight such as starvation or drastic dehydration this has an effect on performance. Thus the athlete who has now "cut weight" is not going to perform at her best therefore indirectly letting her teammates down. Now if the boat does not perform as they were expecting the athlete who had resorted to drastic measures could be to blame. Thus this places an enormous amount of pressure on the athlete to make weight as well as perform at her best. Mental stresses should be kept at a minimum while the athlete is training and racing.

Some of the factors in the decision of an athlete to row lightweight should be observed. The biggest factor in the decision to go lightweight for the subjects of this study was Competition. Height, Weight, and Strength were the other factors in the decision, in that order. Competition is a valid reason to want to compete at a different level within a sport but a person's body composition will ultimately define the weight class the person should be in. It may not be healthy in any way, or even physically possible without a large loss of muscle, for an athlete to lose enough weight to compete in a smaller weight class. Borderline athletes often choose to compete in a smaller weight class because they are so close. This may not be the smartest choice for this athlete.

The complexities of rowing may carry over from the boat into the athletes themselves. The decision to row lightweight should be taken seriously and aspects such as height, weight, and body composition should be taken into consideration. Making weight for lightweight rowing is a process that takes time and there are many factors involved. There are many issues that affect the athlete and should be taken seriously. Mental health, physical health and nutrition, and performance are examples of the factors that are involved in making weight.

7. Conclusion

In conclusion, athletes face many factors in their decision to row lightweight. Mental health, physical health, nutrition, and performance level are only a few major things to consider before deciding to compete lightweight. Whether or not the athlete is prepared to make the sacrifices set before her when deciding to compete lightweight is often a factor people tend to overlook. The athlete needs to be informed of the process of making weight. This includes how to lose weight, the mental challenges of making weight, and the performance aspect of making weight.

The four major issues affecting the lightweight rower are:

~ Nutrition

~ Weight loss

~ Mental health

~ Competition

The complexity of making weight goes far beyond just losing weight. Coaches of lightweight athletes as well as the athletes themselves need to be aware of certain issues that may arise during the season to help keep the athletes training at their best and living a healthy lifestyle. Overall the decision should be taken seriously and given some thought.

8. Recommendations

The sport of lightweight rowing for the female athlete has many complexities that need to be acknowledged by all parties involved, including athletes, coaches, and rowing associations. The mental strains placed on the athletes by teammates, coaches, and pressures of competition can be very hard to deal with. Physical strains accompany every sport at a competitive level and rowing is recognized as one of the most strenuous. With these factors to deal with already the athlete is now asked to lose enough weight to fit into the weight class. This is sometimes more than the athlete can handle whether or not they say so.

Recommendations to athletes:

~ Take the decision to row lightweight seriously.

~ Take into consideration more things than just weight.

~ Avoid unhealthy measures for making weight.

I feel that the athletes being considered for lightweight rowing should take the decision seriously. There are health risks that athletes could be taking when deciding to row lightweight. Some borderline cases, for instance if an athlete is 145 to 150 pounds and wishes to be lightweight, need to really take into consideration more than just weight and take the decision seriously. Some athletes just should not, or simply can not, lose weight to fit into a smaller weight class. The athlete whose body is composed of a large portion of muscle and is already below the average percentage body fat should seriously consider rowing open weight. Aspects such as height, weight, body composition, and the ability to lose weight should be taken into consideration.

Athletes who have to struggle to lose weight may resort to unhealthy measures of making weight to not let down their teammates. At the same time teammates may get aggravated and angry with the athlete wanting them to make weight so they can all compete. This could make for an unhealthy situation. Athletes may turn their heads when they see their teammate resorting to unhealthy measures disregarding the safety of their teammate.

Recommendations to coaches:

~ Intervene when unhealthy situations are observed.

~ Take an active role in the process of making weight.

- Supply athletes with information concerning making weight such as how to lose weight and staying within healthy limits.
- Hold weekly weigh-ins for all lightweight athletes.
- Discuss making weight throughout the season.
- Be aware of the practices the athletes are taking to make weight.

~ Do not allow athletes to dehydrate more than 2 or 3 pounds.

~ Address tensions that may arise among athletes – do not let them go hoping for them to go away.

- Be aware of each athlete's weight and discuss it with the group, especially as competition nears.
- Be aware of tensions between athletes and make them open for discussion.

I feel that situations involving unhealthy measures of making weight can be avoided by choosing only athletes who are able to make the weight limit to compete in the lightweight category. Coaches should intervene when any sign of unhealthy measures occur and make a judgment as to whether or not the athlete should really compete as a lightweight. It is ultimately the athlete's decision, however, if the health of the athlete is in danger in any way there should be someone there to intervene.

It is not the coach's responsibility to decide for the athlete whether or not to compete lightweight. But I feel the coach has a bit of responsibility to his or her athletes and should watch for sings of unhealthy actions and intervene when necessary. Ultimately it would benefit the coach and the whole team to have healthy athletes.

Coaches have to have a certain level of involvement in the process of making weight. Coaches need to be aware of the practices of their athletes. I feel as if some coaches turn their heads when it comes to the question of making weight. The coach may feel as if it is not their responsibility to tell their athletes how to make weight. I do not think that the coach should have to tell each athlete how he or she should be losing weight to make the weight class. However, I do feel that coaches should give their athletes information on how to go about making weight in a healthy and safe manner. If the coach does not have the information to tell the athlete then he or she should be able to direct the athlete to someone who can help them.

Suggestions on how to take an active role in the process of making weight include things like weekly weigh-ins. Weekly weigh-ins are an easy way to get the issue of weight more open. This would also help the coach to know where the athletes are in terms of weight compared to the time constraints. Another suggestion is to have someone like a nutritionist come talk to the athletes about how to safely lose the weight they need to. Having a nutritionist speak to the group at the beginning of the season will give the athletes an idea of how to start losing weight. A one-time meeting would be very helpful to the athletes however I feel that the issue needs to be open throughout the season. The weight of the athletes is going to be an issue throughout the season and it would be very helpful to the athlete if there could be someone to get information from the entire time they are trying to make weight. A second and maybe even third visit from a nutritionist would be a good way to accomplish this.

Observation of first time lightweight rowers was an example to the practices that take place to make weight. Some athletes took extreme measures to lose a substantial amount of water weight. It is frightening to think of the possible consequences of these actions. These athletes resorted to hot showers and baths, long sweat runs, and restrictions of food and water. This creates a very unhealthy competition environment for the athlete.

It has been documented that performance is affected when an athlete undergoes a trial of dehydration and then rehydration.[14] Competition situations involve being on the water sometimes an hour before the start of your race. This means that an athlete that is expecting to perform at her best for a race that could last anywhere from 7 minutes to 10 minutes, depending on the situation, could be sitting in the sun with no chance of shade for an hour right before her race. With the amount of water lost either the night before or the morning of this will only make the situation more unsafe.

Coaches as well as teammates should be aware of how much water the athletes are losing. If someone is not aware of what the athletes are doing it could cause more problems if a situation does occur. Athletes should not be allowed to lose too much weight in water.

Tensions among the group grew larger as competitions approached. Talk amongst teammates became more and more harsh towards athletes who were heavier.

This had an enormous impact on the mood of the team. However, most of the athletes reported trying not to let tensions affect their performance on the water. Anger and frustration towards athletes who seemingly were not going to lose enough weight or were heavier grew rapidly as races approached. The crew average for international races is 5 pounds lighter than the athlete's weight limit. This caused problems due to the fact that some athletes were not able to get to or below the average causing other athletes to lose more weight. This was a large factor in the tensions among the team. Some of the lighter athletes felt it was their responsibility to lose weight for another, heavier athlete. These lighter athletes were opposed to the idea that they should have to "make up the difference" so that other athletes could be heavier. This discrepancy in weights caused an abundance of anger and frustration.

Tensions among the team can become a large problem. Coaches need to be aware of weight fluctuations and the weights of their athletes. The longer the issue goes un-addressed the more anger and frustration the athletes experience. This does not make for a healthy environment. Some athletes complained of the lack of involvement of the coach and had hoped that something would be done about it. The coach left some issues with teammates un-addressed. The athletes involved developed more anger towards their teammates as well as frustration towards the coach. Coaches need to be aware of tensions among the team and, when necessary, address team issues. This can become a big problem when left untouched.

Rowing associations seem not to be involved in the process of making weight at all. Large associations governing the sport might have a hard time imposing more rules on the sport of lightweight rowing. I do not feel it is the responsibility of rowing associations because of the number of people involved in the sport. Rowing associations could require that coaches inform their athletes of healthy ways of making weight. One problem with that might be that there would be a very difficult time enforcing that rule. Coaches are not employed by rowing associations and thus can not truly be required to follow their requirements. Thus rowing associations seem detached from the process of making weight.

In conclusion, the decision to compete as a lightweight should be taken very seriously. There are some serious health problems, both mental as well as physical, which could occur from the decision to row lightweight. Information concerning losing weight and being healthy should be provided to the athlete when deciding whether to compete as a lightweight. I feel the coach has a responsibility to his or her athletes to be able to supply them with the knowledge they need to make an informed decision in one way or another. The coach should take an active role in the process of making weight. The coach as well as teammates should be knowledgeable about what methods the athletes are practicing to make weight and intervene when unhealthy measures are being practiced.

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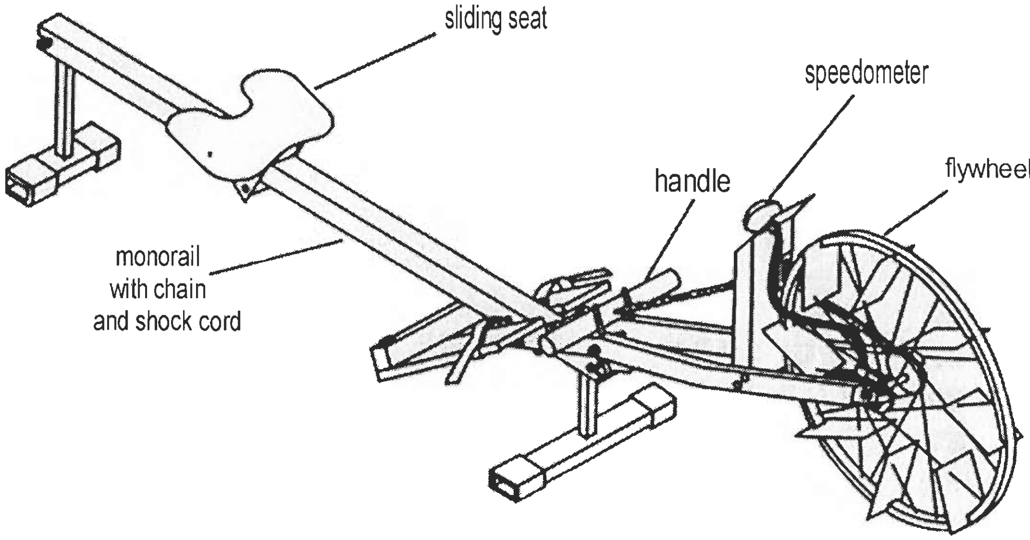
Figure 1

Rowing Ergometer Diagram



Concept 2 Rowing Ergometer

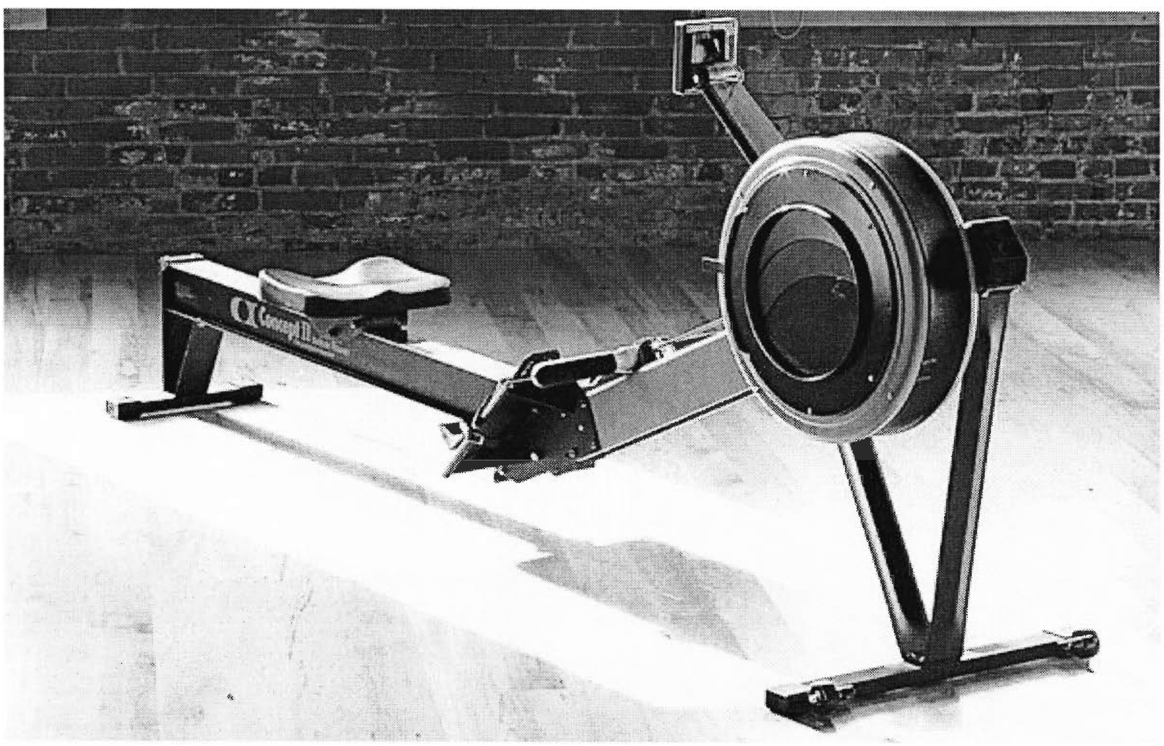


Figure 2

Food Guide Pyramid

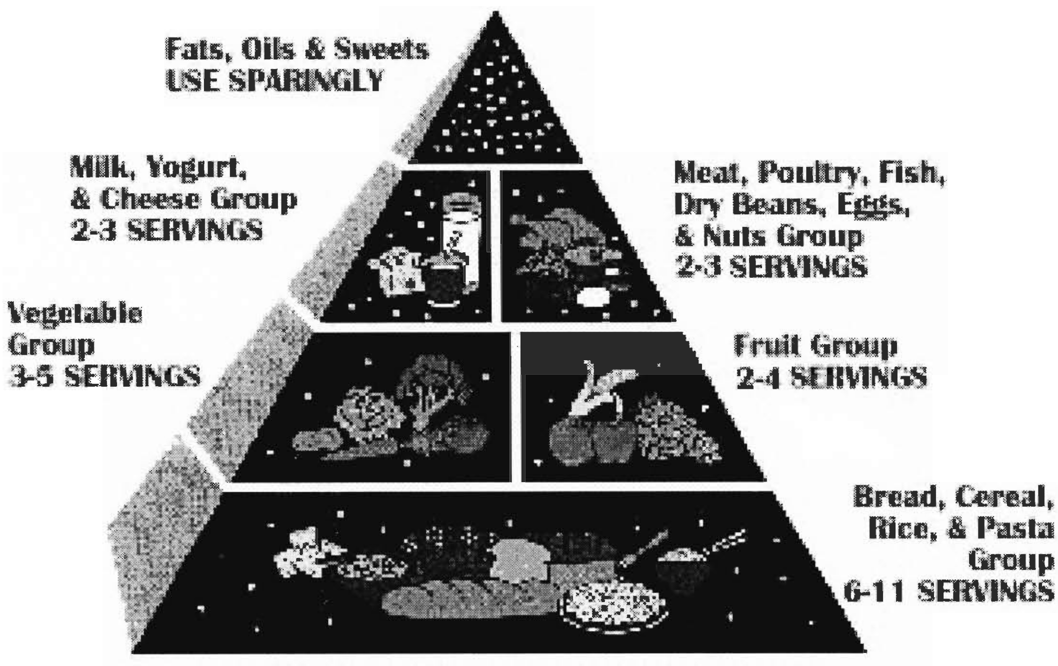


Figure 3[8]

The Bladder

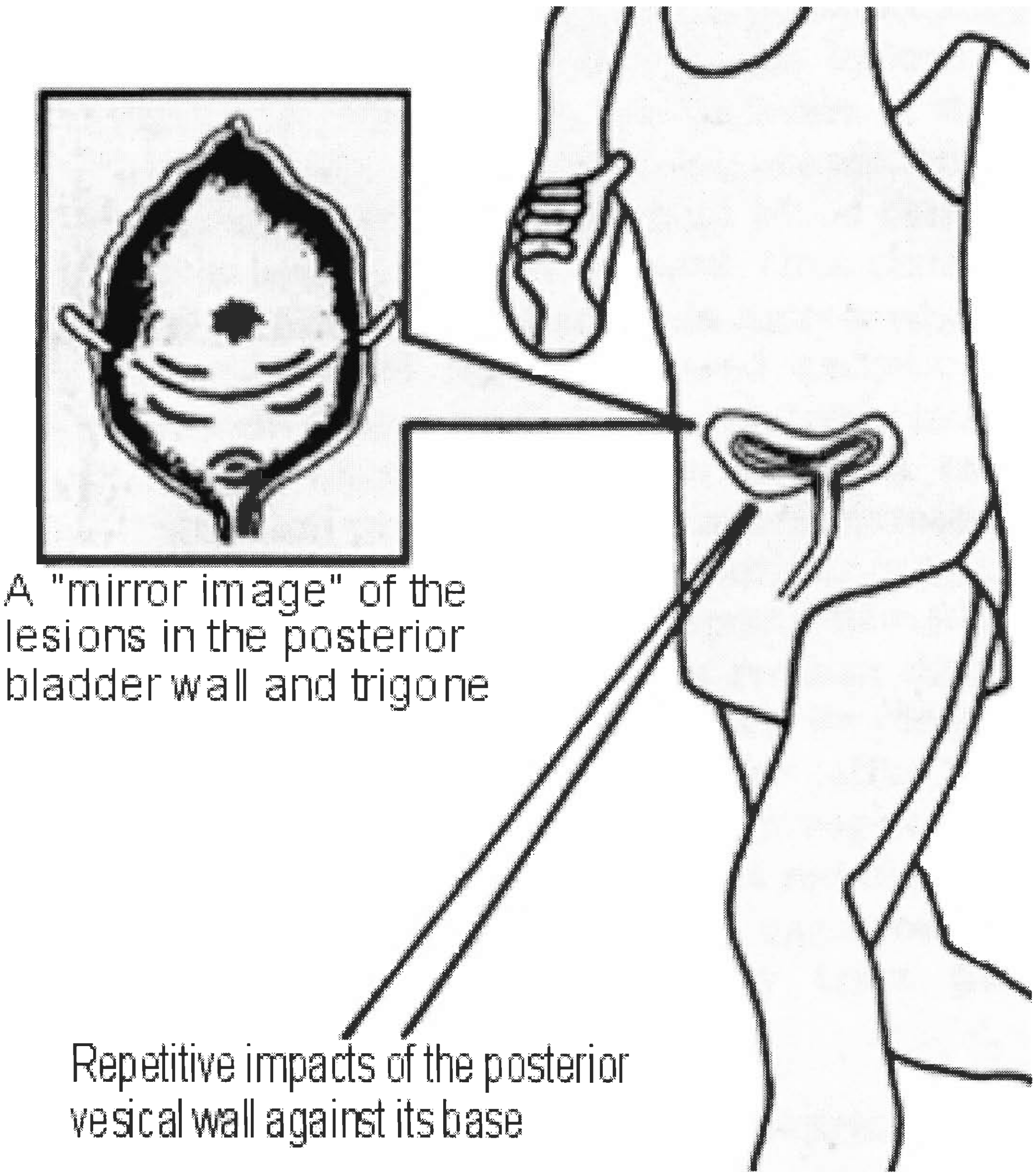
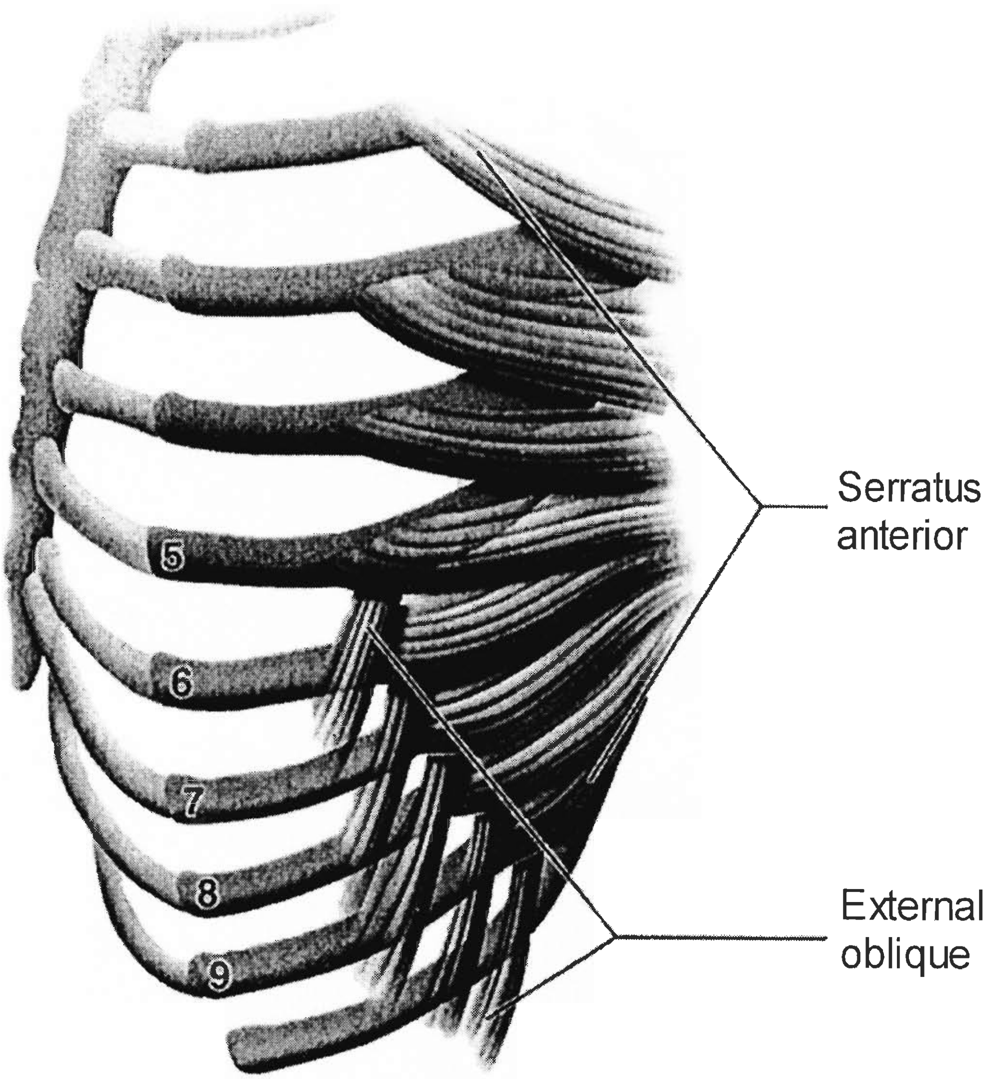


Figure 4

The Serratus Anterior and External Oblique



Anatomy of the serratus anterior and external oblique muscles at the lateral rib.

Appendix 1

Knowing Rowing

Appendix 1

Top 10 Things to Know about Rowing

1. Rowers are probably the world's best athletes.

The sport demands endurance, strength and an ability to tolerate the pain that their muscles experience in the last 500 meters of the race.

2. It's the legs.

Rowing only looks like an upper body sport. Although upper body strength is important, the drive which moves the boat comes from strong legs. Rowing is one of the few athletic activities that involves all of the body's major muscle groups.

3. Meters not miles.

The standard length of a rowing race is 2000 meters—about a mile and a quarter. Rowers refer to the parts of the race in 500 meter sections.

4. Sweep (like a broom) and sculling (with a "c").

There are two basic types of rowing: sweep rowing, where the athlete holds one oar with both hands, and sculling, where the athlete has two oars—one in each hand.

5. Think even numbers.

Sweep rowers come in 2s (pairs), 4s (fours) and 8s (eights). Scullers can row alone (in a single), with somebody else (in a double) or with three other people (in a quad). Scullers steer their own boat, using a rudder that they move with their foot. Sweep rowers may or may not have a coxswain—the on-the-water coach and person who steers. For example, all eights have a coxswain, but pairs and fours may or may not.

6. It only looks easy.

Great rowing looks graceful and fluid, but don't be fooled. Pulling oarblades smoothly and effectively through the water while balancing a boat that may be as narrow as 11" across with 10'-12' oars is very difficult work. Watch how quickly that graceful motion before the finish line turns into pain and gasping for air afterwards.

7. High tech versions of age-old equipment.

Although wooden boats were the norm for many years, most of today's rowing boats—called shells—are strong, lightweight carbon fiber. The smallest boat on the water is the single scull, only 27'- 30' long, a foot wide and approximately 30 pounds. The largest is the eight at 60'. Today's oars—not paddles—are also incredibly lightweight. Sweep oars are somewhat longer than sculling oars and have longer handles that are made of wood, instead of the rubber grips on sculling oars.

8. SPM not MPH.

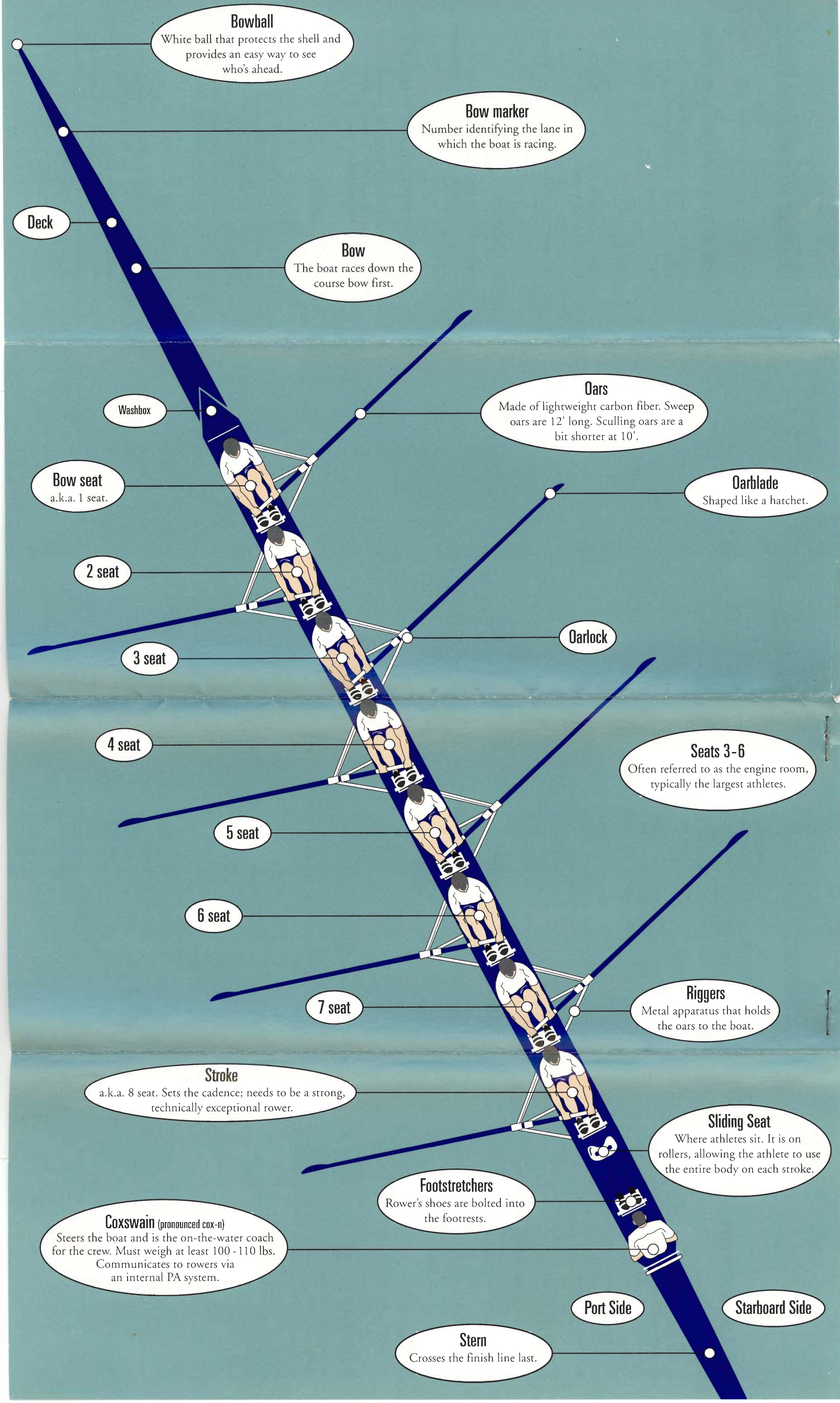
Rowers speak in terms of strokes per minute (SPM); literally the number of strokes the boat completes in a minute's time. The stroke rate at the start is high—38-45— and then "settles" to a race cadence typically in the 30s. The boats sprint to the finish, taking the rate up once again. The coxswain or stroke of the boat may call a Power 10—a demand for the crew's best, strongest 10 strokes. Although the number of strokes a boat is capable of rowing per minute is indicative of speed and talent, the boat getting the most distance out of every stroke may win the race.

9. Timing is everything.

Rowing competitions are typically conducted on six lanes on the water. They follow a double-elimination format in a system designed to identify the fastest six crews for the final race in each category. Heats are first, followed by repechage (French for second-chance) races. There are no style points for rowing—the boat whose bow crosses the finish line first is the winner.

10. Teamwork is number one.

Rowing isn't a great choice for athletes looking for MVP status. It is, however, teamwork's best teacher. The athlete trying to stand out in the eight will only make the boat slower. It is the crew made up of individuals willing to sacrifice their goals for the goals of the team; the athletes determined to match their desire, their talent and their oarblade with the rower in front of them, that will be on the medals stand together.


Bowball
White ball that protects the shell and provides an easy way to see who's ahead.
Bow marker
Number identifying the lane in which the boat is racing.
Deck
Bow
The boat races down the course bow first.
Washbox
Oars
Made of lightweight carbon fiber. Sweep oars are 12' long. Sculling oars are a bit shorter at 10'.
Bow seat
a.k.a. 1 seat.
Oarblade
Shaped like a hatchet.
2 seat
Oarlock
3 seat
4 seat
Seats 3-6
Often referred to as the engine room, typically the largest athletes.
5 seat
6 seat
7 seat
Riggers
Metal apparatus that holds the oars to the boat.
Stroke
a.k.a. 8 seat. Sets the cadence; needs to be a strong, technically exceptional rower.
Sliding Seat
Where athletes sit. It is on rollers, allowing the athlete to use the entire body on each stroke.
Footstretchers
Rower's shoes are bolted into the footrests.
Coxswain (pronounced cox-n)
Steers the boat and is the on-the-water coach for the crew. Must weigh at least 100 - 110 lbs. Communicates to rowers via an internal PA system.
Port Side
Starboard Side
Stern
Crosses the finish line last.

Appendix 2

CALCULATING BASAL METABOLIC RATE (BMR)

Women: Multiply your weight in pounds by 11 and then subtract 2 percent of the total for every decade you are over 20 years of age.
Men: Multiply your weight in pounds by 12 and then subtract 2 percent of the total for every decade over 20.

Harris-Benedict equations:

Men:
BMR = 66 + (13.7 x wt in kg) + (5 x ht in cm) - (6.8 x age in yrs)

Women:
BMR = 655 + (9.6 x wt in kg) + (1.8 x ht in cm) - (4.7 x age in yrs)

BMR without exercise:

note: (wt = body weight in kg)

Sex and Age	BMR Equation (kcal/day)
Males	
0-3 yrs	(60.9 x wt) - 54
3-10 yrs	(22.7 x wt) + 495
10-18 yrs	(17.5 x wt) + 651
18-30 yrs	(15.3 x wt) + 679
30-50 yrs	(11.6 x wt) + 879
Over 60 yrs	(13.5 x wt) + 487
Females	
0-3 yrs	(61.0 x wt) - 51
3-10 yrs	(22.5 x wt) + 499
10-18 yrs	(12.2 x wt) + 746
18-30 yrs	(14.7 x wt) + 496
30-60 yrs	(8.7 x wt) + 829
over 60 yrs	(10.5 x wt) + 596

To include exercise - multiply BMR by the appropriate activity factor:

Level	Type of activity	Factor
Very light	Cooking, driving, ironing, painting, sewing, standing	1.3 men 1.3 women
Light	Walking 3 MPH, electrical trades, sailing, golf, child care, housecleaning	1.6 men 1.3 women
Moderate	Walking 3.5-4.0 MPH, weeding, cycling, skiing, tennis, dance	1.7 men 1.6 women
Heavy	Manual digging, basketball, climbing, football, soccer	2.1 men 1.9 women
Exceptional	Training for professional athletic competition	2.4 men 2.2 women

Appendix 3

Equations to calculate Ideal Body Weight[22]

Y – Ideal Body Weight
Height – measured in inches
Frame – 1 (small), 2 (medium), 3 (large)
Sex – +1 (male), -1 (female)

With indoor clothing and shoes:

$$Y = -139.17 + 3.86 \times (\text{height}) + 9.52 \times (\text{frame}) + 5.01 \times (\text{sex})$$

Nude height and weight:

$$Y = -133.99 + 3.86 \times (\text{height}) + 9.52 \times (\text{frame}) + 3.08 \times (\text{sex})$$

Appendix 4

Questionnaires

Questionnaire 1:

Name: 6/11/00

1. How much do you weigh now? _________
2. What is your goal weight? _________
3. What length of time do you have to reach your goal weight? _________
4. How much did you weigh when you decided to row lightweight? _________
5. How long have you been trying to lose weight? _________
6. Has your diet changed since you have been trying to make weight?

   Yes No
7. Has your mood changed since your change in diet?

   Much better Slightly better Not at all Slightly worse Much worse
8. Have your everyday relationships changed since your change in diet?

   Much better Slightly better Not at all Slightly worse Much worse
9. Has your energy level changed at all since your change in diet?

   Much better Slightly better Not at all Slightly worse Much worse
10. Do you know of any immediate health risks you are taking by trying to make a smaller weight class?

    Yes No if so, what:
11. Do you know of any long-term health effects that might result from making a smaller weight class?

    Yes No if so, what:
12. How much bearing do these health effects have on your decision to row lightweight?

    Long Term: Short Term:

    A lot A little None at all A lot A little None at all
13. What were the biggest factors in your decision to row lightweight? Rank, 1 being biggest factor (add as needed)

    ___ Height ___ Health

    ___ Weight ___ Competition

    ___ Strength
14. How much information do you feel you know about nutrition?

    A lot A little None at all
15. Where have you gotten most of the information you know about nutrition? Rank, 1 being most info(add as needed)

    ___ Coaches ___ Teachers

    ___ Rowing Associations ___ Individual Research

    ___ Peers
16. Was this information presented to you before you asked about it?

    Yes No
17. Was this information presented to you around the time you were deciding to row lightweight?

    Much before Soon before Not at all Soon after Much after
18. Was this information presented in a clear manner?

    Yes No
19. Was this information hard to find?

    Yes No
20. How much initiative have you taken in acquiring knowledge about healthy living?

    A lot A little None at all

Questionnaire 2:

Name: 7/2/00

1. How much information do you feel you know about optimum nutrition?
   A lot   A little   None at all
2. How much information have your coaches told you about healthy living?
   A lot   A little   None at all
3. Do you feel this information is useful to you?
   Yes   No
4. Do you feel the information that your coaches have given you is correct?
   Yes   No
5. Have you received much information from any Rowing Associations, such as IRA or NCAA?
   A lot   A little   None at all
6. What type of information have you received from these associations? Rank
   ___Diet   ___Training   ___Making Weight   ___Health Problems
7. In what form have you received most of this information from the associations? Check all that apply, add any.
   __Newsletters   __Personal Letters   __Conversations   __Pamphlets
8. Do you feel this information is useful to you?
   Yes   No
9. Do you feel this information is correct?
   Yes   No
10. Was this information easy to find?
    Yes   No
11. How much bearing does all of this information have on your decisions concerning your health?
    A lot   A little   None at all
12. Have you utilized this information to better your health?
    A lot   A little   None at all
13. Have you seen a Nutritionist?
    Yes   No
14. If so were they helpful?
    Yes   No
15. Was the Nutritionist easy to find?
    Yes   No
16. How did you find the Nutritionist?
    __Friend/Family   __Coach   __Phone Book   __Doctor   __Other_____________
17. Has your regular doctor given you much information on healthy living?
    A lot   A little   None at all
18. Was the information from your doctor the same or similar to that from other sources?
    Same   Somewhat similar   None at all   Conflicting Information
19. Was the information received from coaches the same or similar to that from the rowing associations?
    Same   Somewhat similar   None at all   Conflicting Information
20. Was the information from personal research the same or similar to that from the coaches and associations?
    Same   Somewhat similar   None at all   Conflicting Information

Questionnaire 3:

Name: 8/1/00

1. Do you feel overall there was a supportive environment created for making weight?

   Strongly supportive   Slightly supportive   Not supportive

2. Do you feel the athletes were supportive in the process of making weight?

   Strongly supportive   Slightly supportive   Not supportive

3. Did you, at any time, fell pressure or tension caused by the rowers?

   Often   Sometimes   Never

4. Do you feel the coach was supportive in the process of making weight?

   Strongly supportive   Slightly supportive   Not supportive

5. Do you feel an adequate amount of information was provided from the coach?

   Yes   No

6. Did you feel, at any time, pressure or tension caused by the coach?

   Often   Sometimes   Never

7. How much did you discuss making weight with the other athletes at camp?

   2-3 times/day   once/day   2-3 times/week   once/week   2-3 times/month   once/month   not at all

8. What aspect of making weight was the most difficult?

9. Do you feel there should have been more help/information provided from the coach or rowing associations about this?

   Yes   No

10. Please list all of the Rowing Specific Publications you know of…How many, which ones have you read or used?

11. What do you feel are the largest problems in the sport of lightweight rowing?

12. How could everyone (rowing associations, coaches, other rowers, etc.) make the experience of making weight better?