HYDRATION STATUS OF HIGH PERFORMANCE NEW ZEALAND RUGBY UNION PLAYERS IN A MATCH CONTEXT

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A thesis submitted in partial fulfilment of the requirements for the degree of

Master of Science

In

Nutritional Science

Massey University, Albany, Auckland,
New Zealand

2005

Massey University

ABSTRACT

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The changes in body mass and urinary specific gravity of 24 rugby union players in the New Zealand Super12 development championship, were measured during five actual matches. The climatic conditions measured were ambient temperature, relative humidity and wind speed. All subjects participating in this study regardless of playing time showed a loss in body mass after each game. Fluid was available from bottles during formal breaks in play and during the ten-minute break at half time. The mean percentage of drink breaks utilised was only 48%, however this varied between games. The average change in body mass, or fluid deficit, of participants playing 60 minutes of rugby or more was calculated to be 1.87% ± 0.19% (SEM), and the range was 0.10% to 4.61%. Urine analysis for specific gravity supported the fluid deficit data, as the average urine specific gravity for players participating in 60 minutes of rugby was 1.025 and therefore considered to be dehydrated.

Final hydration status is related to the length of time a player is on the field, however even reserve players showed a loss of body mass between the pre-match to the post-match weigh-in.

The level of fluid deficit varied between players and for positional groups between games. However, It was observed that some players were

consistently dehydrated to a high level. This indicates individual fluid ingestion strategies are required to meet the needs of each player in a team.

Given the limited opportunities to replace fluid losses during rugby union, there is potential for heat stress and related illnesses to occur, however serious illness is unlikely. Dehydration can also cause impairment of both physical and mental performance, a reduced exercise capacity and impairment in temperature regulation. Rugby union players in this study were dehydrated to a level where performance may have been impaired, although future research is required to determine the level of fluid deficit at which performance impairment occurs during a rugby union match.

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ACKNOWLEDGMENTS

I would like to thank the following people for the valuable assistance and support they provided during this research project. Dr Clare Wall for her assistance and knowledge, Jonathan Folland for his enthusiasm, Mark Harvey for his guidance and the players and staff of the Blues Development team 2003, Nicola Hart for the loan of equipment., Jason Blackmore for his valuable assistance with recording data during the initial stages and Alastair Rhodes for his help and patience in the final stages.

I would also like to thank Ken Quarrie and the New Zealand Rugby Union for providing funding for this research project.

ABBREVIATIONS

ACSM: American College of Sports Medicine

ADH: Antidiuretic hormone

BD: Blues development

BD <60: Group of BD playing less than 60 minutes

BD> 60: Group of BD playing less than 60 minutes

BIA: Bioelectrical impendence

BM: Body mass

CES: Carbohydrate electrolyte solution

CRT: Choice reaction time

ΔBM: Change in body mass

CHO: Carbohydrate

GER: Gastric emptying rate

HRI: Heat related illness

IRB: International Rugby Board

MART: Maximal anaerobic running test

NZRU: New Zealand Rugby Union

ORS: Oral rehydrating solution

RDA: Recommended daily allowance

RDI: Recommended dietary intake

SD: Standard deviation

SEM: Standard error of the mean

Ucol: Urine colour

Uosm: Urine osmolality

Usg: Urine specific gravity

UV: Urinary value

Water is the best of all things
PINDAR (C. 522-C. 438 B.C.), Olympian Odes

1 INTRODUCTION

Both recreational and elite sportspeople explore ways to achieve their maximal potential, and nutrition can play a major role in improving performance. The science of sports nutrition investigates factors that may limit exercise performance in a variety of sports and attempts to reduce or eliminate this factor via nutrition. As nutritionists are becoming an integral part of the support staff affiliated with elite sports teams, nutritional practices conducive to optimal sporting performance are increasingly considered.

1.1.1 Fatigue, hypohydration and hyperthermia

Metabolic heat is produced during exercise; under warm to hot conditions heat may not be dissipated at the same rate as it is produced resulting in a rise in body core temperature. A very high core body temperature can limit exercise performance [1,2,3] and has the potential to be life threatening. Steps must be taken to limit the rise in body temperature and therefore minimise the risk of hyperthermia. Athletes are being advised to acclimatise to hot conditions, pre-cool if possible and ingest fluids during exercise when competing in hot or humid conditions.

Evaporation of sweat is the body's primary system for regulating temperature particularly when ambient temperatures exceed those of the skin and core. An increase in sweat rate reduces the total body water and if not replaced leads to poor hydration status. The body is then said to be **dehydrating**, meaning that a body water deficit is occurring [4]. When there is an existing body water deficit the body is in a state of **hypohydration** [4]. There is a progressive decline in physical and mental function throughout all levels of fluid deficiency that may begin at a loss of only 1.0% body mass during

competition [5]. Dehydration of 2-3% of body mass occurs frequently in individuals participating in high-intensity intermittent exercise [6]. Even though there have been many studies on the general topic of fluid ingestion and the positive effect it has on exercise performance [7,8,9] the exact mechanisms by which a negative fluid balance can reduce exercise performance are still not clear. Body water deficit does have a significant implication for both cardiovascular and thermoregulatory function.

1.1.2 Rugby Union

A rugby union (15's) team will have a maximum of 15 players on the field at any one time with seven reserves, who can be substituted on only once during a game. As this study was based on a 15's team, all practices, laws and regulations mentioned will relate to this form of the game

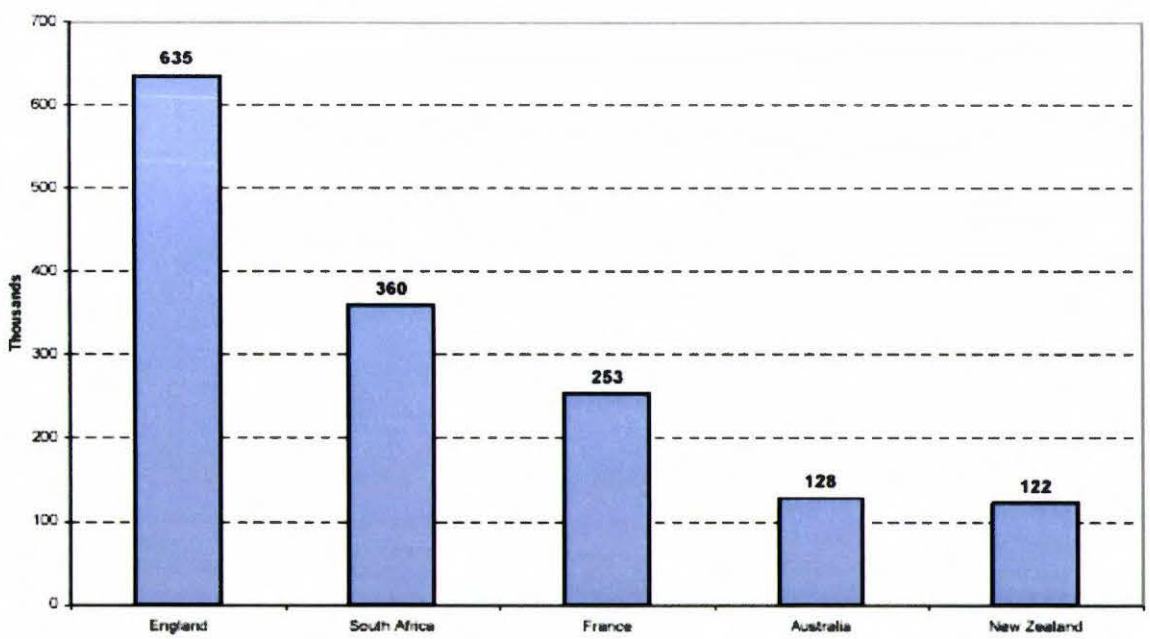
Rugby Union is a game similar to other football codes, in that it is a team sport involving intermittent high intensity sprints with periods of jogging and walking, and repeated physical contact. Players exhibit a wide range of anthropometrical attributes due to the positional requirements of the game. Endurance, speed, strength, power, co-ordination and agility are essential physical characteristics for success in this sport. To be effective players may also be required to reason, evaluate, formulate strategy, decision make, and anticipate opposition tactics instantly. Because of the prolonged duration and intermittent high intensity activity pattern of Rugby Union, intake of fluid and perhaps supplementation of carbohydrate (CHO) during training and competition are likely to be beneficial.

As team sports such as Rugby Union often involve international competition, matches can take place in hot locations and/or during summer or transitional months. Teams may have less than a week in the region prior to a match, and players from colder regions will not have time to acclimatise effectively to a hot environment.

Rugby is played internationally (figure 1-1) and in New Zealand rugby union is one of the top five sports on a population participation basis, and at 3.40% participation rate it is one of the highest rates globally [10]

While many professional teams keep their own statistics of individual players in regards to the change in body mass during a match, very few studies exist that investigate the hydration status of Rugby Union players. One South African group in 1981 [11] studied body temperature and change in body mass and found players to be 2.52% dehydrated when fluid was not ingested during play, another group in 1985 [12] found players to be 1.51% dehydrated after ingestion of 751ml (mean volume) of fluid during a match.

Figure 1-1. Rugby union player numbers (in thousands) of five top rugby playing nations[10]



Due to the lack of research and limitations of previous studies, there is still a need to establish the level and frequency of dehydration that is occurring in rugby union, and to bring this to the awareness of the individuals involved in the sport. Doing so may aid in the pursuit of increased exercise performance, and more importantly could reduce the risk of the potentially life-threatening consequences of hyperthermia and dehydration. In the U.K a newspaper reported that a 'super fit' 35 year old played a charity game of rugby, drank two pints of beer and then collapsed from dehydration and died shortly after [13]. Severe dehydration during sport can result in injury and death, and does so every year [14,15].

1.1.3 Study aims

This study was designed to determine the change in hydration status of rugby union players during seven games of the New Zealand Super 12 development championship, in a range of environmental conditions. A secondary aim was to determine any factors that may affect post-match hydration status of the players.

1.1.4 Study objectives

To complete these aims the following study objectives were determined:

- To measure the hydration status of each rugby player after each match by determination of the players change in body mass during the match and post-match specific gravity of the urine.
- To record drinking frequency for each of the 15 run-on players, by recording how many times they took a drink during a game.

- To record game variables such as environmental conditions (ambient temperature, relative humidity and wind speed), number of drink breaks and final score for each game.

- To calculate any statistical correlation, using Pearsons co-efficient equation, between environmental conditions and post-match hydration status.

- To calculate any statistical correlation, using Pearsons co-efficient equation, between game variables and post-match hydration status.

- To estimate the volume of fluid ingested in the 24-hr period prior to a match and determine if this was related to pre- and post-match hydration status determined by analysis of urinary specific gravity.

- To calculate any statistical correlation, using Pearsons coefficient equation, between environmental conditions and frequency of fluid intake of players during a match.

- To examine dietary intake of players in the 24 hours prior to a match, determined by the use of self-reported 24-hour food records.