*original research*

# Physiological analysis of the metabolic typing diet in professional rugby union players


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## ABSTRACT

*Aim:* The purpose of this pilot study is to investigate whether the metabolic typing diet warrants further investigation as a tool to design dietary regimes in professional rugby union players. The authors of the metabolic diet report that differences in metabolic make-up will alter dietary regimes that should be recommended to athletes who come from varied genetic backgrounds, such as rugby. However, most of the current research in the sport nutrition arena has been completed on Caucasian cyclists and may not be applicable to a power based team sport such as rugby union.

*Data Source:* Five professional rugby players took part in this pilot study. The tests performed include basal metabolic rate measured for 20 minutes at steady state using a metalyzer; fasted blood pH using automatic cartridges; glucose challenge test based on the blood glucose response to a glucose/potassium solution and the metabolic typing questionnaire.

*Outcome Measure:* The results from the questionnaire, basal metabolism, fasted pH and glucose challenge test were converted into a category as defined by the metabolic typing diet to investigate whether there was agreement.

*Results:* The five players were categorised as 'mixed oxidizers' according to the questionnaire. The results from the laboratory tests and the questionnaire differed. The basal metabolic rates resulted in zero 'mixed oxidizers', categorised based on the metabolic rate and four subjects based on the respiratory quotient values, the fasted pH results rated none of the players as 'mixed oxidizers' and the glucose challenge test rated three players as 'moderate fast oxidizers', which is close to mixed oxidizers.

*Conclusion:* Results suggest that at least in Caucasian professional rugby players the metabolic typing diet questionnaire results did not accurately reflect the actual metabolic processes in a usable way.



*Key words:* Metabolic typing, nutrition, diet, rugby.


## INTRODUCTION

The advent of the professional rugby player over the last few years in New Zealand has seen a push towards specialised nutrition regimes for these power-based team athletes. There are changing attitudes throughout rugby and indeed throughout sport in general concerning nutrition, fitness, strength, and training techniques. The growth in sports science, which has lead to a wider array of available information being available to athletes and coaches, has fuelled the desire for sportsmen and women, professional or amateur, to be more competitive[1,2]. This professional approach to sport and the increasing emphasis on winning further emphasises the need for the most advantageous nutritional strategies to provide these elite athletes with the best possible competitive edge. Individual


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and sport-specific nutrition guidelines are required based on evidence specifically based on rugby union and not on laboratory based endurance sports.

Large improvements in strength, size, speed, and fitness of the professional rugby player have been achieved and as a direct result of the increased demand on players, there has been a need to improve nutrition and diet around training and competition[3,4]. Despite the improvement of many rugby union nutrition programmes driven from nutritionists, dietitians and fitness trainers, there are still many professional players failing to fully achieve their true potential due to poor nutrition. In some provinces and franchise areas within New Zealand, well-monitored nutrition programmes have been implemented and driven from academy-level to All Black level. However, many programmes are generic due to the large number of players they must include. Unpublished reports from rugby trainers have shown that some players adhering to traditional 'good nutrition' guidelines still struggle to achieve required standards of increasing lean muscle mass and reducing fat.

Nutrition, as with strength, speed or power training, needs to be specific and customised to meet needs of the individual athlete. If individual nutritional requirements can be fully understood and implemented into everyday training and competing, an athlete should be well-placed to advance and progress toward achieving true athletic potential[5,6]. Therefore, this study examined the possible beneficial effects the Metabolic Typing Diet (MTD) may offer due to its individual based requirements.

The authors of the MTD suggest they can uncover patterns of the genetically-based strengths and weaknesses that make each athlete unique on a physiological and biochemical level[7]. The concept of the diet has "…evolved through a correlation of the known scientific facts concerning the fundamental control systems, with the clinical observation and empirical experience of hundreds of practitioners, with over 60,000 cases over the last 25 years."[8,9]. Nutrition can be an area of confusion amongst athletes with changes in knowledge or interpretation of the knowledge occurring all the time. It is further confused by the fact that individuals respond in differing ways to nutritional regimes. The idea that people differ based on their metabolism is the basis of the MTD, of which the authors claim "…one man's food is another's poison."

The MDT attempts to individualise recommendations to athletes (and sedentary people as well) by estimating metabolic processes by way of a questionnaire. The suggested diets differ in macronutrients consumed that allow "…maximum energy, peak performance, normalise appetite and be as trim as you can be."[7]. According to the diet, after eating you should feel an "…elevation of your energy, a normalization of your moods, and a sense of feeling satisfied. If, within 1-2 hours after eating, you feel more tired, or your mood worsens, or you still feel hungry, crave sweets or feel like you need a "pick-me-up," then you need to change the ratio of proteins, fats and carbohydrates at that meal until your symptoms improve."[7].

Wolcott & Fahey[7] state the MDT is based on the factual information derived from thousands of years of evolutionary history, as people in different parts of the world developed very distinct nutritional needs - referred to as 'biochemical individuality' - in response to a wide range of variables, including climate, geography, and the plant and animal life their environments supplied. They suggest that as a result of biochemical individuality, people now have extensively varying nutrient requirements, especially with regard to the macronutrients. Alternative health care practitioners advocate that individuals have genetically programmed requirements for different amounts of various nutrients, which is believed to explain why a nutrient can cause one person to feel good, have no effect on another, and cause a third person to feel worse.

Wolcott & Fahey[7] propose that there are three general metabolic types:

- Protein types - are 'fast oxidisers' who tend to be frequently hungry, crave fatty, salty foods, fail with low-calorie diets, and tend towards fatigue, anxiety, and nervousness. They are often lethargic or feel 'wired', 'on edge', with superficial energy while being tired underneath.
- Carbohydrate types - are 'slow oxidisers' who generally have relatively weak appetites, a high tolerance for sweets, problems with weight management, "type A" personalities, and are often dependent on caffeine.
- Mixed types - are 'mixed oxidisers' who generally have average appetites, cravings for sweets and starchy foods, relatively little trouble with weight control, and tend towards fatigue, anxiety, and nervousness.

According to the metabolic typing diet, the three metabolic types should eat the following foods:

- Protein types should eat diets that are rich in protein, fats and oils, and high-purine proteins such as organ meats, pate, beef liver, chicken liver, and beef. Carbohydrate intake should be low.
- Carbohydrate types should eat diets that are high in carbohydrates and low in protein, fats, and oils. They should eat light, low-purine proteins.
- Mixed types should eat a mixture of high-fat, high-purine proteins and low-fat, low-purine proteins such as cheese, eggs, yogurt, tofu, nuts. This type requires relatively equal ratios of proteins, fats, and carbohydrates.

For each metabolic type an individual is recommended to consume a diet relative to their metabolic type which is considered to be appropriate and essential to providing them with the correct percentages of the macronutrients. Carbohydrate types are encouraged to eat according to the following ratios:

- 15%-20% protein (proteins = meat, fowl, seafood, dairy)
- 70%-80% carbohydrates (carbohydrates = fruits, vegetables, grains)
- 5%-10% oils/natural fats (fats = butter, oils, fatty foods - excluding nuts, seeds, cheese, and other fatty foods)

Protein types are encouraged to eat according to the following ratios:

- 45%-50% protein (proteins = meat, fowl, seafood, dairy)
- 30%-35% carbohydrates (carbohydrates = fruits, vegetables, grains)
- 20% oils/natural fats (fats = butter, oils, fatty foods - excluding nuts, seeds, cheese, and other fatty foods)

Mixed Types are encouraged to eat according to the following ratios:

- 40%-45% protein (proteins = meat, fowl, seafood, dairy)
- 50%-55% carbohydrates (carbohydrates = fruits, vegetables, grains)
- 10%-15% oils/natural fats (fats = butter, oils, fatty foods - excluding nuts, seeds, cheese, and other fatty foods)

**Methods:**

***Subjects:***

Six professional rugby players competing in New Zealand's provincial rugby competition, the Air New Zealand Cup, were recruited for this study. Two subjects were backs (one back withdrew before completion of this study) and four were forwards (Mean, age = 22 yr, weight = 108.4 kg, height = 187.3 cm, skin folds (sum of six) = 89.5 mm). Subjects were invited to participate depending on position played on the rugby field and availability to participate. It was observed that in a rugby team body types could be broken up into three categories: front row, locks and loose forwards, and backs. Two players from each group were invited to participate. This is a broad generalisation but in many cases body types can be distinguished by these groups. Front rowers are generally more muscular but generally carry more fat, locks and loose forwards are taller players who are usually bigger and more muscular than backs but carry less fat. Backs are generally the leanest and smaller players on the team. Each subject was informed of the procedures that would take place and consent was given. All testing was completed with subjects in a fasted state.

Testing was completed on two non-consecutive days. Day One was used to collect initial results for baselines and to collect resting metabolic rates. Day Two was used to administer the glucose tolerance test and monitor the differences from the initial measures due to the glucose tolerance test.

On Day One weight and height were taken, then informed consent given. Blood pressure was taken with subjects in a seated position using a standard sphygmomanometer and stethoscope, resting heart was monitored using a polar heart rate monitor with subjects lying down. After initial readings had been collected venous blood was taken via finger prick. Blood glucose levels and blood pH were measured using a multi purpose cartridge. Subjects then completed the MDT questionnaire[7]. The final test was the Basal Metabolic Rate Test where each subject lay on the bed in a comfortable position that resembled how they normally sleep i.e. on their front, back or side. A full face mask was worn and RQ, $V_e$ and $V_{CO2}$ were measured. With this information the percentage of energy derived from each fuel source could be established and also the amount of energy used in metabolism could be predicted.

On Day Two subjects were fasted and tested in the morning using the same procedure as for Day One. The main purpose of Day Two's testing was to see how each subject reacted during the glucose tolerance test. Initial data were taken prior to administration of glucose/potassium solution, which included BP, HR and blood glucose. The glucose/potassium solution contained 50g of glucose and 15g of cream of tartar (containing 5g of potassium). Administration of glucose/potassium solution was given to subjects after pre-testing data was completed. Subjects' BP, HR, and blood glucose were collected at the 30$^{th}$ and 75$^{th}$ minute after administration of the glucose/potassium solution. A all subjects were seated and comfortable for the duration of the glucose tolerance test.

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The following table was used to convert the results from the modified glucose tolerance test into a metabolic type category.

**Table 1**. Categorising oxidative types from modified glucose tolerance test – measured in mmol/L.

| Fasted | 30min | 45min | | |
|---|---|---|---|---|
| 5.0 | 8.1 | 4.2 | Extreme **F**ast Oxidation | **acid** Blood (below 7.46) |
| | | | | |
| 5.0 | 8.1 | 5.3 | ACID - Moderate **F**ast Oxidtaion | **acid** Blood (below 7.46) |
| | | | | |
| 5.0 | 8.1 | 6.2 | Slight **F**ast Oxidation | **acid** Blood (below 7.46) |
| | | | | |
| 5.0 | 8.1 | 6.3-6.5 | Balanced Range - Very Slight **F**ast Oxidation | **acid** Blood (below 7.46) |
| | | | | |
| 5.0 | 8.1 | 6.6 | IDEAL / MEDIAN | Neutral blood (7.46) |
| | | | | |
| 5.0 | 8.1 | 6.6–6.8 | Balanced Range – Very Slight **S**low Oxidation | **alkaline** blood (above 7.46) |
| | | | | |
| 5.0 | 8.1 | 6.9 | Slight **Slow** Oxidation | **alkaline** blood (above 7.46) |
| | | | | |
| 5.0 | 8.1 | 7.9 | ALKALINE – Moderate **Slow** Oxidation | **alkaline** blood (above 7.46) |
| | | | | |
| 5.0 | 8.1 | 8.4 | Extreme **Slow** Oxidation | **alkaline** blood (above 7.46) |

Converted from mg/dL (U.S.A) to mmol/L (U.K) (8).

## RESULTS

The major aspects of the MTD were reviewed in five professional rugby players and the MTD questionnaire and corresponding diet category are shown in Table 2. Also shown in Table 2 are the fasted blood pH and the corresponding MTD category that corresponds to the blood pH. There was no agreement between the categories for the questionnaire and the fasted blood pH for any of the athletes.

**Table 2:** Metabolic type diet category results based on questionnaire and fasted blood pH measurements. According to the fasted blood pH results, 7.46mmol/L is a mixed oxidizer, <7.46mmol/L is a fast oxidizer and >7.46mmol/L is a slow oxidizer.

| Subject | Questionnaire Metabolic Type | Fasted blood pH | Metabolic Type based on fasted blood pH. |
|---|---|---|---|
| **1** | Mixed | 7.40 | Fast |
| **2** | Mixed | 7.44 | Fast |
| **3** | Mixed | 7.43 | Fast |
| **4** | Mixed | 7.42 | Fast |
| **5** | Mixed | 7.48 | Slow |

Only raw data has been shown as this was an exercise to determine whether the MTD can correctly categorise individual athletes rather than a group categorisation.
According to the MTD, slow oxidation corresponds to a preference for carbohydrate foods and fast oxidation corresponds to a preference for protein oxidation.

**Table 3:** Metabolic type diet categories based on the resting metabolic rate data. RQ= Respiratory quotient where 0.75-0.85 is a mixed oxidizer and 0.86-1.0 is a carbohydrate or slow oxidizer. RMR = Resting metabolic rate where actual is the reading in the morning, fasted and predicted is based on body weight and activity level.

| Subject | Resting RQ | Metabolic Type based on RQ | Actual RMR (kJ/day) | Predicted RMR (kJ/day) | Metabolic Type |
|---|---|---|---|---|---|
| **1** | 0.89 | Slow | 8236 | 10907 | Slow |
| **2** | 0.76 | Mixed | 11285 | 10765 | Fast |
| **3** | 0.82 | Mixed | 8379 | 11172 | Slow |
| **4** | 0.83 | Mixed | 6850 | 9845 | Slow |
| **5** | 0.78 | Mixed | 7387 | 11592 | Slow |

The metabolic data has been used in two ways: the RQ, which has a value between 0.7 and 1.0 under normal conditions, represents the major fuel burnt at that time, with 0.75-0.85 representing mixed oxidation and 0.86 to 1.0 closer to carbohydrate oxidation. All but one of the athletes in this study were classified as mixed oxidizers, as shown in Table 3. This agrees fairly well with the questionnaire data. However, the resting metabolic rate test measured for 20 minutes and estimated for a whole day appeared to be quite low in all four of the five subjects when compared with the predicted metabolic rate as shown in Table 3. This would categorise four of the athletes as slow oxidizers and one as fast.

**Table 4:** Blood glucose readings at rest, 30 and 75 minutes after 50 grams of carbohydrate and corresponding metabolic type diet category based on the modified glucose challenge.

| Subjects | Fasted | 30 minutes | 75 minutes | Metabolic Type |
|---|---|---|---|---|
| **1** | 4.4 | 6.1 | 4.3 | Extreme Fast |
| **2** | 4.8 | 8.3 | 4.6 | Extreme Fast |
| **3** | 4.9 | 6.8 | 5.2 | Moderate Fast |
| **4** | 4.4 | 7 | 4.9 | Moderate Fast |
| **5** | 4.8 | 5.7 | 4.9 | Moderate Fast |

Finally a modified glucose challenge test was performed on all subjects with measurements taken at rest, 30 and 75 minutes after consumption of 50 grams of carbohydrate - in this case jelly beans. Based on the blood glucose measurements as shown in Table 4, two of the subjects were categorised as extreme fast and the other three as moderate fast. Moderate fast is quite close to a mixed oxidizer category and therefore would be seen to be close to the questionnaire results.

## DISCUSSION

In the past few years dietary regimes written for individuals has become popular. For example, recent research has shown sedentary females displaying signs of the metabolic syndrome may benefit more from a moderate carbohydrate and higher protein intakes than had originally been advocated. Diet plans such as the CSIRO total wellbeing diet have risen from such research and suggest that different people have different metabolic rates and require a diet to match this[10]. However, the CSIRO wellbeing diet is aimed at sedentary females but is unlikely to be appropriate for active male professional rugby players. There has been interest from within the professional rugby teams in New Zealand to go beyond the realms of traditional sport nutrition to find the performance edge. This study was designed as a preliminary study to determine whether the MTD warrants further investigation as a basis for designing nutritional plans for professional players.

### *Modified Glucose Tolerance*

Kristal[8] developed a test which he termed the "Modified Glucose Tolerance Test" to help determine ones metabolic type based on how an individual oxidises the glucose/potassium solution. Kristal[8] reported that a fast oxidiser tended to burn up glucose too quickly and therefore required more dietary protein and fat to slow down the rate of glucose combustion. Conversely, slow oxidisers did not burn up glucose as rapidly and therefore it is proposed they require a higher percentage of glucose (and less protein and fats) to create acid-base balance. Followers of the diet are told to interpret the blood glucose results from the modified glucose tolerance test using the information provided in Table 1. Table 1 assists in determining the metabolic type and also helps categorise an individual within the oxidative system as either Extreme, Moderate, Slight, Very Slight, or Balanced Oxidative.

The modified glucose tolerance test demonstrates how an individual metabolises glucose and the results from this test suggest that, regardless of body type, all subjects in this study presented with a similar tolerance to the glucose/potassium solution. All participants displayed an extreme to moderately fast oxidative rate which, for three of the subjects, agreed quite well with the questionnaire ratings. Research into sedentary subjects suggests that a glucose challenge test will result in differences in blood glucose response between individuals that can be the result of chronic activity levels, obesity and/or genetic differences. That is, sedentary pre-diabetic individuals tend to show a blunted response to 50 grams of carbohydrate, which has implications for weight loss and appetite[11,12]. However, the group of professional rugby players studied appears to respond similarly to the glucose challenge. This is the likely outcome for a group of elite athletes who are regularly training many times a day. Therefore, while the modified glucose challenge may be somewhat useful in a sedentary population, it appears unlikely to detect differences in metabolism in a group of well-trained individuals.

### *Resting Metabolic Rate*

The Resting Metabolic Rate (RMR) test provides a good estimate of what fuel an individual oxidises at rest, signified by the RQ. The predicted RMR, as determined by a subject's age, weight, height, and activity level, is compared to the subject's actual RMR. If the actual RMR is higher than their predicted RMR then the subject would be classed as fast oxidative.

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Subjects with lower actual RMR values than their predicted would be slow oxidative, and those who show a similar RMR value to their predicted RMR value would be mixed oxidative. The RMR measurements from four of the professional rugby players appeared to be lower than predicted based on activity level and age. However it is possible that the predicted values were overestimated, and one player did have a higher than predicted RMR. Similarly, the results from the metabolic rate did not agree with the questionnaire categories.

***Metabolic Typing Questionnaire***

The Metabolic Typing Questionnaire (MTQ) was developed to help determine metabolic type based on 65 questions, ranging from psychological behaviour, physiological appearance, and general metabolic patterns or tendencies[8,9]. This test reportedly also categorises an individual into one of the three oxidative groups – fast, slow or mixed, based on the subject's interpretation of the question and how honestly they answer each question. Respondents are advised to answer the questions based on how they feel about food and how they respond to the different macronutrients, and not by what they think the correct answer is based on the information they have received. It should be noted that this test is relevant for the present and if an individual changes their training stimulus or contracts an illness, then they would need to complete the questionnaire again due to the likelihood of their metabolism or their perception towards food shifting.

The MTQ attempts to determine general metabolic patterns or tendencies and is supposed to enable users to categorise each participant's macronutrient needs and the percentage of carbohydrate, protein and fat needed. The five subjects in the study were classified as mixed oxidizers according to the questionnaire. However, it is possible these athletes had previous sport nutrition knowledge and their choices and preferences may have been influenced by that prior knowledge. Because of this risk, the questionnaire appears to have limited validity and reliability and therefore its use should be questioned in an elite sporting population[13]. The MTQ was compared to both the glucose tolerance and RMR tests and there was no correlation between them or between the metabolic tests.

## CONCLUSIONS

Despite the limitation of the small sample size it is possible to conclude the various measurements suggested by the MTD do not accurately reflect the real metabolic processes going on in the body nor does the questionnaire agree with the laboratory test results. Further study is warranted in a larger sample, in different sporting populations, and in populations of different ethnicity.


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