Summary of Findings from The New Zealand Army Recruit Nutrition and Health Project - 2009

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June 2010
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Abstract

Nutrition and physical training play an important role in the physical and cognitive development of military personnel. This report summarises the extensive findings of each phase of the New Zealand Army Recruit Nutrition and Health Project and provides recommendations to help enhance physical and cognitive performance, both during training and throughout a soldier's career.

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Executive Summary

Background
Nutrition and physical training play an important role in the physical and cognitive performance of military personnel. From studies in sport and exercise, poor nutrition, poor fitness and under- and/or over-training have all been linked to increased injury rates and under-performance. To address this issue in recruits and in response to New Zealand Army’s commitment to developing a workforce that is “Fit to Fight, Fit for Life”, the Recruit Nutrition and Health Project was initiated and the Defence Technology Agency (DTA) engaged to support and evaluate the related initiatives and interventions.

The first phase of this evaluation was to establish the baseline characteristics of a representative cohort of individuals embarking on the New Zealand Army’s All Arms Recruit Course (AARC) and the subsequent impact of AARC on these characteristics. Physical testing and surveys of nutrition and lifestyle knowledge and behaviours were undertaken. This phase also assessed perceptions of food provision during the course. Phase 2 was designed to evaluate the impact of an enhanced catering strategy and a nutrition education programme on recruit health and fitness.

Sponsor
Army Health Services (AHS)

Results
The complete findings of this evaluation are published as a series of DTA reports [1-5]. This executive report provides a summary of the results and key recommendations for the future.

Conclusions and Recommendations
Ongoing, accurate assessment of body composition should be implemented to help explain and monitor potentially negative changes observed during AARC. Implications of some recruits losing fitness should also be considered and the level of fitness required on entry and completion of the course confirmed and justified.

Updated pre-course information will help recruits improve physical readiness and reduce injury risk in preparation for AARC. Other, ongoing, injury prevention strategies should also be explored.

The project has clearly shown that education, focusing on food and fluid choices, is effective at improving knowledge but that changes to catering are now required for this knowledge to be put into practice. Strategies that allow higher energy requirements to be met at mealtimes, between meals and after PT should be implemented and lower-fat and more unprocessed food options provided.

A combined approach, of enhanced catering alongside nutrition education, will ultimately result in improved physical and cognitive performance during training and throughout a soldier’s career. This issue should be addressed as soon as possible to ensure that another opportunity to influence a captive and motivated recruit population is not missed.
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1 Introduction

It is well accepted that nutrition and physical training play an important role in the physical and cognitive performance of military personnel. It is important that soldiers receive appropriate nutrition and hydration to: promote general health; fuel performance; enhance recovery; and contribute to good morale. Recently, Tanskanen et al. [6] confirmed that optimal energy balance facilitates physical performance and enables high training loads to be sustained during basic training. The New Zealand Army’s basic training course, the All Arms Recruit Course (AARC), provides all-corps soldier training for the New Zealand Army (NZ Army). The course is both physically and psychologically demanding, with long days and little down time.

Internationally, recruit training programmes have reported high attrition rates due to illness and injury [7]. From studies in sport and exercise, poor nutrition, poor fitness and under- and/or over-training have all been linked to increased injury rates and under-performance. To address this issue in recruits and in response to NZ Army’s commitment to developing a workforce that is “Fit to Fight, Fit for Life”, the Recruit Nutrition and Health Project was initiated and the Defence Technology Agency (DTA) engaged to support and evaluate the related initiatives and interventions.

1.1 Aims

The aims of the Recruit Nutrition and Health Project were to:

- Improve the nutrition, health, performance and recovery of Army recruits
- Establish good long-term nutrition and hydration habits

To establish the effectiveness of the project and achievement of the above aims, a parallel programme of evaluation was developed to:

- Establish the well-being and fitness of a representative cohort of individuals embarking on the NZ Army’s 14-week All Arms Recruit Course (AARC)
- Determine the impact of the existing AARC on recruit physical fitness and well-being
- Evaluate the effectiveness of delivering nutrition education and an enhanced catering programme during AARC

2 Methods

2.1 Study outline

Three course intakes were recruited to the project - AARCs 352, 353 and 356 (193 males; 29 females). AARC 352 and 353 (both standard 14-week AARCs) would act as the control group and AARC 356 would form the intervention group. This course would also be the first to be conducted over 16 rather than 14 weeks.

To monitor the impact of each AARC on the health, fitness and nutrition knowledge of recruits, various data were collected at the start, middle and end of each course.

Prior to AARC 356, an enhanced catering strategy was developed, including i) an approved menu - specifically designed to meet the nutrition demands of physically
active adults; ii) in-between meal snacks - to increase energy intake, aid recovery and improve concentration; and iii) sports drinks for after physical training (PT) sessions - to increase energy intake, aid recovery and promote hydration.

In addition, a series of nutrition education sessions, designed to improve knowledge and encourage food/fluid choices that promote optimal physical and cognitive performance (Fit to Fight) and general health and well-being (Fit for Life), was developed. Areas covered included: general healthy eating; nutrition and hydration for PT; nutrition in the field; and lifestyle nutrition.

It was agreed that these strategies and activities (the intervention) would be introduced at the start of AARC 356 and continue throughout the course.

2.2 Baseline characteristics

To establish the baseline characteristics of new recruits to the NZ Army, various physical measurements were collected at the start of each AARC and data combined to maximise subject numbers. Measures included:

- Anthropometric measurements
- Resting heart rate and blood pressure
- Physical fitness scores – endurance, strength and flexibility
- Hydration status
- Iron status (females only)

Physical characteristics were determined over separate 2-day periods, during the first week of each AARC. All testing took place at Waiouru Military Camp with data collection sessions scheduled at the camp Medical Treatment Facility (MTF) and gymnasium, as part of the normal AARC course programme. Full details of all testing have been reported previously [1].

In addition, all recruits completed an 8-page lifestyle questionnaire to gather demographic information and to establish injury history, pre-course physical activity habits, nutrition knowledge and practices, smoking habits and alcohol intake.

2.3 Impact of the AARC on health and fitness measures

To determine the impact of AARC on recruit health and fitness, the above measures were repeated at the mid-point (WK 8) and at the end of each course (WK 14 or 16). In addition, all injuries resulting in medical treatment at the MTF were documented.

Questionnaire content differed slightly at each time point, with demographic information collected in WK 1 only and opinions on mess catering gauged only in Weeks 8 and 14/16. A nutrition quiz was completed by recruits in Weeks 1 and 14/16, to monitor the change in nutrition knowledge. A full report on this phase of the project has been published separately [3].

2.4 Perceptions of food provision

At Weeks 8 and 14/16, recruits answered questions about their likes and dislikes in relation to eating in the mess, their perceptions of the time and volume of food available to eat, the quality and variety of meals (both in the mess and in the field) and the propensity to be hungry between meals.
When supplemented by observations and investigations of subject matter experts, this information can be used to inform future catering practices and associated educational strategies. A full report on this phase of the project has been published separately [4].

2.5 Impact of course changes

The planned intervention and changes to AARC 356 were not made in full. The nutrition education sessions ran smoothly and were well received by recruits; however, the enhanced catering programme was only partially implemented. The partial implementation was reported as being due to limited catering resources and a consequence of an imminent change of the catering contract, resulting in none of the intended positive changes to meal provision being made.

As a result of this change to the project, the impact of nutrition education and of extending the course from 14 to 16 weeks became the focus of the evaluation, although the impact of not making changes to catering provision can also be inferred from the data collected and this may provide useful evidence for future initiatives.

Data for all individuals in each intake who completed testing in both Weeks 1 and 14/16 were included in this analysis and the differences in the changes observed pre- and post-intervention assessed. The low number of females in the 356 intake (n = 3) does not allow a comparison of female data between courses. A full report on this phase of the project has been published separately [5].

2.6 Statistical Analysis

Independent and paired samples t-tests were used where appropriate to determine any significant differences between males and females, and repeated measures ANOVA were used to identify significant changes between time-points, with paired samples t-tests used post-hoc to determine where any differences lay (Statistical Package for the Social Sciences, version 17.0, 2008, SPSS, Inc., Chicago, IL, USA). Bonferroni adjustment was made accordingly and significance accepted at \( p < 0.05 \).

Differences in the changes observed during AARC 353 and 356 were analysed using the spreadsheet of Hopkins [8] and the magnitude of the Cohen effect sizes determined using the following criteria: < 0.2 is trivial; 0.2 - 0.5 is small; 0.6 - 1.1 is moderate; 1.2 - 1.9 is large; and \( \geq 2.0 \) is very large [9].

3 Results and Discussion

3.1 Baseline characteristics and the impact of AARC

Subject details for all males and females screened on entry are presented in Table 1. The mean age of recruits was 19.9 ± 3.8 years and the median age 18.8 years.
Males (n = 190) | Females (n = 29)  
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td><strong>Range</strong></td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>19.7 ± 3.3</td>
</tr>
<tr>
<td></td>
<td>17.0 – 40.6</td>
</tr>
<tr>
<td>Stature (m)</td>
<td>1.78 ± 0.07</td>
</tr>
<tr>
<td></td>
<td>1.58 – 1.94</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td>76.2 ± 10.1</td>
</tr>
<tr>
<td></td>
<td>56.0 – 108.8</td>
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</table>

Table 1. Participant details.

### 3.1.1 Anthropometry

As Figure 1 shows, at the start of AARC, the mean Body Mass Index (BMI) was towards the upper end of the normal range (18.5 – 24.9 kg/m²) and remained so throughout the course. This was the same for both males and females.

![Figure 1. Change in Body Mass Index during AARC.](image)

Of particular concern is the large proportion of overweight (BMI ≥ 25) and obese (BMI ≥ 30) recruits (36% and 7% respectively). Higher than recommended waist circumferences in some of these young individuals (≥ 80 cm for females; ≥ 94 cm for males) [10] are also cause for concern, as are increases in females during the course of up to 6.4 cm. Indeed, over 60% of females experienced an increase in body mass and/or waist circumference during the 14 week course, with one individual gaining 6 kg in just 11 weeks.

A quarter of female recruits considered themselves overweight at the start of the course. These individuals (and others) now need help to act on this, ideally prior to commencing the course. Anecdotal reports from female recruits about i) access to junk food late in the course; ii) a tendency for snack options to be high fat sweets (e.g. biscuits and slices) rather than fruit and dairy; and iii) concerns about weight gain and clothes not fitting anymore, suggest that support is also required during AARC.

When grouped by starting body mass (four quartiles), Figure 2 shows that lighter males (lower and 2nd quartiles) got heavier as the course progressed, whereas
heavier males (upper and 3rd quartiles) got lighter. This would be a desirable outcome, assuming that the changes reflect an increase in muscle mass and a decrease in fat mass respectively.

![Figure 2](image-url)  
**Figure 2.** Change in body mass during AARC as a function of starting weight.

In the only previously published study of male New Zealand Army recruits, carried out in the early 1980’s [11], a decline in percent body fat from 12.4% to 10.2% was observed, with no change in total body weight. A 2003 study of 330 Danish recruits completing military basic training over 12 weeks also saw significant reductions in BMI in both trained and untrained groups [12].

Assessment of changes in body composition during AARC via skinfold measurement is now recommended, to confirm the extent of the body composition issue in AARC recruits. The degree of - and reasons for - the variation observed can then be explored.

### 3.1.2 Physical fitness

#### 3.1.2.1 Aerobic capacity

When compared to age-related normative data for the general population (Table 3) [13], the mean aerobic capacity of males at the start of the course was considered “average” and the majority of males fell in to this category of fitness (Table 2). For females however, most recruits were below average at the start of the course, improving to average by the end, although 50% of the females with above average fitness at the start of the course had dropped in to the average category. This is worrying as of course this is average for the general population, not for a physically active population.

<table>
<thead>
<tr>
<th></th>
<th>WK 1</th>
<th>WK 14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>Below average</td>
<td>29</td>
<td>45</td>
</tr>
<tr>
<td>Average</td>
<td>55</td>
<td>36</td>
</tr>
<tr>
<td>Above average</td>
<td>11</td>
<td>18</td>
</tr>
</tbody>
</table>

*Table 2. Aerobic capacity classification (% of recruits) – Wilmore & Costill [13].*
Table 3. Normative data for VO_{2max} (ml.kg^{-1}.min^{-1}) - Wilmore & Costill [13].

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 – 19 years</td>
<td>47 – 56</td>
<td>38 – 46</td>
</tr>
<tr>
<td>20 – 29 years</td>
<td>43 – 52</td>
<td>33 – 42</td>
</tr>
<tr>
<td>30 – 39 years</td>
<td>39 – 48</td>
<td>30 – 38</td>
</tr>
<tr>
<td>40 – 49 years</td>
<td>36 – 44</td>
<td>26 – 35</td>
</tr>
</tbody>
</table>

When grouped by starting aerobic capacity (four quartiles), upper quartile males (higher starting capacity) showed no improvement in aerobic capacity between the start and end of the course (Figure 3) and many lost fitness.

A similar phenomenon was seen in the study of Danish recruits [12]. Only the previously untrained group of soldiers improved their aerobic capacity by the end of the course.

The mean increase in estimated VO_{2max} of 9.3% observed during the 14 week AARC for males is notably lower than the 16.2% increase observed over just 10 weeks in NZ Army recruits tested in the early 80’s [11].

Overall range (or spread) of scores decreased during the course, which is unsurprising given that the intensity of military training is often dictated by the ability of the least fit individual. A more homogeneous population (smaller spread) is therefore inevitable, but the consequences of a loss of fitness in some individuals should be recognised.

### 3.1.2.2 Upper body strength-endurance

The push-up, or press-up, is a classic exercise used to assess upper body strength-endurance in a range of military organisations and emergency services. Males performed significantly better on this test than did females, although two males and four females did not meet the NZ Army’s Entry Fitness Level at the start of course.

When compared to data for the general population, mean scores for males were considered “Fair” (below average) [14] at the start of the course, but significant ($p < 0.005$) improvement was made by both males and females (males: 35%; females:
66%) during the course. By the end of AARC, all but two male and two female recruits could meet the G2 push-up standard (the level required to graduate recruit training).

3.1.2.3 Core stability

The prone hold, or plank, to fatigue test provides a reasonable indication of the functional strength-endurance of the trunk musculature. Males significantly out-performed females on this test and improved significantly during the course (141 ± 19 v 119 ± 34s; \( p < 0.001 \)) while female scores remained constant. This test requires a degree of mental toughness, as well as physical strength, which should be taken into account when addressing this difference.

3.1.2.4 Hamstring flexibility

Male recruits tended to have consistently tighter hamstrings than females. Bilateral imbalance was similar (and acceptable) in males and females, although differences of up to 22° were recorded. This may have implications for injury risk and performance during tasks involving running and/or striding [15]. Individuals with imbalance \( \geq 10° \) were provided with guidance to help reduce this imbalance. By the end of the course, absolute values had improved significantly in both males and females and imbalance was also reduced, suggesting that the advice provided was heeded and should be provided in future courses.

3.1.2.5 Summary

The 14-week AARC resulted in worthwhile enhancement of a range of important physical attributes, in some recruits. Implications of some recruits losing fitness should however be considered, including the potential for an associated increase in injury risk. Analysis of AARC injury data revealed a possible link between lower aerobic fitness and increased injury incidence.

In addition, the level of fitness that is required on entry and on completion of the course should be re-confirmed and should reflect current and future demands and requirements of Army operations.

Given the physical demands of AARC, the base fitness of individuals on entry to the NZ Army highlights the need for enhanced education and training for potential recruits prior to AARC. Adaptation of the current course programme may also be needed to ensure that recruit fitness is safely progressed to the required level without undue risk of injury.

Questionnaire responses revealed that in preparation for the course, over 30% of recruits did not change their exercise habits and almost a third of females claimed to take part in no physical activity of a moderate intensity each week. Physical data would suggest that this is not because recruits already had a high level of natural fitness.

Ratings of fitness and the importance of fitness would suggest a perception amongst male recruits that soldiers don’t need to be particularly fit. If this is not a perception that NZ Army is comfortable with, pre-course education should address this to help optimise physical development before and during the course.

Finally, only 10% of recruits took part in any pack walking or tramping prior to the course. Given the pack marching content of AARC and of Army life in general, it may
be beneficial to recommend more pack walking in preparation for AARC. Indeed, updated guidelines are required to help potential recruits improve physical readiness and reduce injury risk via generic and more AARC/Army-specific physical training methods. These need to be disseminated widely through both the internet, recruiters and other identified channels.

3.1.3 Injury history and incidence

On entry, a high incidence of previous lower limb strains and sprains was reported. This shouldn’t necessarily be a barrier to AARC selection, but strategies are needed to reduce the higher risk of re-injury in these individuals. Data for current injuries at the start of the course is skewed by the timing of survey completion for female recruits (2 weeks later than males). However, the high rate of injury (25%) among females, at such an early stage of the course, is cause for concern.

Of the 143 recruits who enrolled in WK 1, 58% of females and 27% of males were not available for physical testing in WK 14, due to injury, back squadding or removal from course. In total, 29 injuries required medical treatment at the MTF (AEP data), corresponding to an injury frequency rate (IFR) of 0.16 injuries per 1000 hours\(^2\). This is higher than that observed in occupations such as construction and mining (0.02 injuries/1000 hours), which are generally regarded as high risk [16].

Of the 29 injuries sustained, 14 were lower limb injuries, which is of particular concern for NZ Army. In 9 cases, the mechanism of injury was “running” or “running down hill”.

All but one of the injuries to male recruits who finished the course were sustained by recruits in the lower two quartiles for aerobic capacity, with 73% sustained by the least fit group. Other studies [12] have also shown an inverse relationship between physical fitness level and incidence of overuse injury. Data from Royal Navy recruits also suggests that less aerobically fit recruits experience more injuries than fitter recruits during training [17].

The high IFR identified for AARC recruits (0.16 injuries per 1000 hours) provides a baseline on which future injury incidence can be compared. Targeted injury prevention strategies are warranted based on these findings, with a particular focus on high risk groups.

3.1.4 Hydration status

At the start of the course, hydration status, as represented by urine osmolality, was consistently poor for both genders. Values for dehydration were well above the upper limit of the optimal range (Figure 4), which is a concern for both cognitive and physical performance. This widespread dehydration persisted throughout the AARC, although some improvement was seen during testing in WK 14.

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\(^2\) Based on 138 recruits being engaged in AARC activities from 0600 to 2200, 6 days a week, for 14 weeks.
Questionnaire responses would suggest that recruits recognised the importance of hydration, although fluid intake would appear to be over-estimated by most. Practical education, focusing on identifying individual fluid requirements, should be provided, along with the provision of regular opportunities and encouragement to drink adequate and appropriate volumes of fluid to ensure hydration.

3.1.5 Iron status

Iron is essential for good health but is the most common single nutrient deficiency worldwide, resulting in fatigue; reduced tolerance to work; impaired immunity; decreased aerobic capacity; reduced appetite; reduced resistance to the cold; and impaired cognitive function.

Female recruits are particularly at risk of iron deficiency. Of the 24 females tested in WK 1, seven (29%) had low iron stores (serum ferritin ≤ 20 µg/L) and two also had low haemoglobin (Hb) counts (≤ 115 g/L). A third recruit had a Hb count of 116 g/L which would be considered low in a clinical setting. These rates are of concern so early in the course, given the intensity of the activity to follow. Identified individuals were prescribed iron supplementation and by WK 14, only one was still classified as having Iron Deficiency Anaemia (IDA). In all seven cases, haemoglobin had improved from baseline. There were, however, five new cases of low iron stores in WK 14 and the average serum ferritin value for the group had decreased from 48.7 to 29.5 µg/L (including data for those on supplementation).

Of the 24 female recruits tested in WK 1, only 10 completed the course on time and had blood measurements taken at the start and end. Of these, three started and five (50%) finished with low iron stores and one recruit started and finished with IDA. The reasons for the high reported drop-out should also be addressed.

There is clear evidence that routine iron tests for females should continue to be supported, to ensure that deficient individuals (and/or those with the potential to become deficient) receive appropriate supplementation, to reduce the risk of health and performance issues during the course. Questionnaire responses revealed that females typically consumed less red meat than males. In order to achieve and maintain healthy iron status, for optimal physical and mental performance, all non-
vegetarian females should be encouraged to consume three to four meals containing red meat (beef or lamb) each week. Choices available in the dining hall should enable this to happen. Iron status of all females should be monitored routinely and supplementation provided as required. Females who have a history of iron deficiency, or do not eat red meat regularly, should be encouraged to have their iron status checked prior to enlistment. If supplementation is required, it will be better to start this process prior to training.

3.1.6 Nutrition knowledge and practice

Nutrition quiz scores would suggest that recruits have reasonable nutrition knowledge, but the ability to put this knowledge into practice is lacking. For example, although 80% of recruits knew that they should consume 5 or more servings of fruit and vegetables per day, only 35% were definitely getting this amount and 37% definitely were not.

Similarly, recruits recognised the importance of hydration, although fluid intake would appear to be over-estimated and urine osmolality scores showed widespread dehydration.

Lower milk consumption among female recruits is of concern, given the link between increased consumption of milk products and reduced stress fracture risk in military recruits [18]. Most recruits used standard milk and although this is an active population, with a high energy requirement, the selection of lower fat, calcium-rich milk and milk products may be beneficial for short-term (reduced stress fracture risk) and long-term (reduced risk of osteoporosis) health and performance. Availability of such products in the dining halls should reflect these recommendations.

Consideration should also be given to the reintroduction of flavoured milk into the mess, given its nutritional value (good source of protein and calcium and low fat); its appropriateness in contributing to overall energy requirements; and its morale boosting properties.

Some recruits consumed bacon up to 14 times per week, which is a concern for health and body composition, given the typically high saturated fat and sodium content of bacon. Recruits should be advised to make bacon an occasional choice and to remove excess fat (on this and other meat products). In addition, the availability of processed and manufactured meats should be limited in the dining halls in order to match education.

Finally, it should be noted that one-fifth of female recruits reported a regular intake of alcoholic drinks prior to AARC that exceeded the safe drinking guidelines of ALAC. This has implications for health and performance due to both the alcohol and energy content of these beverages.

Although over half of recruits (56%) considered their diet unhealthy, most were motivated to change, which is encouraging and bodes well for future education and intervention strategies.

3.2 Food perceptions

3.2.1 Quantity of food

Over 30% of recruits felt that there was not enough food available to them during AARC. More recruits felt hungry between meals during the day than at night;
however, over 60% of recruits still reported hunger between dinner and bedtime (Table 4).

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
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<tbody>
<tr>
<td></td>
<td>Week 8</td>
<td>Week 14</td>
</tr>
<tr>
<td>Breakfast and lunch</td>
<td>87</td>
<td>86</td>
</tr>
<tr>
<td>Lunch and dinner</td>
<td>79</td>
<td>85</td>
</tr>
<tr>
<td>Dinner and bedtime</td>
<td>62</td>
<td>67</td>
</tr>
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Table 4. Incidence of hunger (% of recruits) by gender and stage of course.

It is well recognised that different individuals have different energy and nutrient requirements and that these requirements are difficult to satisfy with quantity catering. However, given that catering staff have advance knowledge of the number of recruits (and other personnel) requiring feeding at any one time, under (and indeed over-) catering should not be an issue at any stage of the course, as was reported.

Strategies that allow higher energy, and particularly carbohydrate requirements to be met, should be explored, e.g. increased provision of bread, breakfast cereals, fruit, high carbohydrate salads (e.g. rice, pasta, noodle, potato and kumara) and dairy products (e.g. milk and yoghurt). In-between meal snacks and sports drinks, where appropriate, should also be provided as standard.

3.2.2 Time to eat

Over 30% of recruits felt that they did not have enough time to eat their meals in the mess. Guidelines on meal time duration (and the practices of platoon staff during meal times) should be standardised and adhered to across platoons, to ensure that all recruits queue, sit and eat for similar times where possible.

3.2.3 Quality and variety

Quality and variety was considered better for cut lunches than for mess meals, but decreased for both as the course progressed. Mean ratings were always mid-scale or worse. Desserts and being able to sit down to a hot meal, in a warm environment, were the most enjoyed aspects of eating in the mess.

The appeal of dessert may be due as much to its use as a treat (or reward), as to its taste. To ensure the morale boosting effects of dessert are retained, whilst also ensuring it contributes appropriately to meeting nutritional requirements, lower fat and reduced sugar options that focus on providing milk and fruit should be explored, without sacrificing taste. In addition, dessert accompaniments should be reviewed and cream, for example, replaced by lower fat alternatives. This is particularly important in light of the high proportion of overweight recruits identified in this population [1].

To help increase perceived variety and prevent the boredom with food that is inevitable in any population that is forced to eat the same sorts of food in the same environment for a prolonged period, changes in the presentation and layout of food, as well as the menu itself, should be considered in consultation with catering staff. A staggered introduction of new, healthier options as the course progresses may
enhance attraction and uptake. At breakfast in particular, where recruits commented that the choice was the same everyday, reducing the number of options each day, but changing these options daily, would be a cost-effective strategy to increase perceived variety.

Finally, the reported overuse of spices and salt on food items, particularly vegetables, should be noted. This may be limiting the consumption (and appeal) of these foods. The addition of salt should also be limited due to the known impact of sodium consumption on blood pressure and subsequent risk of cardiovascular disease in later life.

3.2.4 Health and hygiene

A small number of complaints about the cleanliness of cutlery and crockery are a reminder that optimal hygiene practices should be adopted in and around the mess at all times. It is well recognised that bacteria can be easily spread from dirty utensils to the user and then on to others in their contact.

In addition, it was noted by the research team that despite hand sanitisers being available outside the mess, these were not always functioning and the hands of recruits were invariably ingrained with dirt. Recruits should be provided with the materials and time to thoroughly clean their hands and nails, particularly after periods in the field, to prevent the spread of bacteria and infection.

Although reheating and reusing leftover food can be an efficient catering strategy, care must be taken to ensure that the age of all meal content is tracked, to ensure the same content does not appear on the press several days after its first preparation. The warm and moist environment in and around the press is ideal for multiplication of bacteria.

3.2.5 Summary

The military diet is following general civilian trends and diseases of affluence are likely to affect the military population in the same way as the civilian population [19]. Although the NZ Army’s AARC is physically demanding, and the energy expenditure of recruits likely higher than civilian counterparts, the amount and composition of energy intake is still important for optimal performance and health and to establish good dietary habits for the future.

The opinions of recruits cannot be used in isolation to dictate food provision during AARC, but some important issues have been raised. Arguably the most important question is “Are recruits provided with and consuming the right amount and type of foods, at the right times, to fuel performance and promote recovery?” This issue has been addressed with Australian Army recruits [20] and the findings are in part reflected in the Minimum Nutrition Standards for NZ Army published by Jensen and Martin (2006).

In the absence of a full review of energy intake and expenditure among NZ Army recruits, international recommendations should be used alongside the findings of the current study and observations of expert NZ Army personnel and DTA scientists, to ensure catering provision during AARC is optimum. A full list of short and longer term measures has been published previously [4] but includes:

- Ensure the NZ Army Minimum Nutrition Standards are met and all food provision is documented
ii) Provide high carbohydrate snacks and fluids at appropriate time points
iii) Provide a continued programme of practical and theoretical nutrition and hydration education
iv) Introduce standard guidelines for course staff regarding meal time durations, use of food as reward/punishment, etc
v) Address hygiene issues in the mess and barracks
vi) Increase quantity and variety of carbohydrate (and other) food options
i) Conduct a follow-up survey to evaluate changes made to catering and education practices

3.3 Impact of course changes

The extension of AARC from 14 to 16 weeks appears to have had little, if any, impact on changes in recruit health and fitness. It is disappointing that an enhanced catering programme was not implemented during AARC 356 as proposed. Concerns were raised during all courses with regard to the quality and quantity of food provided in the mess and unsurprisingly, no significant differences in the changes in anthropometric, general health and physical fitness characteristics were observed between courses.

The same issues were identified during all courses, namely poor hydration status; above average BMI scores; likely negative changes in body composition during AARC; poor dietary and lifestyle habits; low base fitness and a loss of aerobic fitness for many recruits. The poor iron status of female recruits in this population identified previously [1] should also be taken into consideration.

On a positive note, the planned nutrition education sessions ran smoothly and were well received by recruits. As a result, recruits on AARC 356 had significantly improved scores on the nutrition quiz at the end of the course, both compared to baseline and to 353 recruits.

Clearly, nutrition education sessions are effective at improving the nutrition knowledge of recruits, but changes to catering are necessary for this knowledge to be put into practice and for the required improvements in physical characteristics of recruits to be made. This combined approach (enhanced catering alongside nutrition education) will encourage positive changes in knowledge, attitudes and practices, which will ultimately result in improved physical and cognitive performance during recruit training and throughout a soldier’s career. This issue should be addressed as soon as possible to ensure that another opportunity to influence a captive recruit population is not missed.

4 Conclusions and Recommendations

This project has identified a number of important issues relating to the preparation and long-term health and performance of AARC recruits. Probable high proportions of overweight and obese recruits on entry and negative changes in body composition during AARC highlight the need for ongoing, accurate assessment of body composition (e.g. skinfold measurements) in future AARCs.
Worthwhile enhancement of a range of important physical attributes was seen in some recruits, but implications of some recruits losing fitness should be considered, including the potential for an associated increase in injury risk. In addition, the level of fitness that is required on entry and on completion of the course should be re-confirmed and should reflect current and future Army requirements.

Updated guidelines are required to help potential recruits improve physical readiness and reduce injury risk in preparation for AARC. These need to be disseminated through the most appropriate channels, which must first be confirmed. Individual and group injury prevention strategies during AARC should also be explored.

Widespread dehydration should be addressed via both education and the provision of regular opportunities to drink adequate and appropriate volumes of fluid. Nutrition education sessions have been proven to be effective at improving the nutrition knowledge of recruits and should continue, but changes to catering are also necessary for this knowledge to be put in to practice.

All recruits should receive appropriate between-meal snacks and sports drinks after all PT sessions. Strategies that allow higher energy (particularly carbohydrate) requirements to be met at mealtimes should be explored and the consumption of lower fat, calcium-rich milk and milk products encouraged. Access to processed and manufactured meats should be reduced and lower fat and reduced sugar dessert options and accompaniments introduced.

Ongoing monitoring of iron status in females, as previously endorsed, is a sensible approach and availability of improved food choices can complement supplementation as required. The implications of excessive alcohol consumption should also be addressed with females.

Variation in the presentation and layout of food, as well as the menu itself, is recommended, particularly later in the course. Reducing the number of breakfast options at each sitting, but changing this selection daily, will improve perception of variety and should also be more efficient for catering staff.

Finally, hygiene practices in the mess and barracks should be optimised and standard guidelines produced for course staff regarding meal time durations and the use of food as reward/punishment, etc.

In summary, the recommendations of the NZ Army Minimum Nutrition Standards should be enforced and follow-up surveys conducted to evaluate the effectiveness of the changes made.

The combined approach of enhanced catering alongside nutrition education will encourage positive changes in knowledge, attitudes and practices, which will ultimately result in improved physical and cognitive performance during training and throughout a soldier’s career. This issue should be addressed as soon as possible to ensure that another opportunity to influence a captive and motivated recruit population is not missed.

**Acknowledgements**

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