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MILITARY HEALTH & PERFORMANCE

DEFENCE SCIENCE AND TECHNOLOGY GROUP
MINISTRY OF DEFENCE, BRUNEI DARUSSALAM

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THE THRUST

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Dato Paduka Seri Haji Awang Halbi bin Haji Mohd Yussof
SECOND MINISTER OF DEFENCE

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بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

In 2020, Brunei Darussalam and the rest of the world witnessed the catastrophic COVID-19 pandemic and its devastating effects on all aspects of life. The COVID-19 pandemic serves as a reminder of the importance of military readiness in combating various security threats at present and in the future.

The Royal Brunei Armed Forces (RBAF) is constantly working towards maintaining mission readiness, ensuring national security and supporting the whole of government approach in a wide variety of areas. The uncertainty of the current dynamic environment makes achieving these goals challenging. In order for the RBAF to keep up with these increasing global threats, its fundamental strength, which is the military forces itself, should be highlighted. Advancements in the field of human performance optimisation in view of Defence Science & Technology (S&T) should be underscored in the RBAF and the Ministry of Defence.

There is an ever-growing focus on achieving operational capabilities in the military in this modern era. However, to this day, the RBAF's most important weapon system is not the latest fighter plane, warships or any other futuristic technology. Its most critical asset is still its soldiers. In order to maintain military preparedness, fight enemy in multidomain operations, protect national interests and stay resilient themselves, military personnel must demonstrate the superior physical fitness and health required for combat.

The RBAF must adapt a holistic, multidisciplinary approach to managing and optimising human performance and health, increasing resiliency and keeping the military personnel as healthy as possible, for as long as possible.

On this note, I am pleased to see the exponential growth in terms of advancements in the field of performance optimisation within the RBAF and I look forward to see more achievements in the future. I would like to congratulate the FRONTIER Journal's Editorial Board, Publication Team, Defence Science and Technology Secretariat (DTS), and the contributing authors on the publication of this Diamond Jubilee Special Edition in conjunction with the 60th Anniversary of the Royal Brunei Armed Forces with the theme "Military Health & Performance".

Wabillahi Taufiq Walhidayah Was'salamualaikum Warahmatulahhi' Wabarakatuh

FOREWORD

Brigadier General (Retired) Dato Seri Pahlawan Shahril Anwar
bin Haji Ma'awiah
PERMANENT SECRETARY, MINISTRY OF DEFENCE

السلام عليكم ورحمة الله وبركاته

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

The performance of the military plays a vital role in contributing to Brunei Darussalam's defence and security. With increasing discoveries in S&T, there has been a great thrust towards military research on advanced capabilities. Nevertheless, an equally strong emphasis should be accentuated on the platform on which our capabilities are based, that is our soldiers.

It used to be sufficient for soldiers to undergo physical training and to be able to run, jump, drive and shoot. In the past 60 years, the RBAF's fit and able soldiers have been able to succeed in their operations attributed primarily to their physical training. But today, it is imperative for our soldiers to be more than just physically fit; they have to be able to quickly adapt to growing unconventional threats and react well in every situation. The RBAF strive to be an armed forces in which our soldiers utilise technology and equipment as tools to carry out their tasks, and not where the weapon and technology are the priority and are simply manned by our soldiers.

The RBAF and the Ministry of Defence must actively conduct S&T research into the improvements in military training and fighting abilities. The Defence Science & Technology Group (DTSG) recognises the vast potential in the human performance optimisation research field and its influence on the future development of the RBAF. The goal is to make our soldiers the most developed humans that Brunei Darussalam can produce.

The Brunei Darussalam Defence White Paper (DWP) (2011) highlighted the significance of military preparedness and sustainability towards maximising force effectiveness. Capitalising on the optimisation of soldiers' performance to produce resilient, highly adaptive and *ever-ready* soldiers will be crucial in achieving this goal.

To end my speech, I would like to extend my congratulations to the FRONTIER Journal's Editorial Board, Publication Team and Defence Science and Technology Secretariat (DTS), as well as, my appreciation to the contributing authors for the release of this Diamond Jubilee Edition of FRONTIER with the theme 'Military Health and Performance'. It is my hope that FRONTIER continues to foster impactful scientific researches in Defence S&T within the RBAF.

Wabillahi Taufiq Walhidayah Was'salamualaikum Warahmatulahhi' Wabarakatuh

EDITORIAL FOREWORD

Hasrinah binti Matyassin
INTERIM EDITOR-IN-CHIEF

السلام عليكم ورحمة الله وبركاته

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

The Defence Science and Technology Group (DSTG) is pleased to release FRONTIER'S second volume, also commemoratively the Diamond Jubilee Special Edition in conjunction with the 60th Anniversary of the Royal Brunei Armed Forces (RBAF).

Being the primary resource and fighting force, the well-being and performance of our military servicemen are paramount to ensure their safety and efficacy whilst undertaking their respective daily tasks and responsibilities. Over the past years, our organisations had made good progress in understanding soldiers' performance better through credible research spearheaded by the Performance Optimisation Centre (POC), Centre of Science and Technology Research and Development (CSTRAD) as well as Medical Services Unit (MSU). This edition of FRONTIER features the theme of "Military Health and Performance" with three articles, which highlights the various aspects of human performance within a military:

1. **"Understanding and assessing the food service in OCS"** is a part of the on-going Fuelling for Fighter Performance (F3P) project, which aims to assess and improve the provision of food in Officer Cadet School (OCS), Royal Brunei Armed Forces (RBAF);

2. **"Evaluation of the efficacy of RBAF weight loss programme"** evaluates the efficacy of the Performance Optimisation Centre (POC) weight loss programme, which was developed to reduce the number of overweight personnel; and

3. **"Influence of gender on functional movement screen (FMS) values in Officer Cadet candidates"** assesses whether gender plays a role in the FMS assessment, which aid in identifying individuals with biomechanical deficiencies and other compromising attributes that could cause injury.

With this publication, we hope to impart to our readers the valuable knowledge on health, well-being and human performance. Needless to say, this would not have been possible without the collective efforts of the journal's Editorial Board, Publication Team, Defence Science and Technology Secretariat (DTS) as well as esteemed authors who had put a lot of efforts in their research and studies. Our sincerest appreciation to the collective hard work, dedication and continuous efforts and we hope that FRONTIER will continue to enrich our readers with valuable knowledge.

Wabillahi Taufiq Walhidayah Was'salamualaikum Warahmatulahhi' Wabarakatuh

INTRODUCTION

About FRONTIER

FRONTIER is a Defence Science and Technology (DS&T) journal formatted under the guidance of the Defence Science and Technology Group (DSTG), for the periodic publication of a curated set of articles, reports and technical papers written by members of the Ministry of Defence (MINDEF) and the Royal Brunei Armed Forces (RBAF), in support of the ongoing effort to institutionalise knowledge within the organisation. Moreover, through publication and hence sharing of DS&T content, FRONTIER aspires to be a platform that creates awareness, generates discussion and inculcates innovation among members of MINDEF and RBAF.

In alignment with the ongoing digitisation effort spearheaded by DSTG, FRONTIER will be made available primarily as soft copy, via MINDEF Intranet and DSTG Core, both accessible via MINDEF Defence Administrative Network (DAN), as well as, via the MINDEF official website. Limited hard copies of FRONTIER will also be distributed to MINDEF and RBAF's leaderships and made available in MINDEF and RBAF's libraries.

"A DSTG Initiative"

Fuelling For Fighter Performance (F3P): Understanding and Assessing the Food Service in Officer Cadet School

About the Author

Alisa Lau Hui Na is a dietitian who completed her Bachelor of Health Sciences (Nutrition) and Master of Dietetics Studies at the University of Queensland, Australia. She is currently working at the Performance Optimisation Centre (POC), where she is involved in research around nutrition, health and soldier performance. She has a wide range of nutrition interests including improvement of the RBAF food service, general nutrition education, and sports nutrition. In addition to her roles at POC, Alisa also provides weekly outpatient dietetic clinics at Bolkiah Garrison Medical Centre for military personnel and their families.

ABSTRACT

Fuelling For Fighter Performance (F3P) is an ongoing project to assess and improve the provision of food in Officer Cadet School (OCS), Royal Brunei Armed Forces (RBAF). Menu planning, nutritional adequacy and healthfulness were investigated by observation and estimation over a period of seven weeks during the generic term. It was found that menu planning was non-existent, and that the food provided was high in fat, sugar and salt. Recommendations such as implementing basic menu planning principles and healthy modifications to recipes were then provided to the caterers and OCS command team. Future studies should be carried out to determine the energy expenditure of officer cadets to more adequately meet training needs through nutrition. Nutrition education to officer cadets and cooperation from key stakeholders is essential for the effective implementation of food service recommendations.

1. Background

Military trainees have high energy requirements, and food provided in training units such as Officer Cadet School (OCS) must meet both energy and nutrient requirements [1,2]. The provision of nutritious meals contributes to well-being, morale and health of military trainees. Proper nutrition maintains general health, the immune system and aids in recovery after fitness training. In a garrison setting where personnel are required to meet weight and fitness standards, a healthy diet also plays an important role in maintaining body weight and maintaining or improving physical performance. Therefore, it can be said that nutrition contributes to military readiness.

In military populations, the basic training environment may be the best place to implement healthy eating interventions, as this is when habits are formed. Modifications to food choices in dining facilities can also have a positive impact on food choices [3,4].

To date, no study or intervention has been carried out to audit and consequently improve the provision of food in Royal Brunei Armed Forces (RBAF) camps. Project Fuelling For Fighter Performance (F3P) aims to assess the provision of nutrition in OCS and determine the adequacy of nutrition for officer cadets' needs. This is an ongoing project to improve the food service in OCS, with plans to extend the improvement of the food service to all RBAF camps. The provision of food in RBAF camps is currently based mainly on price and taste. Although there are guidelines on healthy food preparation within catering contracts, there is no proper policing of the guidelines. The RBAF conducts training over different times of the year, spanning over a period of three months up to a year. The OCS training period spans over 52 weeks, making it imperative that the food provided is healthy and adequate to meet the needs of officer cadets in training. This article details the first phase of this ongoing project.

2. Methods

This study was investigative and observational. No intervention was implemented during this phase. OCS was chosen due to its controlled environment and conditions. It is relatively isolated and their training schedules and activities are fixed with scheduled time for book out. The OCS leadership was also cooperative in allowing observations to be carried out freely. Weeks 20 to 26 of the training programme within the OCS generic term, were chosen as the data collection period, as the programme included a mix of practical and classroom-based lessons.

2.1. Food Provision by Caterer

To assess if the food served to the officer cadets is in accordance with what is stated on the menu, a copy of the menu was obtained, and food served for each meal was inspected. Meals were inspected every Tuesday and up to two randomly picked additional days each week.

To assess consistency over the menu cycle, days when meals were inspected on the first and second weeks of the review were repeated when the menu cycle repeated. The kitchen was visited to observe how food was prepared and cooked. The food provided was also taste tested and examined for usage of ingredients such as oil, sugar and salt.

Food preparation and cooking methods were compared with the Manual on Healthy Menu and Food Preparation, which is a compilation of best practices for safe food preparation and provides examples and suggestions on how to prepare healthy meals.

The plating of meals was observed for each day of data collection. Officer cadets were also observed to see if more food was taken during mealtimes.

2.2. Energy Requirements and Calculations

To assess the nutritional adequacy of food, the macronutrient distribution and energy content of the food was estimated using precalculated values according to portion sizes and compared to the officer cadets' estimated energy expenditure. Assumptions were made regarding the portion sizes of the food and the amount of food taken by the cadets.

Energy expenditure was estimated by multiplying the average body weight of the officer cadets by a Physical Activity Level (PAL) score based on activities in their training schedule. Scheduled Physical Training (PT) sessions and additional PT were observed where possible and taken into account. Officer cadets also reported their daily activities.

3. Results

3.1. Menu Planning and Compliance

The menu provided was a 4-week cycle menu. However, the food provided did not adhere to the menu and compliance to the menu was almost non-existent, as seen in Table A. The food that is cooked is decided by the cooks and is dependent on what is bought the previous night. The suggested menu appears to be a template and is not strictly adhered to on a daily basis. Food that was sampled on consecutive days and weeks showed repetition. Reasons for this included lack of availability of fresh produce, and special requests from the end users.

Table A below shows the food served in OCS during the data collection weeks, where B refers to the breakfast meal, L refers to the lunch meal, and D refers to the dinner meal. The bold text indicates that a dish is high in fat. Areas that are left blank indicate that menu data was not collected for that particular day or meal.

Since OCS follows a 4-week menu cycle, each week has been labelled and coloured accordingly to allow a comparison of the food provided. A indicates Week 1 of the menu cycle, B indicates Week 2, and so on. Both A1 and A2 are weeks corresponding to Week 1 of the menu cycle. Based on the comparisons of food served in matching weeks on Table A-3, it can be seen that the food on both weeks do not match. If the menu was adhered to, the food on both weeks would be the same or similar. Repetition in the menu can be seen in A2 where vegetable curry was served for lunch on two consecutive days.

Table A

A1		BF: **American BF** L: **Chicken curry** Sambal Egg Long beans Sliced Papaya D: Beef Tempeh & tauhu **Labu air & carrot masak lemak**	BF: **Mee goreng** **Nuggets** L: D: **Curry Fish** Sambal Egg Stir fried beans & carrots	
B1		B: Spaghetti L: Soy sauce chicken Veggie omelette **Sayur lodeh** Sliced melon D: **Curry fish** Sambal egg Stir fried beans & carrot		B: **Corned beef fried rice & Fishballs** L: **Buttermilk chicken** Sambal egg **Sayur nangka** D: Ginger beef Potato, tempeh, ikan pusu Baby kalian & mixed veg
C1	B: **Fried kueh teow & Fishballs** L: **Fried chicken** Veggie omelette Mixed veg Sliced watermelon D: **Lamb gulai** Salted egg Stir fried pak choi	B: Fried mee hoon & **Sausages** L: **Chicken curry** Sambal egg **Cangkuk manis pumpkin, masak lemak** D: Soy sauce beef Egg roll Chinese cabbage, carrot, pak choi		B: **Corned beef fried rice** & **Fishballs** L: **Chicken masak lemak** Sambal egg Sayur nangka D: **Sweet and sour fried fish** Potato, tempeh, pusu Sambal eggplant Apple
D1		B: **Fried rice** & **Chicken nuggets** L: D: **Buttermilk chicken** Tempeh, tauhu, pusu Stir fried kangkong / mixed veg	B: **Mee goreng** & **Sausages** L: **Ayam masak opor** Sambal egg Baby kalian w carrots Banana D: Mango fish Salted egg **Daun ubi masak lemak**	
A2		B: **Corned beef fried rice & nuggets** L: Ayam masak merah Egg masak lemak **Cangkok manis pumpkin masak lemak** Banana D: **Buttermilk fish** Tempeh, tauhu sambal Pak choi Banana	B: **Fried kueh teow & Fishballs** L: **Fried chicken** Egg roll **Curry veg** D: Black pepper lamb Salted egg Mixed veg Sliched melon	B: **Fried mee hoon & Sausages** L: Sambal chicken Soy sauce egg **Curry veg** Sliced papaya D: Curry fish Sweet and sour crabstick Cucumber with sausage Watermelon Banana cake Sausage rolls
C2	B: Mee hoon Fishball L: Soy sauce chicken Egg roll Mixed veg D: Mango fish Crabstick in sauce Stir fried beans and carrot Banana	B: Kolomee **Nuggets** L: Ayam masak merah Oyster sauce egg Cucumber, carrot in gravy Oranges D: Spaghetti Garlic bread S: **Corned beef fried rice** **Fried chicken**	B: Mee mamak Sausages	B: **American breakfast** L: **Fried chicken** Egg roll Daun ubi D: Ginger beef Salted egg Stir fried pakis Sliced watermelon

A1		BF: **American BF** L: **Chicken curry** Sambal Egg Long beans Sliced Papaya D: Beef Tempeh & tauhu **Labu air & carrot masak lemak**	BF: **Mee goreng** **Nuggets** L: D: **Curry Fish** Sambal Egg Stir fried beans & carrots	
A2		B: **Corned beef fried rice & nuggets** L: Ayam masak merah Egg masak lemak **Cangkok manis pumpkin masak lemak** Banana D: **Buttermilk fish** Tempeh, tauhu sambal Pak choi Banana	B: **Fried kueh teow & Fishballs** L: **Fried chicken** Egg roll **Curry veg** D: Black pepper lamb Salted egg Mixed veg Sliced melon	B: **Fried mee hoon & Sausages** L: Sambal chicken Soy sauce egg **Curry veg** Sliced papaya D: Curry fish Sweet and sour crabstick Cucumber with sausage Watermelon Banana cake Sausage rolls
C1	B: **Fried kueh teow & Fishballs** L: **Fried chicken** Veggie omelette Mixed veg Sliced watermelon D: **Lamb gulai** Salted egg Stir fried pak choi	B: Fried mee hoon & **Sausages** L: **Chicken curry** Sambal egg **Cangkuk manis pumpkin, masak lemak** D: Soy sauce beef Egg roll Chinese cabbage, carrot, pak choi		B: **Corned beef fried rice & Fishballs** L: **Chicken masak lemak** Sambal egg Sayur nangka D: **Sweet and sour fried fish** Potato, tempeh, pusu Sambal eggplant Apple
C2	B: Mee hoon Fishball L: Soy sauce chicken Egg roll Mixed veg D: Mango fish Crabstick in sauce Stir fried beans and carrot Banana	B: Kolomee **Nuggets** L: Ayam masak merah Oyster sauce egg Cucumber, carrot in gravy Oranges D: Spaghetti Garlic bread S: **Corned beef fried rice** **Fried chicken**	B: Mee mamak Sausages	B: **American breakfast** L: **Fried chicken** Egg roll Daun ubi D: Ginger beef Salted egg Stir fried pakis Sliced watermelon

3.2. Portion Control

All food was pre-portioned onto plates, and portion sizes were consistent between plates however the portion sizes can be considered large, especially for females. The portion size of vegetables was small, and not all officer cadets had a preference for vegetables. It was also observed that many officer cadets were unable to finish their food, mainly due to insufficient time.

According to calculations, the food provided daily is more than sufficient for the officer cadets' energy requirements. However, officer cadets often have insufficient time to finish their food. Since it is both unreasonable and virtually impossible for meals to be portioned out according to individual needs, the solution is that officer cadets need to be aware of matching their energy intake to their needs and eating accordingly. Energy content of the food can also be modified based on cooking methods. Some officer cadets appear to control their intake of food by eating less rice, and others have been observed taking extra food.

3.3. Nutritional Adequacy

The estimated energy expenditure for males and females, as well as the average energy expenditure, was calculated using the Mifflin-St Jeor Equations and is tabulated below [5]. The age used was 25, which is the average age of the intake. It must be considered that these values for energy expenditure are averages. Officer cadets may need more or less calories depending on their body weight and personal physical activity level.

PAL	MALE (kcal)	FEMALE (kcal)	INTAKE AVERAGE (kcal)
BMR	1564 ± 90	1254 ± 66	1486
1.4	2190 ± 126	1755 ± 92.4	2080
1.6	2503 ± 143	2006 ± 106	2377
1.7	2660 ± 153	2131 ± 112	2525
2.0	3129 ± 179	2508 ± 132	2971
2.4	3755 ± 215	3009 ± 158	3566

Table 1: Physical Activity Level and Estimated Energy Expenditure of Officer Cadets

3.4. Carbohydrate

Carbohydrate is the main source of energy for the body. Individuals with a lower physical activity level will rely less on carbohydrates as a source of energy. Carbohydrate requirements increase as energy expenditure increases. Furthermore, physical activity conducted in the heat causes the body to preferentially use carbohydrates as a source of energy. It is recommended that 50-65% of daily energy intake comes from carbohydrates.

The provision of carbohydrate was determined to be adequate, where the main carbohydrate source was rice. Other sources included noodles, pasta, bread, cakes and fruits. Drinks containing added sugar were also served.

3.5. Protein

Protein is required for the maintenance and repair of muscle stores in the body, especially after exercise. The provision of adequate protein after intense exercise promotes post-exercise muscle recovery, enhancing adaptations to

training. Inadequate protein intake and delayed timing can lead to a delay in repair of muscle and tissue, resulting in injury occurrence or slow recovery from injury. With a varied schedule, it is difficult to adjust protein portions on a daily basis, therefore it is more convenient to provide relatively large portion sizes of protein. Protein should consist of 15–25% of total daily energy intake.

Protein portions were also determined to be adequate, as there were two protein sources provided during each mealtime. Animal protein sources provided included egg, chicken, fish, beef and lamb. Protein from plant sources included tofu and tempeh.

3.6. Fat

Fat is required to maintain body functions and contributes to the production of hormones. It is also a compact source of energy. Fat should make up 20–35% of total energy intake. Saturated and trans fats, such as animal fats and skin, coconut milk and oils used for frying, should make up less than 8–10% of total energy intake. Excess fat intake may lead to weight gain in terms of body fat percentage, which is undesirable for most officer cadets. Some officer cadets who have a Body Mass Index (BMI) on the lower end of the range or who struggle to put on or maintain weight may benefit from consuming more fat, but for most, fat intake should be limited. Further elaboration on the fat content of the meals served is found in the following section on healthfulness.

3.7. Macronutrient Distribution and Energy Content of Meals

Table 2 presents the estimated number of calories for each main meal (breakfast, lunch and dinner). When compared with the daily energy expenditure of the officer cadets, the food provided contains more than enough calories. Energy from the macronutrients as a percentage of total energy intake is shown in the figure below. These values only represent an estimation of the calories provided by the main meals. Officer cadets may not finish all their meals, therefore may not consume all of these calories. On the other hand, these values do not take into account the additional snacks or drinks (those not provided by OCS) consumed during the day.

	Calories from carbohydrate	Calories from protein	Calories from fat	Total calories
Breakfast	690	193	472	1354
Lunch	409	165	336	910
Dinner	463	196	266	925
Total	1562	554	1074	3190

Table 2: Estimated energy content of main meals

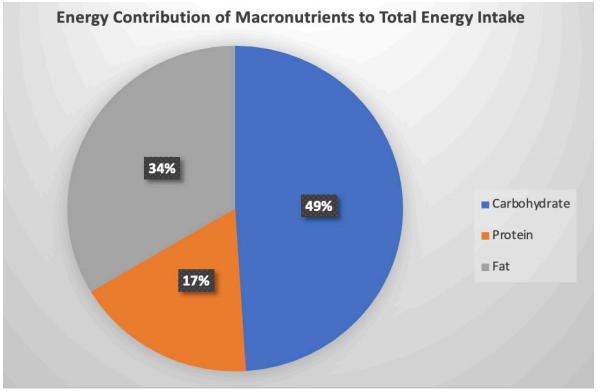

Figure 1: Energy Contribution of Macronutrients to Total Energy Intake

As shown in the chart above, the proportion of energy from carbohydrate is just under the recommended amount of 50–65% of total energy intake. The proportion of energy from protein is within the recommended range, and the proportion of energy from fat is 34%, near the upper limit of the recommended amount.

4. Healthfulness

Overall, the food provided to officer cadets is high in fat, sugar and salt. Cooking styles and methods need to be modified to reduce the provision of 'empty calories' and to allow food to be nutrient dense instead of calorie dense. The food provided should be of high quality to support optimal health, facilitate recovery from training and encourage healthy eating behaviours. A comparison of the food provided in OCS with the RBAF Healthy Cooking Methods Checklist can be found in Table B.

Table B

RBAF HEALTHY COOKING METHODS CHECKLIST	
Healthier Options	
Use wholegrain options	No
Vegetables at every meal	Yes
Source of protein from fish during lunch or dinner	Source of protein from meat
Always serve fruits	Once a day
Oil and Fat	
Reduce oil, fat and coconut milk in cooking	No, oil used liberally
Choose healthier cooking methods (boiling, steaming, grilling)	Most food is fried
Choose products with the healthier choice logo	-
Reduce use of products such as cream, mayo, butter margarine	-
Reduce use of fatty meats	No
Discard fat from meat or chicken before cooking	No, skin is on
Sugar and Sugar-Sweetened Beverages	
Reduce sugar in food and drink	Yes, on Wednesday
Swap cordials for plain water	No
Choose fresh fruits over tinned fruits	Yes
Choose fresh milk over condensed milk	No
Sweet drinks do not need to be served	No
Swap with low calorie or low sugar options	No
Hot drinks	
Reduce sugar in tea and coffee	Sometimes
Serve sugar and milk for drinks separately	No
Use low fat milk instead of condensed milk or evaporated milk	Evaporated milk is used
Water	
Serve water at every meal	No, but water is available

4.1. Fat and Oil

Most of the food provided contained generous amounts of oil. Breakfast dishes such as fried noodles and fried rice were generally quite oily. Many foods and the majority of meat used in meat dishes were deep fried before being cooked in sauce. Egg dishes were mostly fried, and some egg dishes were served whereby boiled eggs were fried before being cooked in sauce. Coconut milk and milk were commonly used in many dishes throughout the day (e.g. curry, *masak lemak*, buttermilk). During the first two weeks, the milk provided for cereal was low fat milk, however during some of the following weeks either full cream or low fat milk were provided. There was no consistency with the usage of milk.

4.2. Added Sugar

Sugar was used in cooking as the gravy and sauces in some dishes were sweet. Cordials were provided for all meals (breakfast, lunch and dinner). Hot drinks (*teh tarik* and Nescafe) were provided for breakfast. These were pre-made with milk and sugar and placed in a dispenser for cadets to take. It was observed that Wednesday was been designated as 'no sugar day'. This is a good initiative; however, it was not adhered to by the caterer, with the reason given that drinks will not taste good without sugar. As a result, the sugar was reduced but not omitted completely.

4.3. Salt

Salt and flavourings are used liberally in cooking, as seen in the kitchen. Some dishes were particularly salty. A common food that was served throughout the data collection period was salted egg. Sauces (*kicap manis*, tomato sauce, chilli sauce) and table salt are provided for cadets on their dining tables.

4.4. Processed Foods

Processed foods were served regularly for breakfast. These include sausages, nuggets, fish balls and crab sticks. These foods are high in fat, salt and additives, and low in protein. These foods are considered discretionary foods and should be limited as much as possible.

5. Discussion and Recommendations

Menu planning is widely implemented in the food service industry to help in the management and delivery of food and beverages, including forecasting and purchasing raw materials for dishes, providing consistency and catering to end-user requirements. When planning a menu, a number of aspects should be considered. For example, the type of menu, food production processes being used (i.e., cooking styles), the type and frequency of foods that can be served, meal timings, nutrition and end-user

requirements. The majority of publicly available standards and guidelines are tailored towards the hospital food service, where the food served aims to promote health and recovery [6]. Patients in hospital may be admitted for different lengths of time, and different menus are specified for different purposes [7,8].

In contrast, in facilities such as military camps where the majority of meals in a day are eaten, the menu should be pre-planned so that there is adequate variety in the types, flavours and textures of dishes served, with as little repetition as possible. However, these principles can only take effect if the food served adheres to the menu. Therefore, poor menu planning or a lack of adherence to the menu can result in flavour fatigue and reduced satisfaction, leading to decreased intake and increased food wastage. As observed, the food served in OCS does not adhere to the menu and the food service possibly lacks basic menu planning principles. This could be due to the lack of guidelines in place.

The US Army and the United Kingdom Ministry of Defence have published guidelines for the implementation of healthy menus in dining facilities [9-11]. This includes instructions on the menu cycle, the selection of food items on offer, as well as cooking styles and preparation methods. For example, it is specified that items should not be deep fried and that pre-packaged or processed food be limited. Menu planning principles such as variety and avoiding repetition are also mentioned.

The training environment is an ideal place to start promoting healthy eating behaviours among military personnel. When recruits and cadets transition from civilian to military life, they undergo a 'remodelling'. This crucial period of transition and training can also be used as an opportunity to shape healthy behaviours around food and fuelling, as a basis for their career in the future [12]. The US Army successfully implemented the Initial Military Training (IMT) Soldier Fueling Initiative (SFI), which makes use of this period to influence the nutritional intake of army recruits. The implementation guide for the SFI describes menu standards and guidelines regarding menu planning and food preparation specifically catered for IMT [13]. Currently rolled out across various IMT camps, the aim of this initiative was to improve operational readiness by promoting healthy eating among basic trainees by modifying the menu standards, providing nutrition education on the association between nutrition, health on performance, and providing labelling to help recruits make healthier choices. This is expected to mitigate long term effects of poor nutrition knowledge on the health and readiness of the army [14].

Similar interventions in overseas military dining facilities (DFACs) include point of service (POS) nutrition labelling and traffic light systems, which help military personnel to make healthier dining choices. An example is the successful United States Special Operations Command (USASOC) Human Performance Program (HPP) intervention, whereby the menu was modified, POS labelling was implemented, and nutrition education was provided [15]. This intervention improved the Healthy Eating Index of soldiers over a period of 12 months. It is important to note that these DFACs service a large number of military personnel and have an extensive range of food choices.

These interventions are therefore mainly focused on helping trainees make healthier choices from the selection of food provided. As a result, trainees' food selection behaviours and intake improves in quality. Implementation of the SFI in non-trainee dining facilities have also been shown to improve the nutritional quality and decrease total fat and saturated fat intake of military personnel [16].

In contrast, the dining facilities in RBAF do not provide a range of choices for trainees or personnel to choose from. For example, trainees do not have a choice between different protein sources, carbohydrate sources, or cooking styles such as in overseas dining facilities, where personnel can choose from two or three dishes. This means that choice-based interventions cannot be implemented. Since trainees do not have a choice, the only solution is to modify the food served to meet healthy food guidelines. One disadvantage associated with this is the satisfaction of trainees with the food, as individuals have different preferences. Some trainees may not be in favour of the modification of food to meet healthy eating recommendations, leading to low satisfaction rates, poor food consumption and reliance on other food sources.

The RBAF should consider the healthfulness and appropriateness of food provided to all camps, especially training units. It was recommended that basic menu planning principles and guidelines should be followed to ensure adequate management of raw materials for meals. Recommendations on the frequency and variety of protein sources, carbohydrate sources, dishes and cooking styles were also discussed with the caterer.

The macronutrient content of the food in OCS can still be improved, compared with macronutrient contents suggested by other guidelines [10]. Carbohydrate content can be increased by lowering the fat content of meals. In line with healthy eating guidelines, modifications to the menu were also recommended, such as limiting oily or fried foods and changing cooking styles, as well as providing low fat dairy options. It was

also recommended that non-processed and lean cuts of meat be served more often. Added sugar can be reduced by limiting the use of sugar in cooking, and not providing sugar-sweetened cordials during mealtimes.

6. Conclusion

Ongoing review of the food service is required, and menu planning principles should be applied properly to ensure that food provision is adequate to meet training needs. In order to more adequately meet the energy needs of officer cadets during training, further in-depth research needs to be carried out to more accurately estimate or measure energy expenditure during different stages of training.

Further improvement of food service delivery must involve key stakeholders, from leadership to kitchen staff. Nutrition education should be provided to military trainees before and during training to help them understand the importance of proper nutrition for health and training.

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Evaluation of the Efficacy of RBAF Weight Lose Programme

About the Author

Lt Col (Dr) Fetty has been serving in the Royal Brunei Armed Forces since 2010 and is currently working as a Medical Officer at the Medical Reception Station at Penanjong Garrison. She presented the initial findings of this research in the 4th ASEAN Chiefs of Military Medicine Conference in 2014. She has an MBChB from the University of Dundee, MSc in Primary Health Care from the Universiti of Brunei Darussalam and MSc in Sports and Exercise Medicine from the University of Nottingham. She is also a member of the Royal College of General Practitioners (Int).

ABSTRACT

INTRODUCTION: 40% of Royal Brunei Armed Forces' (RBAF) personnel are overweight, and of that, 10% are obese. The aim of this study is to evaluate the efficacy of the Performance Optimisation Centre (POC) weight loss programme, which was developed to reduce the number of overweight personnel. This study will identify the number of participants who had lost weight, and the relationships between weight loss and gender, rank, attendance, medical board status and starting weight.

METHODOLOGY: This retrospective study looks at the weight loss programme conducted by POC from September 2013 until February 2014 in 111 participants. The associations between gender, rank, medical board status and weight loss were analysed using Pearson's chi square test. The association between attendance and weight loss was analysed using Paired t-test.

RESULTS: The study found that the programme led to weight loss in 67.6% of participants but only 4.5% of participants achieved the target weight loss (≥ 12 kg). There is a significant positive association between attendance and weight loss ($p = 0.013$) and starting weight and weight loss ($p = 0.030$). However, there are no significant associations between gender, rank and medical board status on weight loss found.

Conclusion: The POC weight loss programme leads to weight loss, however only a small number of participants achieved the target weight loss. Improvements need to be made to the POC weight loss programme to improve the success rate of participants achieving target weight loss. RBAF needs to continue combatting the overweight and obesity problem.

1. Introduction

In 2008, World Health Organisation (WHO) estimated that 1.4 billion adults (older than 20) are overweight of which 200 million men and 300 million women were obese [1]. The prevalence of obesity in Brunei Darussalam was also found to have increased from 12% in 1996 [2] to 27.2% in 2011 [3]. The civilian and military communities mirror each other in the noticeable increase in body weight trend. In 2012, 40% of Royal Brunei Armed Forces (RBAF) personnel were found to be overweight, and of these 10% were obese [4]. Body mass index (BMI) is widely used to classify weight into categories. BMI is measured by dividing the height in metre by weight in kilograms squared. WHO has identified different BMI categories; <18.5 kg/m^2 as underweight, 18.5 to 24.9 kg/m^2 as normal range, 25.0 to 30.0 kg/m^2 as overweight and >30.0 kg/m^2 as obese [5]. The ideal target BMI is 21.0 to 23.0 kg/m^2 [5].

Individuals with raised BMI are at a relatively higher risk of developing health problems including type 2 diabetes mellitus, hypertension, hyperlipidaemia, heart disease, stroke and arthritis [6]. The increase in number of personnel with raised BMI has multiple implications on RBAF. As the number of personnel with chronic diseases increases, the number of personnel on medical board with job restrictions will also increase, hence reducing the number of healthy, combat ready personnel in RBAF. There will also be a financial strain on the organisation on the treatment and management of the health problems, lost workdays attributed to such conditions and not to mention the resources that have been spent on training these individuals.

RBAF developed the "BMI Policy" in 2009. All personnel must have a BMI of below 28.0kg/m^2. Male personnel must have a body fat percentage of less than 25% whilst female personnel must have a body fat percentage of less than 32%. Personnel who do not meet these requirements have negative impact on their promotions, appointments, training opportunities and service extension. In 2010, the Performance Optimisation Centre (POC) developed a Weight Loss Programme for RBAF personnel who did not meet the RBAF BMI requirement. The POC is a unit within Ministry of Defense that is responsible for physical testing of all RBAF personnel and rehabilitation of active personnel. The weight loss programme is held over 6 months. There are 3 1-hour sessions per week, consisting of intensive exercise including endurance, agility & speed and circuit training, as summarised in Table I. The intensity of the training is gradually increased over the duration of the programme.

Modules on healthy nutrition and effects of obesity on health were also incorporated. These sessions were conducted by invited endocrinologist, dietician and Diabetic Nurse Educators from Raja Isteri Pengiran Anak Saleha (RIPAS) Hospital. Questionnaires were also given by RIPAS' psycholgists to participants to identify the participants' "relationship" with food, for example whether they are stress eaters.

Table I : Weekly schedule for the POC weight loss programme

	Day	Time	Activity
1.	Monday	1630 – 1730H	Strength
2.	Wednesday	1400 – 1500H	Zumba / Body Combat
3.	Friday	1630 – 1730H	Speed / Endurance

Chronic diseases can be prevented, both primarily and secondarily by regular physical activity [7]. The programme aimed to result in personnel losing weight, improving their physical fitness, and simultaneously reducing the risks of personnel developing chronic non-communicable diseases. It is also hoped that participants would continue to live a healthy lifestyle after completing the weight loss programme.

This research aims to evaluate the effectiveness of the POC weight loss programme in achieving weight loss. The target weight loss for the POC programme is 0.5 to 1.0 kg per wek which amounts to 12 to 24 kg at the end of 6 months. The objectives of this research are to identify the number of personnel who achieved the target weight loss, and identify the relationships between weight loss and gender, rank, attendance, medical board status and start weight.

Participants' attendance to previous programme was an issue as participants' attendance was not always regular. This study looks at attendance to ascertain if regularly attending the programme would lead to more weight loss. The influence on rank was also assessed. It is thought that lower ranks would achieve better weight loss, as their weight (and BMI) has a direct effect on their career progression. Personnel who suffer from chronic diseases and are on medical board sometimes believe that their overlying condition stops them from doing exercise and losing weight. The study looks at the effect of medical board status with weight loss to determine if chronic disease hinders weight loss.

2. Literature Review

A search on PubMed with terms consisting "weight loss programme" did not show many results of weight loss programme with a duration of 6 months, as is the case in this study. One study showed patients who enrolled into the Counterweight Programme found that 10.2% of patients achieved weight loss of > 5% after 12 months [8]. A 16 month exercise program consisting of 5 exercise days per week found that overweight and obese women were resistant to weight loss, and that exercise only prevented them from gaining weight [9]. The same study found that men had reduced both their body weight and BMI at the end of the 16 weeks programme [9]. A study looking at a 13-week supervised aerobic exercise programme for 5 times per week showed there was no change in body weight [10].

A study done on the Health Promotion Centre (HPC), MoH's weight management programme found that their partcipants had significant weight reduction [11]. A study done on Type 2 Diabetes patient showed a mean weight loss after a 24-week programme on meal preparation training [12]. A significant reduction in body weight was also found at 12 and 24 weeks in a study done in overweight women [13]. A study on women with weight loss intervention with LC n-3 PUFA or with placebo oil had weight loss compared to the control group [13].

The findings from the different studies of various interventions and duration were all varied and have been summarised in Table II. No research has been done to identify the efficacy of the POC weight loss programme before. The hypothesis of this study is that the POC weight loss programme is an effective structured programme in reducing body weight.

Table II: Summary on findings of various studies on weight loss

Author	Description of study	Duration	Findings
Morrison et al[8]	Counterweight programme looking at dietary advice given in local pharmacies	12 months	10.2% of participants had ≥ 5% weight loss
Donelly et al[9]	Exercise programme consisting of 5 days per week session	16 months	**Women**: resistant to weight loss, and exercise only prevented them from gaining weight. They gained 0.6 (SD 3.8) kg, with an increase in BMI 0.1 (SD 1.3) kg/m^2. **Men**: reduced both their body weight [5.2 (SD 4.7) kg] and BMI [1.6 (SD 1.4) kg/m^2].
SoJung Lee et al[10]	Supervised aerobic exercise	13 weeks	No change in body weight (p>0.1)
Zakaria Kamis et al[11]	Weight management programme emphasising on importance of behaviour change in achieving weight loss in combination with exercise	6 months	Significant weight reduction of 5.35 (SD = 0.47) kg (p <0.001). 55% of their participants had also lost ≥ 5% of their body weight at the end of the programme.
Dasgupta K et al[12]	Meal preparation training on Type 2 diabetes patients	24 weeks	Mean weight change of -2.2%, 95% CI: -3.6, -0.8
JD Krebs et al[13]	Comparison of different interventions in overweight women (BMI > 27 kg/m^2, mean weight 92.7 (SD 15.3)kg: - weight loss intervention with LC n-3 PUFA, - weight loss with placebo oil and - control group	24 weeks	Significant (p <0.001) reduction in body weight at 12 weeks and 24 weeks in a study done. Weight loss intervention with LC n-3 PUFA had weight loss of 10.8 (SD 1.0) % Group with placebo oil had weight loss of 12.4 (SD 1.0) %

Legend: SD = standard deviation. CI = confidence interval.

3. Methodology

Recruitment

114 personnel who fit the inclusion criteria were identified in the different units within RBAF; Royal Brunei Land Force (RBLF), Royal Brunei Air Force (RBAirF), Royal Brunei Navy (RBN), Training Institute (TI) and Ministry of Defence (Mindef) and were forwarded to POC to be enrolled to the weight loss programme. All participants took part for the whole duration of the programme. The inclusion criteria are RBAF personnel of any rank with BMI >30kg/m^2 whilst pregnancy is an exclusion criteria.

Programme design

The programme is conducted by trained physical training instructors (PTI) and designed by the sports scientist in POC. There are 3 1-hour sessions per week, consisting of intensive exercise including endurance, agility & speed and circuit training. The POC programme aims to lose a modest 0.5 to 1.0 kg per week which amounts to 12 to 24 kg at the end of 6 months. [14-16]. The weight loss programme used in this research study took place from September 2013 to February 2014. It was held at POC in Bolkiah Garrison.

Ethics approval

Written consent was gained from all participants for their data to be used in the analysis of this research. Permission was also granted from the Commander of Royal Brunei Armed Force's Office to perform this research study. The ethics committee in the PAPRSB Institute of Health Sciences, Universiti Brunei Darussalam also approved this study.

Data Collection

The height of participants was measured in metres (to two decimal points) by using the standard equipment available in POC. Participants were required to stand upright without any shoes or socks on. Weight (measured in kilograms (kg), to one decimal point) was measured using TANITA Composition Analyzer, Type: BC-418 MA, which is regularly calibrated by technicians. Participants are required to be barefoot with minimal clothing (sports attire) for this procedure. Medical assistants based in POC took these measurements at the start and end of the weight loss programme.

Data Analysis

All data collected in this study were analysed using IBM SPSS Statistics version 20. The association between weight loss and gender, rank and medical board status were analysed using Pearson's chi square test. The association between weight loss and attendance and start weight were analysed using Pearson's correlation coefficient.

Table III: Participants' characteristics

		n (%)	mean (SD)
Gender			
	Male	83 (74.8)	
	Female	23 (25.2)	
Rank			
	Officers / WO	8 (7.2)	
	Sgt / SSgt	19 (17.1)	
	Pvt / LCpl / Cpl	84 (75.7)	
Medical Board Status			
	On medical board	32 (28.8)	
	Not on medical board	79 (71.2)	
Unit			
	RBLF	32 (28.8)	
	RBAirF	17 (15.3)	
	RBN	21 (18.9)	
	TI	3 (2.7)	
	Mindef	38 (34.2)	
Height (m)			1.64 (0.07)
Mean Weight (kg)			100.64 (13.33)
Mean BMI (kg/m^2)			37.43 (3.34)

Legend: SD = Standard deviation. WO = Warrant Officer. SSgt = Staff Sergeant. Sgt = Sergeant. Cpl = Corporal. LCpl = Lance Corporal. Pvt = Private. RBLF = Royal Brunei Land Force. RBN = Royal Brunei Navy, RBAirF = Royal Brunei Air Force, TI = Training Institute. Mindef = Ministry of Defense.

4. Results

114 participants enrolled into the weight loss programme but end weights were missing from 3 therefore only data from 111 participants are analysed. Table III shows that there were 83 male and 23 female participants. Lower ranks made the most of the participants where 75.7% of the participants were privates, lance corporals and corporals, 17.1% of the participants were sergeants and staff sergeants. Officers and warrant officers made up the remaining 7.2%. There were only 28.8% participants who were on medical board. Most of the participants were from the unit Mindef (34.2 %) and the least represented unit was TI.

Table IV shows the mean weight of all 111 participants at the start of the programme was 100.64 kg (SD 13.33) and this decreased to 98.25 kg (SD 13.01) at the end of the programme which is a significant reduction of 2.39 kg ($p = 0.000$) in the mean weight. Similarly, there is also a significant reduction in the mean BMI from 37.43 kg/m^2 (SD 3.34) to 36.55 kg/m^2 (SD 3.71) with $p = 0.000$. The study found that 72 (64.9%) participants lost weight at the end of the programme, but only 5 (4.5%) participants achieved the target weight loss of ≥ 12 kg. One participant achieved a weight loss of 34.3 kg which is more than the maximum expected weight loss of 24 kg. It was also found that 24 (21.6%) participants had lost ≥ 5% of their initial body weight.

Table V shows the mean weight differences by gender and rank. There is significant mean weight loss in two groups of participants: male sergeants and staff sergeants ($p = 0.020$) and male privates, lance corporals and corporals ($p = 0.001$). The mean weight loss achieved in the other groups are not statistically significant. Table VI shows that there is no significant association between weight loss and gender, medical board status and rank as the p values were more than 0.050. Table VII shows that there are significant positive correlation between weight loss and attendance loss ($r = 0.235$, $p = 0.013$, R^2 value = 5.5%) as well as participants' start weight ($r = 0.206$, $p = 0.030$, $R^2 = 4.24\%$).

Table IV: Summary of results

		n (%)	Mean (SD)
Mean Weight (kg)			
At start			100.64 (13.33)
At end			98.25 (13.01)
Loss			2.39 (5.51)
		t (df 110, n = 111) = 4.579, p = 0.000	
BMI (kg/m^2)			
At start	BMI 30.0 - 34.9	26 (23.4)	37.43 (3.34)
	BMI 35.0 - 39.9	66 (59.5)	
	BMI ≥ 40.0	19 (17.1)	
At end	BMI 25.0 - 29.9	3 (2.7)	36.55 (3.71)
	BMI 30.0 - 34.9	38 (34.2)	
	BMI 35.0 - 39.9	54 (48.6)	
	BMI ≥ 40.0	16 (14.4)	
		t (df 110, n = 111) = 4.624, p = 0.000	
Weight Outcome			
	Weight loss (kg)	72 (64.9)	
	< 12	70 (63.1)	
	≥ 12	5 (4.5)	
	Weight loss (%)		
	< 5	48 (43.2)	
	≥ 5	24 (21.6)	
	No weight lost	39 (35.1)	
Attendance			39.15 (16.005)
Attendance percentage			54.66 (22.195)

Legend: df = degree of freedom

Table V: Mean weight at start and end of programme of participants by gender and rank

		n	Mean weight [kg (SD)]		Paired t-test		
			At start	At end	t value	df	p value
Male	Officers / WO	6	115.0 (13.2)	110.0 (14.9)	1.234	5	0.272
	Sgt / SSgt	10	97.8 (4.1)	92.8 (6.7)	2.817	9	0.020
	Pvt / LCpl / Cpl	67	105.0 (12.2)	102.6 (12.4)	3.525	66	0.001
Female	Officers / WO	2	86.6 (5.5)	86.6 (6.0)	0.143	1	0.910
	Sgt / SSgt	9	85.5 (8.4)	82.4 (9.5)	2.223	8	0.057
	Pvt / LCpl / Cpl	17	89.7 (8.0)	89.9 (7.6)	-0.316	16	0.756

Legend: df = degree of freedom

WO = Warrant Officer. SSgt = Staff Sergeant. Sgt = Sergeant. Cpl = Corporal. LCpl = Lance Corporal. Pvt = Private.

Table VI: Association of weight loss with gender, medical board and rank

		Number of participants with weight loss	Number of participants with no weight loss	Pearson's chi square test		
				X^2	df	p value
Gender	Male	60	23	3.347	1	0.101
	Female	15	13			
Medical Board	On MB	19	13	1.377	1	0.268
	Not on MB	56	23			
Rank	Officers / WO	4	4	3.696	2	0.158
	Sgt / SSgt	16	3			
	Pvt / LCpl / Cpl	55	29			

Legend: MB = Medical Board. WO = Warrant Officer. SSgt = Staff Sergeant. Sgt = Sergeant. Cpl = Corporal. LCpl = Lance Corporal. Pvt = Private.

Table VII: Association between weight loss and attendance and starting weight

	Pearson's correlation coefficient		
	r value	p value	R^2
Attendance	0.235	0.013	5.5%
Starting weight	0.206	0.030	4.24%

Legend: r = linear correlation coefficient. R^2 = coefficient of determination

5. Discussion

POC, HPC and Counterweight Programmes

This research study found that 4.5% of the POC programme's participants achieved a modest target weight loss of 12 to 24 kg at the end of 6 months. Additionally, 21.6% participants achieved weight loss of ≥ 5% of their initial body weight, which is better when compared to the Counterweight Programme (10.2%) [8]. but not when compared to the HPC programme (55%) [11]. However, it should be appreciated that the HPC programme had a big drop out number of patients who had higher BMI than those who completed the programme. It can be deduced that a structured weight loss programme combining exercise and dietary advice, as used in both the HPC and POC programmes, will achieve more weight loss compared to the Counterweight Programme where participants received information on weight management and behaviour change strategies only.

Both the POC and HPC programmes are similar: 6 months programme of structured combination of exercise and lifestyle advice. However, this study shows that the POC weight loss programme is not as effective in achieving the target weight loss when compared to the HPC programme. One of the main differences between the POC and HPC programmes is that the HPC programme emphasises on sustainable behaviour change leading to weight loss. Future POC programmes should further emphasise the importance of behaviour change in achieving weight loss.

POC and Weight Watchers Programmes

The 3-month Weight Watchers programme which also aims for 0.5 - 1.0 kg weight loss a week, has been identified as one of the most successful commercial weight loss programmes [17]. The Weight Watchers programme is group-based, with one-to-one support for new members and during weigh in [17]. Regular 1-hour meetings

delivering programme material is conducted over five weeks [17]. After 3 months, there is a mean weight loss of 4.43 (SD 4.3) kg and a third of their participants had 5% reduction in body weight after 1 year, both higher than the results achieved in the POC programme [17]. The Weight Watchers programme proves that group support and knowledge on the food points system, beating hunger, taking more physical activity, eating out, and keeping motivated can lead to effective weight loss [17]. This highlights the importance of providing support, thus future POC programme should divide the participants into smaller groups, and similar support to that of Weight Watchers should be provided to the participants.

Attendance and weight loss

The POC participants did not attend all the sessions provided mainly due to work commitment. There was a significant positive correlation identified between attendance and weight loss ($r = 0.235$, $p = 0.013$, $R^2 = 5.5\%$) suggesting that a participant will lose more weight if they attended more regularly. Participants who are enrolled into the weight loss programme should be excused from their soldiering duties and attendance to the programme must be made mandatory.

Starting weight and weight loss

A participant who is heavier at the start is expected to lose more weight following the weight loss programme. Conversely, it is more difficult for "lighter" participants to lose weight and achieve the target weight loss as there is a significant positive correlation between the starting weight and the weight loss achieved by the participant ($r = 0.206$, $p = 0.03$, $R^2 = 4.24\%$). The lightest participant at the start of the programme (starting weight 73.1 kg) only lost 2.1 kg. As expected, the target weight loss was not met; however, she was successful in reducing her BMI from 33.4 to 32.4 kg/m^2. POC should give priority to participants who are found to be relatively heavier amongst the nominated list of eligible RBAF personnel to attend the programme, but "lighter" participants should not be ignored. Motivated and keen personnel who are heavier (with greater BMI) would be ideal participants to join the weight loss programme. As weight loss is achieved, their relative risk of developing health problems will be reduced and simultaneously, their physical fitness should improve to make them combat ready.

Medical Board and weight loss

There was no significant correlation found between medical board status and weight loss. This proves that being on medical board, and suffering from a chronic disease, does not affect the effectiveness of an individual to lose weight in the POC programme. It thus should not be reason to exclude obese personnel with chronic diseases from participating the programme.

Rank, gender and weight loss

The group of personnel that had the most difference in mean weight are the lower ranked, male personnel (from privates to staff sergeants). As mentioned before, personnel who do not meet the RBAF BMI requirement have negative impact on their careers in RBAF; affecting their appointments, promotion and extension of service. Lower ranks are probably more motivated to achieve weight loss and reach the RBAF BMI requirement in order to improve their career progression. However, there was no significant association found between rank and weight loss [X^2 (d.f 2, n 111) = 3.696, p 0.158] thus this link cannot be proven. Interestingly, this weight loss significance was not replicated in the female lower rank group. As mentioned, Donnelly et al [9]also found overweight and obese women were resistant to weight loss, when the men in that study had significant weight loss. This study shows that the weight loss in the women who participated in the POC programme was statistically insignificant [X^2 (d.f 1, n 111) = 3.347, p 0.101]. Research should be done to identify why women do not achieve as much weight loss as men when they undergo intensive exercise, simultaneously identifying factors affecting successful weight loss for women.

Physical fitness and body composition

Physical fitness are made of five components; cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition [18,19]. Physical fitness refers to a physiologic state where one is able to meet the needs of daily living or the basis for sport performance (or soldiering duties), or both [7]. Obesity is defined as an excess of body fat, and the accumulation of this excess fat is associated with ill- health [20]. Regular physical activity is also proven to improve body composition by reducing abdominal adiposity and improved weight control [21]. BMI alone is a weak and inaccurate measure of body composition [21]. Body composition looks at the ratio of the body's muscles, vital organs and fats [18,19]. Measurement of body fat is best done using underwater weighing equipment, however, skin fold test and electrical equipment are widely used [18.19]. Bioelectrical Impedance Analysis is the only method to measure body fat content that is simple, rapid and non-susceptible to operator variability [20]. The limitation of this study is that body composition of participants were not collected despite the availabilty of the TANITA Composition Analyzer, Type: BC-418 MA. The body fat percentages of the participants in this weight loss programme should have been collected, and analysed to determine whether the

weight loss programme leads to an improvement in body composition, affecting physical fitness, and indirectly impacting combat readiness.

Other factors and weight loss

One participant had a weight loss of 34.3 kg beyond the target weight of 12 to 24 kg. He was a male, private who initially weighed 115.1 kg with a BMI of 40.3 kg/m^2. It should be noted that he attended 75% of the sessions. The participant who was least successful in losing weight in this weight loss programme gained the most weight (8.3 kg). He was also a male, private with a starting weight of 95.2 kg with a BMI of 31.8 kg/m^2. He attended 80.6% of the sessions. The reasons why this participant failed to lose weight should be assessed, so as not to assume that the POC weight loss programme was a failure.

Although attendance has a positive correlation with weight loss, comparing the two personnel mentioned above, it reiterates a known fact that exercise on its own will not necessarily lead to weight loss. RBAF must appreciate that enrolling an obese or overweight personnel into the weight loss programme will not guarantee weight loss. The participants need to be empowered to take responsibility of their own weight. The main behaviour goals in achieving weight loss are to increase physical activity and modify eating habits to reduce caloric intake [22]. A person's determination and drive to lose weight play a very important role in losing weight [23]. Ideally, participants of the programme must volunteer to join the programme, be motivated and keen to lose weight. After completion of the programme, they must continue with the healthy lifestyle to be able to maintain their weight loss.

It would be in the best interest of RBAF to allow as many of their obese personnel, or personnel who failed the RBAF BMI, to enroll into a weight loss programme. Obese RBAF personnel who are motivated to lose weight and live a healthier lifestyle should be encouraged to participate in the POC programme. It should be clearly pointed out that participants of subsequent weight loss programmes must be allowed and accommodated for to attend the daily sessions.

Participants who lost weight at the end of the weight loss programme should be assessed in a follow-up to assess whether they maintained their weight loss after 1 year, signifying long-term weight loss. Maintaining the weight loss in the personnel would reduce the negative impact on their promotions, appointments, training opportunities and service extension, hence improving their careers.

POC might not be the best entity to follow-up on all participants after the completion of the programme, so it is imperative that the different units play a more involved role. Regular follow-up, perhaps every three months, should be done where continuous support in motivating participants to lose or maintain weight loss ensuring that participants have not gained more weight. Participants who have completed the POC programme can also be made into ambassadors in their own units, where they can share their experience with other obese personnel, and motivate personnel within their units to start a healthier lifestyle.

Further research assessing the different factors affecting weight loss should be done. The 21.6% participants who had ≥ 5% weight loss should be assessed to determine the factors that led to their success in weight loss. This may include analysis of participants' psyche, personal habits and beliefs about weight loss. Identified reproducible positive factors should then be incorporated in subsequent programmes, enhancing the success rate in achieving weight loss. Similar studies can also be done on participants who did not lose weight at the end of weight loss programme. This would help identify factors that hinder weight loss, and as such needs to be addressed.

Feedback from all the participants must be sought to identify what they found helpful in the POC programme, and what they think can be improved on. If applicable, these changes should be made to the next POC programme. Table VIII represents a summary of recommendations for future POC programmes.

6. Conclusion

RBAF needs to continue combatting the overweight and obesity problem to avoid direct and indirect financial burden on the organisation and ensuring that the number of personnel who are combat ready is always high. POC's weight loss programme has the potential to further improve their results and the programme should be used as a stepping-stone in catapulting an individual to live a healthier lifestyle. A healthy, physically fit individual with a normal BMI and healthy body composition will have a higher self-esteem [24]. and will portray the image that is expected of a fit soldier.

Table VIII: Summary on recommendations for future POC weight loss programme

1.	Emphasise the importance of behaviour change in achieving weight loss.
2.	Divide participants into groups to be able to replicate the Weight Watchers support and group discussions.
3.	Attendance to the POC programme should be made mandatory, and participants must be excused from soldiering duties.
4.	Personnel who are motivated and "heavier" should be given priority to join the POC programme, as they are more likely to lose more weight.
5.	Body composition of participants using Bioelectrical Impedance Analysis needs to be measured, to identify the association between body composition and weight loss.
6.	Participants to perform measurable physical fitness activities example timed run 2.4km, push-ups and sit-ups in 1 min at the start and end of POC programme. This will allow the identification of the relationship between physical fitness and body weight.
7.	After the completion of the POC programme, regular follow-up in participants is required to monitor whether participants have maintained weight loss. This could be done by the different units instead of POC.
8.	Participants can be made into ambassadors in their unit, to share their experience and motivate other personnel within their unit to live a healthier lifestyle.
9.	Analysis including psychological, personal habits and beliefs about weight loss should be done on participants who had achieved target weight loss or > 5% weight loss.

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INFLUENCE OF GENDER ON FUNCTIONAL MOVEMENT SCREEN (FMS) VALUES IN OFFICER CADET CANDIDATES

About the Author

Authors: Lt Amalina A'liah Hj Gapor, Alisa Lau, Cpt Dk Dr Nurhayatul Filzah Pg Damit, Michelle Charlene Basir, Dr Noreffendy Ali, Performance Optimisation Centre (POC)

The main author, Lt Amalina A'liah, is a research officer from Human Performance Lab, Performance Optimisation Centre (POC), Ministry of Defence. The author has a Bachelors Degree in Sports Science, majoring in Sports Management from the University of Malaya, Malaysia and has been working as a research officer in POC since 2019. The author is interested in doing research on human performance and sports management especially those related to military and other uniform personnel in order to enhance soldiers' performance in the Royal Brunei Armed Forces (RBAF).

ABSTRACT

In the Royal Brunei Armed Forces (RBAF), officer cadets, regardless of gender, undergo the same type, intensity and frequency of training throughout their officer cadet course. Previous studies have suggested that female cadets have a higher risk of musculoskeletal injury compared to male cadets during training. The Functional Movement Screen (FMS) is an assessment designed to identify individuals with biomechanical deficiencies and compromised movement patterns that may put them at risk of injury. Therefore, the aim of this study is to assess the differences in gender with regards to their movement competencies for officer cadet candidates using FMS assessment.

Method 61 male candidates (age: 25±1.48, height: 1.7±0.05m, weight: 64.5±7.24kg) and 22 female candidates (age: 26±1.14, height: 1.57±0.04m, weight: 55.3±6.03kg) from the 18th Intake of the RBAF Officer Cadet School participated in this study and were assessed using the seven stations of FMS.

Results The results indicated the lack of significant difference between genders in total FMS scores (male=15±1.77, female=16±1.87, $p=0.36$). However, significant differences in FMS average score were observed between genders for individual stations such as inline lunge (male=2.1, female=2.4, $p=0.033$), shoulder mobility (male=2.3, female=2.8, $p<0.001$), active straight leg raise (male=2.1, female=2.4, $p=0.033$), and trunk stability push up (male=2.8, female=2, $p<0.001$).

Conclusions About 16% of the entire intake had general movement incompetency, which may put them at a high risk of musculoskeletal injury. Male candidates were observed to have poorer flexibility while female candidates were weaker in strength. Thus, this study suggests the need for training planners to include corrective exercises focusing on these targeted areas in order to reduce the risk of musculoskeletal injury during their training programme. Furthermore, FMS can potentially be part of a screening tool to assess the risk of injury not only for potential officer cadets but also for other Royal Brunei Armed Forces (RBAF) personnel.

1. Introduction

Basic Military Training (BMT) for any military organisation is a training designed to transition a civilian into a trained soldier that is equipped with basic military skills and a well-developed physical fitness capacity. Due to its high intensity and frequency of training, it increases the risk of physical stress, musculoskeletal injury and excessive stress syndrome [1]. One previous study has observed an increase in number of injuries during BMT due to a few risk factors such as unfamiliar environment, and its physical and mental demand on the soldier so as to excel during training [2]. Lower body injury such as the knee, lower leg and ankle accounted for 80% of the injuries during BMT [3].

Similar to other military organisations, officer cadets in Brunei, regardless of gender, undergo the same type, intensity and frequency of training throughout their 52-weeks course. Data from studies suggest that female cadets have a higher risk of injury which resulted in time loss during training as compared to male cadets [4]. Majority of these injuries are in the lower body, such as lower back, knee, shin, ankle and foot [4, 5].

The Functional Movement Screen (FMS) is an assessment screening designed to identify individuals with biomechanical deficiencies and compromised movement patterns that may put them at risk of injury [6]. It is also used to improve movement of the participants by identifying the movement deficits whilst performing the assigned stations. With limited fundamental movement, individuals tend to compensate in order to achieve or maintain the level of performance needed for the activity. FMS is not only used in the athletic population, but it has also been used for uniformed personnel such as military personnel including officer candidates, police officers and firefighters [7].

Therefore, the aim of this study is to assess the differences in the movement competencies for RBAF Officer Cadet School (OCS) candidates across both genders using FMS prior to their training.

2. Method

Participants

61 male candidates and 22 female candidates were recruited from the 18th intake of the RBAF OCS.

Criteria	Male	Female
Number of Candidates	61	22
Average Age	25±1.48years	26±1.14years
Average Height	1.70±0.05m	1.57±0.04m
Average Body mass	64.5±7.24kg	55.3±6.03kg

Functional Movement Screen (FMS) Assessment

FMS assessment comprises of seven stations that can be scored on 0-3 scale. The seven stations were; 1) deep squat; 2) hurdle step; 3) inline lunge; 4) shoulder mobility; 5) active straight leg raise; 6) trunk stability push up; and 7) rotary stability [8].

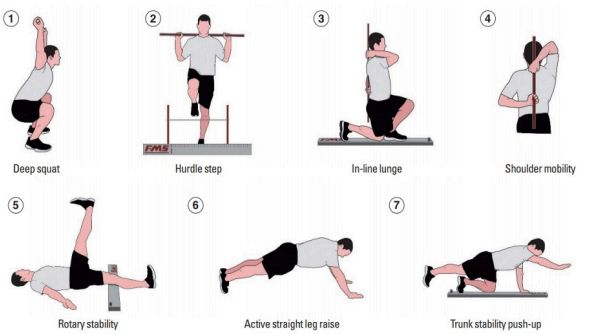

Figure 1: *The Seven FMS Test Stations*

A score of 3 indicates that participants completed the movement as instructed and free of compensation. A score of 2 indicates the participants completed the movement with the help of compensation. A score of 1 indicates the participants could not complete the movement as instructed; and a score of 0 will be given to participants who experience pain whilst doing the prescribed movement. Participants can obtain a maximum score of 21. A total score of less than 14 may indicate a higher risk of injury due to their poor movement patterns. However, this score cannot be used solely to predict the overall risk of injury as other factors may contribute to injury risk and occurrence.

Scoring criteria for FMS are as stated below:

Score	Criteria
3	Complete movement without any compensation
2	Perform movement with compensation
1	Unable to perform movement
0	Pain with perform movement

Table 1: FMS Scoring Criteria

Statistical Analysis

A two-sample t-test and chi-square test were used to analyse the differences of scores between gender using Microsoft Excel. Significance was set at $p<0.05$.

3. Results

The total score for FMS is shown in Figure 2 and Table 2. The results indicate that there was no significant difference between gender seen with regards to average total FMS score (male=15±1.77, female=16±1.87, p=0.36). The majority of candidates scored between 14 and 16 (63.1%, male=39, female=14) while 13 candidates scored less than 14 (15.7%, male=11, female=2).

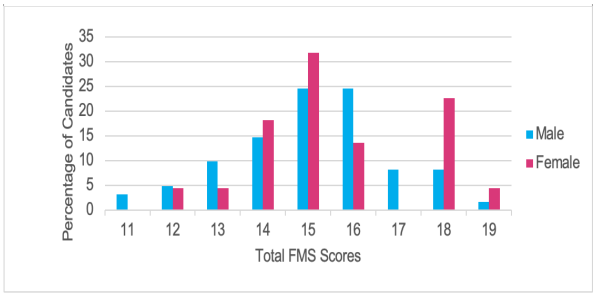

Figure 2: Total FMS Score in Percentage by Gender

Total FMS scores of below 14 indicates that officer cadet candidates were at higher risk of injury during their training. No significant difference seen between gender with regards to indicator of high risk of injury was observed, as shown in Table 2. However, the percentage of candidates that with total FMS scores below 14 is seen to be higher in male candidates with 18% as compare to their female counterparts.

Total FMS Score	Male	Female	p<0.05
<14	12.364	12.5	0.828642669
≥14	15.7	15.9	0.589627654

Table 2: Average total FMS score for below and above 14

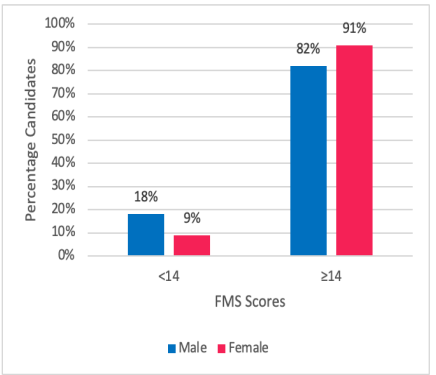

Figure 3: Total FMS Scores below and above 14 in Percentage by Gender

The average FMS score between gender has shown significant differences in inline lunge (male=2.1, female=2.4, p=0.033); shoulder mobility (male=2.3, female=2.8, p<0.001); active straight leg raised (male=2.1, female=2.4, p=0.033); and trunk stability push up (male=2.8, female=2, p<0.001). The results are illustrated in Figure 4.

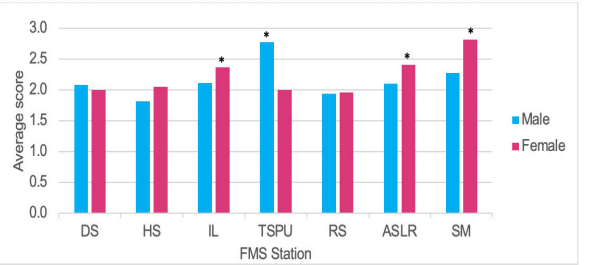

Figure 4: Average FMS Score for Each Test Station by Gender (*represents statistical significance, where p-value < 0.05)

Stations	Male	Female	p<0.05
Deep Squat	2.082	2.000	0.6993789
Hurdle Step	1.820	2.045	0.1394482
Inline Lunge	2.115	2.364	0.03323278*
Trunk Stability Push Up	2.770	2.000	0.00048931*
Rotary Stability	1.934	1.955	0.03253844
Active Straight Leg Raise	2.098	2.409	0.000327277*
Shoulder Mobility	2.279	2.818	0.73764603*

Table 3: Average FMS Score (*represents statistical significance, where p-value < 0.05)

4. Discussion

The results showed significant differences in inline lunge, shoulder mobility, active straight leg raise and trunk stability push up. Males scored higher in physical strength whereas female scored higher in flexibility-based stations [9]. These findings are consistent with previous studies on gender differences in the military with regards to musculoskeletal, biomechanical and physiological characteristics [10]. No significant difference in balance and motor control for both genders was observed.

There were also no significant differences seen between gender in total FMS score (<14 and ≥14) as shown in Figure 3. However, the percentage of male candidates who scored a total FMS score of <14 is higher (18%) than in female (9%). Candidates who obtained a total score of less than 14 and scored zero or one in individual FMS test stations may indicate a higher risk of injury during military training. Muscular strength, endurance, flexibility and motor control may influence the risk of injury during military training.

This study suggests the need for planners to include corrective exercises in their training programme focusing on improving flexibility, especially for male candidates, and strength training, especially for female candidates in order

to reduce the risk of musculoskeletal injury [11]. Correcting muscular asymmetry should also be a priority as it is also considered a high risk factor for injury during intensive training.

Gender-specific interventions may be useful in improving such biomechanical deficiencies detected from the FMS assessment and in optimising the cadets' physical fitness and readiness as well as in reducing the risk of injury during such gender-neutral training [10]. However, due to the nature of the school, the training should still be holistic and encompass all the fitness components required for basic military training with more focus on specific biomechanical deficiencies and compromised movement patterns so as to reduce their risk of musculoskeletal injury and enhance overall soldiers' readiness.

Future studies in similar settings are recommended not to be restricted to FMS but to also include tests for agility and aerobic capacity as well as collect data such as medical history and smoking habits so as to make the screening process more complete.

FMS can potentially be part of a screening tool to assess the risk of injury not only for potential officer cadets but also for other RBAF personnel.

5. Conclusion

Although no significant difference was observed in the FMS total score across both genders, certain FMS stations resulted in significant differences. Male officer cadet candidates were found to be less flexible as compared to their female counterparts. However, female candidates were weaker in terms of strength. Hence, gender-specific interventions may be useful in their training programmes. Corrective exercise programmes should also be introduced so as to make the training program more holistic as well as to reduce injuries and time loss during training, subsequently affecting their readiness as a whole.

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ADVISORS

Brigadier General (Retired) Dato Seri Pahlawan Shahril Anwar bin Haji Ma'awiah
Permanent Secretary, Ministry of Defence

Pg Dr Haji Mohd Esa Al-Islam bin Pg Hj Md Yunus
Deputy Permanent Secretary (Development and Maintenance), Ministry of Defence

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