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EDITORIAL ADDRESS

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EDITORIAL

ORIGINAL ARTICLE

LETTER TO THE EDITOR

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Travel medicine: Travelling to space and the reality on the ground

Lokman Hakim Sulaiman

The tourism industry has been among the hardest hit global industry and most damaged by the COVID-19 pandemic causing an estimated loss of about 2.89 trillion US dollars.[1] Nevertheless, there are already signs of recovery. The United Nations World Tourism Organisation (UNWTO) reported that international tourism experienced a 4% increase in 2021 although the international arrivals were still 72% below the pre-pandemic year of 2019. According to the latest UNWTO Panel of Experts, most tourism professionals (61%) see better prospects for 2022 but the majority of experts (64%) now expect international arrivals to return to 2019 levels only in 2024 or later (www.unwto.org).

Malaysians just love to travel. Before the pandemic, R Hirschman in his report on the number of outbound trips dated 9 August 2019 (www.statista.com), estimated that 11.9 million outbound trips were made by Malaysians in 2016. He continued by stating that Malaysians love to travel, and despite a sluggish economy and weak currency compared to the US dollar, the number of outbound travellers from Malaysia is increasing. This appears to be supported by Malaysian government statistics. According to the Department of Statistics Malaysia Official Portal (accessed on March 24, 2022), before the pandemic, the outbound tourism expenditure by Malaysians showed a steady increase from RM31.1 billion in 2015 to RM44.8 billion in 2019. Fauziah Ismail in her article published on January 9, 2019 in the New Straits Times, also supported the contention that Malaysians just love to travel, despite complaining about rising prices of essential items in the country and the plummeting Ringgit value against most major world currencies. Cheap air travel with innovative business strategies and attractive taglines such as "Now everyone can fly" by AirAsia, the low-cost air carrier, greatly facilitate this love to travel.

Leisure travel trips are planned for the purpose of recreation, entertainment, and relaxation. And all these can only be achieved when you travel in good health. Good health does not necessarily mean healthy with no disease or ailment. Individuals with chronic diseases such as diabetes, hypertension and even cancer can still achieve reasonably good health to enjoy travelling. To enjoy the trip, the traveller must also understand and appreciate the risk to their health and safety associated with the travel. This is where travel medicine has an important role to play in ensuring travellers achieve the purpose of their travel.

Travel medicine is practised by family physicians, specialised travel clinics or vaccination centres. It is an interdisciplinary field involving travel related fields of epidemiology, disease prevention, and self-treatment. The primary goal is to keep travellers alive and healthy through minimising the impact of illness and accident through preventive measures and self-treatment.[2] Travelers need to appreciate the risk to their health and well-being throughout the travel and the travel medicine practitioner's role is to help guide their patient/client to understand and manage those risks.

Traditionally, the mainstay of travel medicine includes the following[2]:

- Information, mainly of the 3 Fs, with the goal of behaviour modification – Food/beverage, Flies/mosquitoes, and Flirtation/unprotected sex.
- Immunisation by required and recommended vaccines, for example many countries have regulated mandatory entry requirement for yellow fever vaccination.
- Chemoprophylaxis, especially the risk against malaria, and
- Self-treatment especially for traveller's diarrhoea.

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Now, with non-communicable diseases (NCD) being so prevalent, the scope of travel medicine has also expanded beyond the traditional "tropical medicine". There is a growing appreciation of the NCD and injury burden in travellers. In a study among last minute travellers, a large proportion of them were found to have pre-existing medical conditions especially NCD.[3] Inadequate assessment of their NCD status may put them at higher risk of ill health during their travel, thus compromising the goals of the travel itself.

People are now talking about space travel. Gerard Flaherty has written a letter to the editor about that in this issue of the IeJMSE[4] but where are we with regards to travel medicine and travellers' health in Malaysia and in this region? The fact is that there is very limited literature about the subject in this country. And the little that is published revealed the poor state of knowledge, attitude, and practice about this discipline. In one study among 316 outbound travellers at Malaysian international airports, only 40.5% sought pre-travel advice and of these, only 12.5% sought it from physicians. The rest were from friends (39.8%) and the internet (36.2%).[5] Another study showed a much lower proportion (36.8%) who sought pre-travel health advice but this time mostly (64.7%) from their doctor. It also revealed a risk-taking behaviour – 40% were uninsured and 50% do not know how to access medical care when overseas.[6] Another study among community pharmacists to understand their role in the provision of travel medicine advice revealed other interesting findings. Most respondents (82%) were not trained in travel medicine and graduates from foreign universities possessed significantly higher knowledge score than the locally trained graduates.[7] It may not be surprising since travel medicine is generally not incorporated into the curriculum, both for medicine and pharmacy courses in this country.

The need for travel medicine services in the country is huge if measured by the number of outbound travellers. However, awareness about the need, both among the client and service provider, is very much lacking. Access to travel medicine education at primary care level is also very limited. Thus, the efforts of the International Medical University and National University of Ireland, Galway to organise the world's first holistic Massive Open Online Course (MOOC) in travel medicine for the undergraduates, which was piloted before the pandemic in 2019, is an effort to address this gap.[8]

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A structured lifestyle intervention combined with mobile health application to reduce chronic disease risk among employees at a university workplace

Ching Li Lee, Harvinder Kaur, Gilcharan Singh, Winnie Siew Swee Chee

Abstract

Introduction: This pilot study assessed the impact of a structured lifestyle intervention combined with mobile health application on chronic disease risk in a healthcare-based university.

Methods: A total of 24 overweight/obese university employees participated in a 12-week intervention that included group nutrition education and exercise sessions, a structured low-calorie meal plan, meal replacements, and a mobile health application.

Results: A pre- and post-intervention analysis showed that the participants had weight loss ($p < 0.001$), a reduction in blood triglyceride ($p = 0.010$), and a reduction in systolic blood pressure ($p < 0.001$). There was an increase in the proportion of participants who achieved their clinical targets for systolic blood pressure from 16.7% at baseline to 58.3% after the intervention ($p = 0.004$). A focus group discussion demonstrated good acceptability of the intervention that was driven by the use of practical nutrition knowledge gained from the group education sessions and structured meal plans, and timely feedback on eating behaviour from use of the mobile heath application.

Conclusion: A structured lifestyle intervention combined with mobile health application supports significant clinical improvements including weight loss and reductions in blood triglyceride and blood pressure.

Keywords: *Chronic diesease, Mobile health, Obesity, Structured lifestyle intervention, Workplace wellness*

Introduction

Globally, the greatest cumulative impact on health are metabolic risks driven by high Body Mass Index (BMI), blood sugar, blood pressure, and cholesterol.[1] In the Malaysian workforce, the prevalence of adults living with either high blood sugar, blood pressure or cholesterol range from 12.7% to 42.9%.[2] This population also follows an unhealthy diet, a behavior that propels the progression of these chronic conditions.[2]

The workplace is a priority setting for health promotion.[3] Well-designed and well-executed workplace wellness programs can improve health scores, generate cost savings, and retard the growth in total medical expenditures of workplaces.[3,4] Nonetheless, the key issues when implementing a workplace wellness program include engagement of stakeholders, employee participation, judicious use of resources, and the effects of the program on clinical outcomes.[5-7] A promising solution to this conundrum is the use of multi-disciplinary collaboration to incorporate lifestyle interventions tailored to individual behaviour within a workplace wellness program.[8-10] Mobile health applications can also be used to improve employee participation in workplace wellness programs. However, this strategy has been limited to self-monitoring activities, with a decline in technology use and engagement observed over time.[11,12] Addressing antecedents such as perceived usefulness, ease of use, enjoyment, and cues to action when designing the application, can increase motivation to use mobile health applications.[13]

Existing workplace wellness programs in Malaysia do not offer a combination of a lifestyle intervention and mobile health application. Hence, this pilot study assessed the impact of a 12-week structured lifestyle intervention combined with a mobile health application with a function that cues self-monitoring of behaviour, on chronic disease risk in a healthcare-based university.

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Methods

Study design

This study utilised a pre- and post-test design whereby the participants were measured at baseline and at the end of a 12-week workplace wellness program – IMUHEALxNaluri. The IMUHEALxNaluri is a structured lifestyle intervention program designed to manage chronic disease risk. This program incorporated the use of group education sessions, structured meal plan, meal replacements, and a mobile health application.

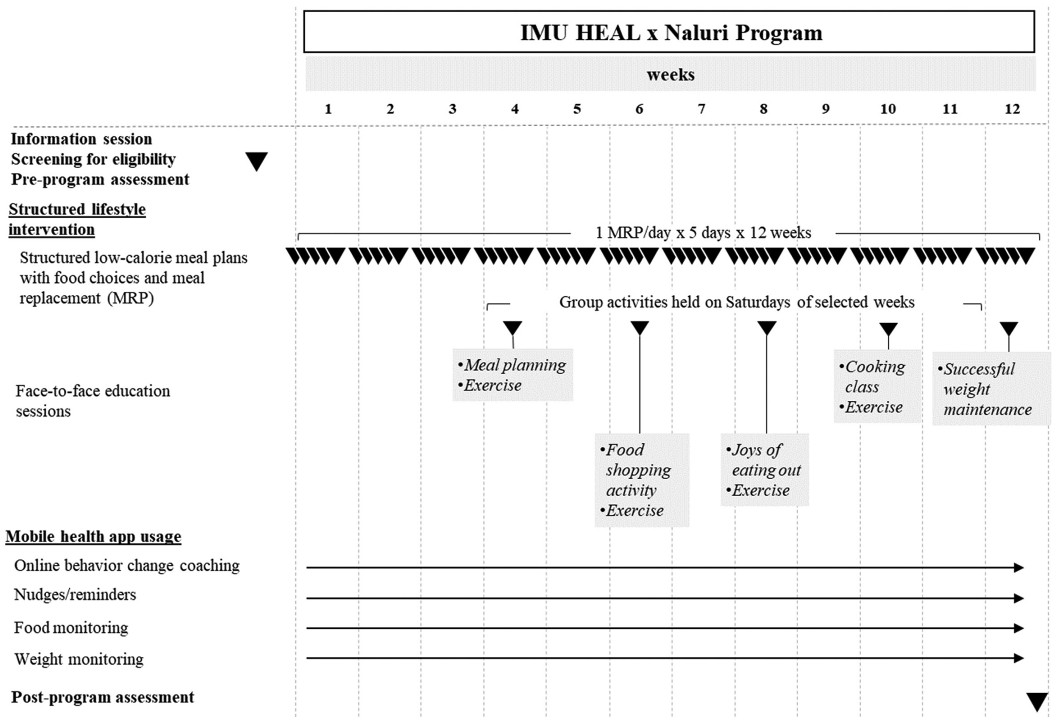
Participants

Employees of the International Medical University (IMU) in Kuala Lumpur, Malaysia were invited to participate in IMUHEALxNaluri through email and during a health screening event. A minimum of 30 participants were targetted for this pilot study to detect weight change at a moderate to large effect size.[14] Subsequently, the interested employees were screened for eligibility. A health assessment identified participant eligibility based on presence of overweight and obesity at BMI > 23 kg/m^2 due to higher risk of chronic diseases at BMIs lower than 25kg/m^2 in the Asian population.[15] The exclusion criteria were pregnancy and lactation. Approval to conduct the study was given by the ethics committee of IMU (Project number: R454/2019). Informed consent was obtained using a mobile health application.

Intervention

Five group nutrition education sessions led by dietitians were held once every two weeks. The group nutrition education sessions were complemented with group exercise sessions lasting between 30 to 45 minutes each. A structured meal plan was provided at baseline to keep daily calorie intake within 1200 - 1500 kcal. The meal plan was an illustrated booklet containing 155 Asian food and beverage choices that were color-coded for calorie, fat, sugar and salt content. The use of meal replacements was available as a portion control strategy. Figure I shows the components of the IMUHEALxNaluri program.

Figure I: Components of the IMUHEALxNaluri workplace wellness program



Throughout the study, the participants used a mobile health application based on cognitive behavior therapy and motivational interviewing approaches to support behavior change. Nudges were sent from the mobile application to encourage the participants to self-monitor their diet and weight. The participants uploaded photographs of their food intake for feedback from a dietitian via the application. The participants also weighed themselves at home using a digital weighing scale that was connected to the mobile application. After the 12-week intervention, the participants were given the option to attend individual consultations with a dietitian at the IMU Healthcare Clinic to support weight maintenance.

Data collection and processing

The outcomes of interest were collected at baseline and at the end of the 12-week intervention. Sociodemographic information and medical history – including self-reported presence of obesity related co-morbidities, were assessed using a questionnaire. Standing body weight and height was measured using a digital weighing scale with an attached rod (Tanita WB-800H). BMI was calculated as a ratio of the measured body weight to height. Venous blood samples were analyzed for HbA1c and lipid profile using a fully automated analyzer at a commercial diagnostics laboratory (Roche Cobas® 8000). Blood pressure was measured with a fully automated blood pressure monitor (Omron HEM-907, Omron, Japan). Depression, anxiety, and stress levels were measured using the Depression, Anxiety and Stress Scale (DASS-21) that was embedded in the mobile health application. The proportion of participants achieving clinically significant improvement was defined for each risk factor based on the following targets: HbA1c < 5.6%; Total cholesterol ≤ 5.2 mmol/L; LDL-cholesterol < 3.0 mmol/L; HDL-cholesterol ≥ 1.0 mmol/L for men and ≥ 1.2 mmol/L for women; Triglyceride ≤ 1.7 mmol/L; Systolic blood pressure < 120 mmHg; and Diastolic blood pressure < 80 mmHg.

Employee participation was assessed using an attendance log captured at the start of each group education session. The participants also provided self-reported frequencies of meal-replacement and mobile application use at the end of the intervention. Additionally, three focus group discussions were conducted at the end of the intervention to explore relevance and acceptability of the intervention. Each focus group met once. The 30 – 45 minute discussions were facilitated by two researchers who used a discussion guide. The discussion guide covered five areas: difference between current and previous lifestyle change attempts; strategies for lifestyle change learned from the intervention; successes and difficulties faced during the intervention; and lifestyle changes made because of the intervention. Each discussion was audio-recorded, transcribed verbatim, and coded for thematic analysis.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 23.0). Body weight, HbA1c, lipid profile, blood pressure, and mental health status scores (depression, anxiety, and stress) were analysed on a pre- and post-intervention basis using the Wilcoxon signed-rank test and effect size calculated using strength of association, r[16]. The proportion of participants who achieved their clinical targets were analyzed using the exact McNemar's test. Further analysis was conducted by segregating the data into upper and lower 50th percentiles of weight change to determine if changes in HbA1c, lipid profile, blood pressure, and mental health status scores might result from weight change. The difference in health changes between the upper and lower 50th percentiles of weight change were analyzed using the Mann-Whitney test. Statistical significance was set at $p < 0.05$.

Results

Of the 30 adults who provided consent, a total of 24 participants completed the program (Figure II). The study participants had a median (IQR) age of 35.5 (9.0) years, and more than half were women and of the Malay ethnic background. Using Asian-specific BMI thresholds, 87.5% of the participants (n = 21) had obesity or a BMI > 27. Baseline characteristic in the upper and lower 50^{th} percentiles of weight loss was evenly distributed with respect to age. The median body weight and BMI were higher in the upper versus lower 50^{th} percentile of weight loss. When compared to the lower 50^{th} percentile of weight loss, the upper 50^{th} percentile of weight loss had more participants who were men, Malay, and with diabetes and hypertension (Table I).

Figure II: Flow of participants through the program

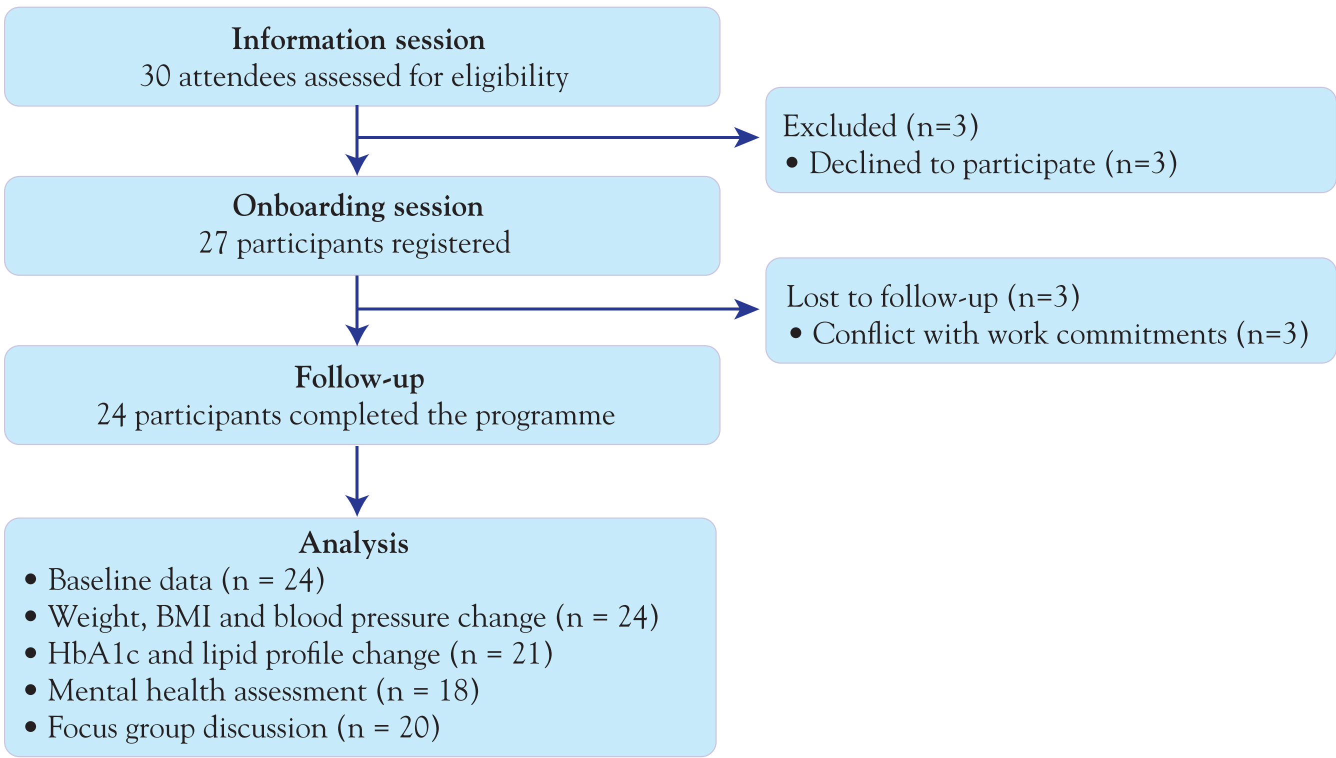


Table I: Baseline characteristics of the study participants (N=24)

Characteristics	Upper 50th Percentile -10.7kg to -2.4kg (n=12)	Lower 50th Percentile -2.4kg to +1.9kg (n=12)	Total (N=24)
Age (years) †	35.5 (8.0)	35.5 (12.0)	35.5 (9.0)
Gender‡			
Men	5 (41.7)	3 (25.0)	8 (33.3)
Women	7 (58.3)	9 (75.0)	16 (66.7)
Ethnicity‡			
Malay	9 (75.0)	6 (50.0)	15 (62.5)
Chinese	1 (8.3)	2 (16.7)	3 (12.5)
Indian	2 (16.7)	4 (33.3)	6 (25.0)
Weight (kg)†	84.2 (17.2)	73.0 (27.5)	79.4 (21.0)
BMI (kg/m^2)†	31.6 (8.0)	30.1 (5.1)	31.2 (6.8)
Presence of co-morbidities ‡			
Diabetes	2 (16.7)	1 (8.3)	3 (12.5)
Hypercholesterolaemia	3 (25.0)	3 (25.0)	6 (25.0)
Hypertension	7 (58.3)	3 (25.0)	10 (41.7)

† Data for age, weight and BMI are median (IQR)s

‡ Data for gender, ethnicity, and presence of obesity related co-morbidities are n (%)

Pre- and post-program health outcomes

Participating in the wellness program elicited a statistically significant difference in body weight ($p < 0.001$) and BMI ($p < 0.001$) (Table II). Median (IQR) body weight decreased from 79.4 (21.0) kg to 74.3 (20.3) kg, while median (IQR) BMI decreased from 31.2 (6.8) kg/m^2 to 30.4 (6.8) kg/m^2, after 12-weeks of intervention. The differences seen in weight and BMI were of a large effect size.

Of the participants who completed the intervention, three were excluded from analysis of HbA1c and lipid profile because of failure to find an appropriate vein for the blood collection. After the wellness program, the participants had a statistically significant increase in HbA1c ($p = 0.011$), but the increase was not clinically relevant. The intervention also produced an increase in LDL-cholesterol ($p = 0.001$) and HDL-cholesterol ($p = 0.017$), and a decrease in blood triglycerides ($p = 0.010$). Participating in the wellness program produced a statistically significant difference in systolic blood pressure ($p < 0.001$) with a median (IQR) systolic blood pressure that dropped from 131.5 (19.0) mmHg to 117.5 (25.3) mmHg. The difference seen in blood pressure before and after the intervention was of a large effect size. An exact McNemar's test showed a statistically significant increase in the proportion of participants who achieved their clinical targets for systolic blood pressure from 16.7% (n = 4) at baseline to 58.3% (n = 14) after the wellness program ($p = 0.004$).

Of the participants who completed the intervention, six participants did not complete the mental health assessment as the application did not fully load on their smartphones. Median (IQR) depression, anxiety and stress scores decreased after the wellness program, but this trend was not statistically significant.

Table II: Body weight status, glycaemic control, lipid profile, blood pressure and mental health status before and after the intervention

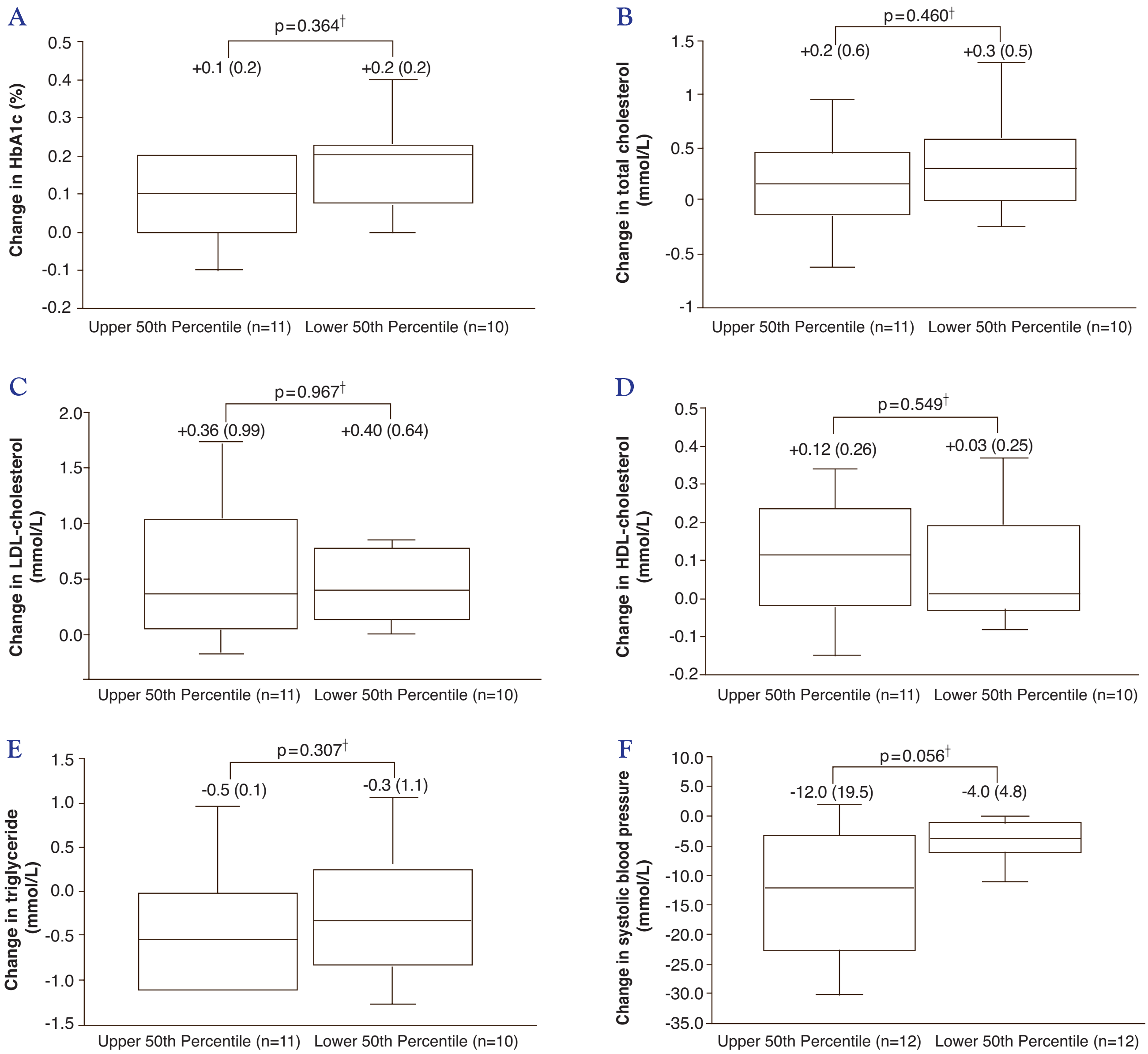
Study outcomes	Baseline	12-weeks	Effect size (r)	p-value
Body weight status† (n=24)				
Weight (kg)**	79.4 (21.0)	74.3 (20.3)	0.56	< 0.001±
Body Mass Index (kg/m^2)**	31.2 (6.8)	30.4 (6.8)	0.51	< 0.001±
Glycaemic control† (n=21)				
HbA1c (%)*	5.4 (0.5)	5.5 (0.5)	0.39	0.011±
Lipid profile† (n=21)				
Total cholesterol (mmol/L)**	4.8 (1.0)	5.1 (1.1)	0.41	0.009±
LDL-cholesterol (mmol/L)**	2.58 (0.80)	2.97 (1.1)	0.53	0.001±
HDL-cholesterol (mmol/L)*	1.17 (0.39)	1.25 (0.47)	0.37	0.017±
Triglycerides (mmol/L)*	2.1 (1.6)	1.7 (1.5)	0.40	0.010±
Blood pressure† (n=24)				
Systolic blood pressure (mmHg)**	131.5 (19.0)	117.5 (25.3)	0.52	< 0.001±
Diastolic blood pressure (mmHg)	84.5 (15.8)	78.5 (16.8)	0.11	0.466±
Mental health status† (n=18)				
Depression score (points)	4.0 (7.0)	2.0 (5.0)	0.26	0.104±
Anxiety score (points)	5.0 (7.0)	4.0 (6.0)	0.26	0.096±
Stress score (points)	9.0 (10.0)	7.0 (11.0)	0.29	0.065±

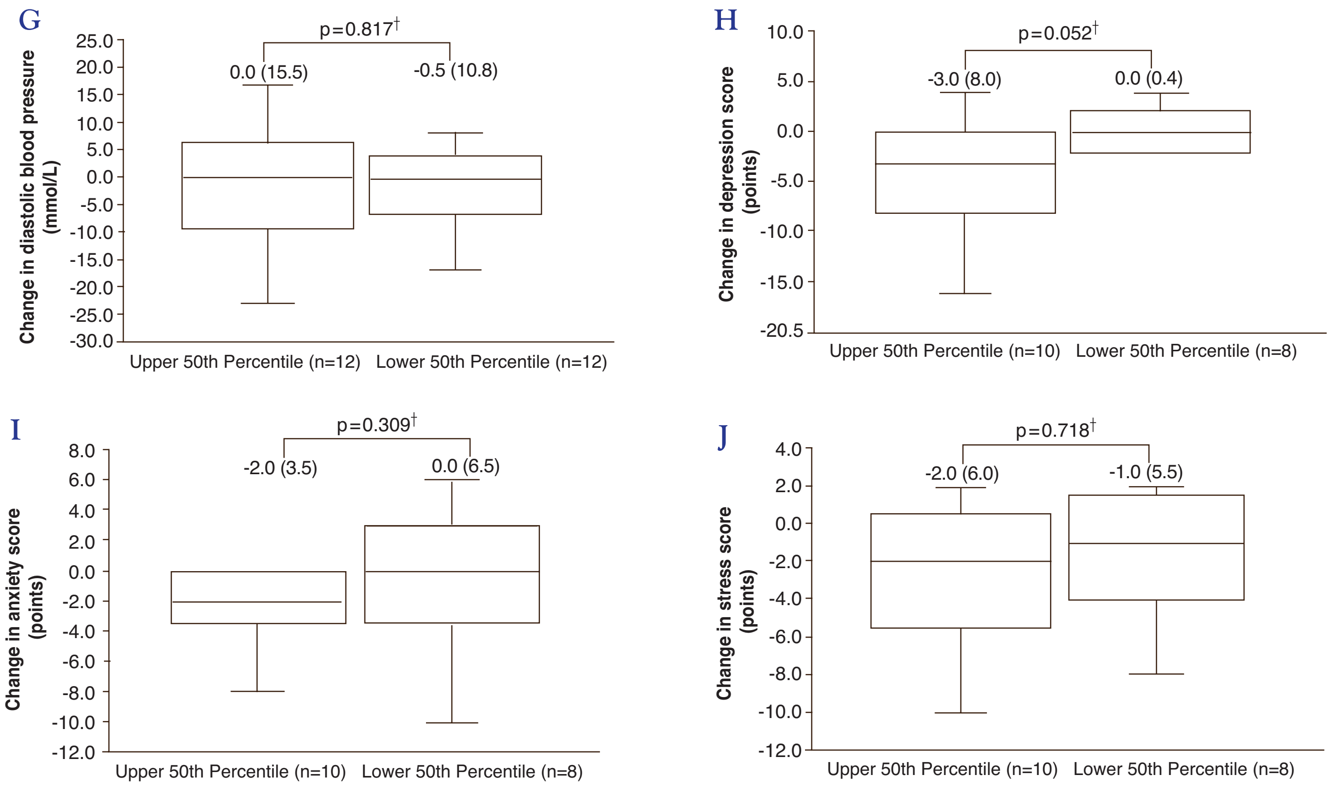
† Data for body weight status, HbA1c, lipid profile, blood pressure, and mental health status are median (IQR)s
± Wilcoxon signed-rank test
** Statistically significant difference between pre- and post-test results at the level of p<0.05*
*** Statistically significant difference between pre- and post-test results at the level of p<0.01*

Health outcomes by weight change percentiles

When segregated into upper and lower 50th percentiles of weight change, the median (IQR) change from baseline in body weight was -4.2 (2.4) kg in the upper 50th percentile and -1.3 (2.0) kg in the lower 50th percentile. A Mann-Whitney test showed that the changes in health outcomes were not associated with the degree of weight loss (Figure III).

Figure III: Changes in glycaemic control, lipid profile, blood pressure and mental health status by weight change percentiles.





The box represents the median (IQR), the upper and lower whiskers indicate the minimum and maximum value (outliers are not shown). † = Mann-Whitney test, A = HbA1c, B = total cholesterol, C = LDL-cholesterol, D = HDL-cholesterol, E = Triglyceride, F= Systolic blood pressure, G = Diastolic blood pressure, H = depression score, I = anxiety score, J = stress score

Employee participation

Nearly all the participants (87.5%) attended at least three out of the five group education sessions (Table III). A total of 16 participants self-reported their frequencies of meal-replacement and mobile application use at the end of the intervention. All 16 participants consumed the meal replacements as part of their structured meal plan, with 75% reporting use of meal replacements once a day. Three quarters of the participants used the mobile application during the intervention with varying degrees in the frequency of application use per week.

Table III: Employee participation status by attendance, meal-replacement use, and mobile application use

Participation status	n (%)
Attendance at group sessions (n=24)	
2 sessions	3 (12.5)
3 sessions	8 (33.3)
4 sessions	11 (45.8)
5 sessions	2 (8.3)
Meal-replacement use (n=16)	
1 meal-replacement / day	12 (75.0)
2 meal-replacements / day	4 (25.0)
Mobile application use (n=16)	
No application use / week	4 (25.0)
1 to 2 days of application use / week	5 (31.3)
3 to 4 days of application use / week	6 (37.5)
5 to 7 days of application use / week	1 (6.3)

Relevance and acceptability of the program

The 20 participants that attended the Focus Group Discussion had positive views on the components and impact of the program. The components in the program that helped the participants generate strategies to sustain lifestyle change were the group education sessions, structured meal plan, meal replacements, and timely support given by the dietitians via the mobile health application. The practical skills and simple nutrition messages imparted at the group education sessions were memorable as these gains can be implemented into everyday life.

"I'm more particular in buying. I look at everything. So, I see the calories and everything and then only I buy rather than looking at the packaging itself." [Focus Group 2, Male]

"I think the 'suku-suku separuh' [plate method] is very doable longterm." [Focus group 1, Female]

The participants felt that the illustrated and color-coded meal plan affirmed autonomy when eating a healthy diet.

"I don't call it as diet. I just, I prefer to call it as a structured meal." [Focus Group 2, Male]

"This one I get to eat as I want. Like I have control over my timing." [Focus group 1, Female]

Replacing one to two meals a day with a portion-controlled formulated product reduced the burden of self-care behaviors.

".. because we don't need to think about many things, [like] what to consume." [Focus Group 2, Female]

"But sometimes dinner also I take the replacement meal. It's good. Save my time." [Focus Group 2, Female]

Timely feedback after uploading of food photos and nudges from the diet coach helped the participants build a self-monitoring habit.

"Food journal because all the dietitian, they will reply, comment." [Focus Group 3, Female]

"I have set target not to eat 'nasi lemak' for two, two months when we started this program and I achieved that. So, I'm going to continue it." [Focus Group 2, Female]

The participants' social environment appeared to both reinforce and detract from their newly developed lifestyle change. Changes to routine and lifestyle preferences of important others seemingly disrupt participant adherence. Weight loss of the participants positively affected their family and colleagues.

"End of last year. Because uh, we have all those unavoidable 'makan makan' [social dining]." [Focus Group 2, Male]

"Dinner we're with our family so, tsk, it's difficult to be on a diet when we're with our family." [Focus Group 2, Female]

"At first my parents, uhm, didn't believe, like I will follow the [program]. Then now because they saw me like I lose some weight then they start to ask. I mean like they can see the outcomes from this program." [Focus Group 3, Female]

"So from there I teach them what food that can take, the good food." [Focus Group 3, Female]

Discussion

This present study showed that the IMUHEALxNaluri program elicited significant weight and BMI reductions. These results corroborate related study findings that workplace wellness programs are useful obesity interventions.[17] The magnitude of weight reduction seen in this present study is comparable to that shown in clinical trials involving reduced energy diets, wherein a mean weight loss of 5 to 8.5 kg was observed during the first 6 months of the intervention.[18]

Of remark, this present study showed that the post-intervention reduction in systolic blood pressure was clinically meaningful and comparable to that shown in trials that limit sodium intake,[19] promote the DASH eating plan – a diet rich in vegetables, fruits, whole grains, fat-free or low-fat dairy products, fish, poultry, beans, nuts, and vegetable oils; and low in saturated fat and sugar interventions,[20] and use hypertensive medications.[21] While this present study did not titrate use of hypertensive medications, the structured meal plan encouraged the participants to choose food that are low in saturated fat, sugar and salt, and high in fibre. A systematic review and network meta-analysis demonstrated that reducing systolic blood pressure to below recommended targets may reduce the risk of cardiovascular disease and all-cause mortality.[22]

An unexpected finding of this present study was the juxtaposed post-intervention improvements in triglyceride and HDL-cholesterol levels, but regression in LDL-cholesterol level. Weight loss interventions primarily demonstrate an improvement in lipid profile where a reduction in body weight is accompanied by a reduction in blood triglyceride and LDL-cholesterol, and an increase in HDL-cholesterol levels.[23] Exceptions to this are participants who experienced major weight loss or were following reduced sodium diets. Major weight loss can result in a transient increase in blood cholesterol levels, resulting from mobilisation of adipose cholesterol stores.[24] Nonetheless, the weight loss seen in this present study is average and not likely to have contributed to the increase in blood cholesterol levels. This present study however recommended use of low-sodium over high-sodium food choices. A systematic review showed that a proportion of participants who reduced sodium intake to healthy eating recommendations had an increase in total-cholesterol and LDL-cholesterol.[19] The inverse relationship between blood cholesterol and sodium intake can be explained by the upregulation of epinephrine, renin and angiotensin to revert low plasma volume as reduced sodium intake can reduce body water content.[25]

The focus group results of this present study showed good employee acceptability driven by the use of practical nutrition knowledge in the group education sessions and structured meal plans. Practical nutrition knowledge is considered more relevant and closely related to dieatary intake than factual nutrition knowledge.[26] The use of meal-replacements in this current study also reduced the burden of self-care related to meal planning. Use of meal replacements improve convenience and dietary structure by reducing the number of decisions required for food choices.[27] This current study also used a mobile health application to ensure timely feedback on eating behavior is given to the participants after they upload photos of their meals. This cue to action facilitated self-monitoring of dietary intake. Self-monitoring of dietary intake is an important factor to support dietary adherence and weight loss in behavior-based weight-loss intervention programs.[28]

In this current study, the participants who were lost to follow-up cited conflict with work as a reason. The focus group discussion also shed light on how social pressures detract from the lifestyle changes the participants were trying to make. Indeed, lack of time when finding a balance among life's obligations, and social pressures including work routines, holidays and influence of peers, act as barriers to lifestyle change.[29]

Some limitations of this current study should be noted. There is a known trend of weight regain after weight loss, but the short-term nature of this present study precludes interpretation of its sustainability.[30] Caution should also be applied when generalizing this study findings to a broader workplace setting as this pilot study involved voluntary participation of a small segment of employees who work in a healthcare education setting, not all of whom had obesity related comorbidities. In addition, medication and dietary intake was not measured and as such, the associations of these parameters and health outcomes cannot be elucidated. Future research should assess the scalability of hybrid workplace wellness programs to include long-term follow-up for deeper insights into weight loss and cardiovascular risk reduction over time.

Conclusion

This study demonstrated that the IMUHEALxNaluri program resulted in good employee acceptability and significant clinical improvements including weight loss, improvements in blood triglyceride and blood pressure.

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Prevalence of malnutrition among patients with breast cancer and colorectal cancer in Hospital Tuanku Ja'afar, Seremban

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Abstract

Background: Malnutrition is common among cancer patients, and it can impact the surgical outcomes of the patients undergoing elective surgery. Addressing malnutrition at the early stage of treatment will enhance the recovery process of the patients after anti-cancer treatments. Our study aimed to assess the nutritional status among breast and colorectal cancer patients who were scheduled for elective surgery and treatment.

Methods: A total of 89 patients, 46 breast cancer patients and 43 colorectal cancer patients participated in the study. Sociodemographic information and medical history were collected using a questionnaire. Body weight and height were measured using a weighing scale and stadiometer. Body composition data were collected using an 8-point bioimpedance analysis machine. Dietary intake was collected using a 7-day diet history. Handgrip strength was evaluated using a dynamometer. The prevalence of malnutrition was determined based on the AND/ASPEN malnutrition clinical characteristics. The differences between groups were analysed using independent sample t-test, Mann Whitney U test and chi-square test.

Results: Out of 89 patients, 51.7% were diagnosed as being malnourished based on the AND/ASPEN characteristics. The most common malnutrition characteristic observed among the breast and colorectal cancer patients was reduced handgrip strength (56.2%), followed by experience of muscle loss (43.8%) and reduced food intake (42.7%).

Conclusion: There was a high prevalence of patients at risk of malnutrition among breast and colon cancer patients undergoing surgery. Early detection of malnutrition in cancer patients allows healthcare professionals to provide prompt intervention and improve their prognosis.

Keywords: *Malnutrition; nutrition assessment; hospital; breast cancer; colorectal cancer*

Introduction

Cancer is one of the leading causes of death worldwide, which accounts for up to nearly 10 million deaths in 2020.[1] Breast cancer and colorectal cancer are the most common type of cancers not only worldwide but also in Malaysia. There is a high prevalence of breast cancer and colorectal cancers in Malaysia, accounting for 17.3% and 14.0% of the total number of cancer incidences respectively.[2] Malnutrition is common among cancer patients, be it among newly-diagnosed cancer patients or patients with advanced-stage cancer. A study on the nutritional status assessment among cancer patients in National Cancer Institute, Malaysia conducted by Norshariza et al. found that the prevalence of malnutrition ranged from 43.5% to 61.9%.[3] Another study conducted by Menon *et al.* on the east coast of Peninsular Malaysia found that more than one-third of the cancer patients were malnourished at the point of diagnosis.[4]

Malnutrition can be defined as deficiency, excess or imbalance in either macronutrients or micronutrients intake of an individual.[5] Malnutrition among cancer patients is either caused by the disease itself or from the cancer treatment.[6–8] Cancer itself affects the dietary intake of patients, increasing the energy expenditure and putting patients in a negative energy balance. Changes in nutrient metabolism and inflammation will also

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affect the overall nutritional status.[8–11] Chemotherapy is reported to affect nutritional status by inducing metabolic abnormalities such as hyperglycaemia, hypercalcaemia, or micronutrients deficiencies, thus affecting the immune competency of the patients. Radiotherapy has a direct impact on the taste buds of the tongue, thus affecting the taste changes among cancer patients.[8] In addition, surgical procedures to treat cancer can increase the nutritional requirement of the patients in the recovery process.[12] When the surgical procedure involves the gastrointestinal track, there is a chance of reduced food intake after the surgical procedure.[13] A study conducted by Williams *et al.* on the effect of cancer resection reported that muscle loss may last up to 6 weeks after a surgical procedure.[7]

Malnutrition is associated with an increased length of hospital stay.[14] Marshall *et al.* found that cancer inpatients categorised as malnourished have a mean length of hospital stay of 20 days, and it is significantly longer than well-nourished cancer patients.[14] Another similar study conducted by Loan *et al.*, reported that the mean length of hospital stay of well-nourished patients is 3 days shorter than malnourished patients after surgical procedures.[15] The rate of hospital readmission is also associated with the nutritional status of the patients. Several studies have associated malnutrition status as an independent risk factor for increased readmission rate.[16,17]

Currently, there is no single, universally accepted approach to the identification of adult malnutrition. In 2009, the Academy of Nutrition and Dietetics (AND) and American Society for Parenteral and Enteral Nutrition (ASPEN) recognised the need to standardise the definition to the diagnosis of malnutrition in adults and to manage the efforts among their respective organizations.[18] The International Consensus Guideline Committee was formed to develop an aetiology-based approach to the diagnosis of adult malnutrition in clinical settings. Thus, AND/ASPEN malnutrition clinical characteristics was developed on a consensus basis. This tool investigates the six (6) characteristics, recommended by the group in the diagnosis of adult malnutrition. The characteristics include insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, fluid accumulation and diminished functional status.[19] This study aimed to evaluate the prevalence and characteristics of malnutrition among patients diagnosed with breast and colorectal cancer from a large tertiary hospital in Seremban, Malaysia using the AND/ASPEN diagnostic criteria, to compare their similarities and differences.

Materials and Methods

Study design and participants

This was a cross-sectional study conducted at the surgical outpatient department of Hospital Tuanku Ja'afar, Seremban, Malaysia (HTJ, SOPD). The study period was from December 2018 to January 2020. Ethics approval was obtained from the Malaysian Medical Research and Ethics Committee (NMRR-18-392-40035 (IIR)) and the International Medical University Joint Committee on Research and Ethics (IMU R 204/2017). Written informed consent was obtained from the patients before enrolment into the study.

A total of 89 breast and colorectal cancer patients who were preparing for elective surgery were recruited. The recruited patients were: (1) registered adult outpatients at SOPD, HTJ, (2) aged 18 years old and above and (3) scheduled for elective surgery. Patients who were diagnosed with dementia, pregnant or lactating mothers, on enteral or parenteral feeding and had physical impairments were excluded from the study.

Sample size calculation

The sample size was calculated using a single population proportion formula: $n=\frac{Z^2 \times [p(1-p)]}{d^2}$ with n = the required sample size, Z = 1.96, p = prevalence of malnutrition reported among hospitalised cancer patient, and d = precision (assumed at 0.10). Based on the literature search, a study among hospitalised head and neck patients reported a prevalence of malnutrition at 67% using AND/ASPEN malnutrition characteristic tool.[20] Therefore, the minimum sample size required for the present study was estimated at 85 patients.

Measurement

Questionnaire

Sociodemographic data including age, date of birth, gender, ethnicity, marital status, educational level, employment status, monthly household income and medical history were collected via interview using a standardised questionnaire. The median household expenditure survey reported by the Department of Statistics in 2019 was used in categorising the household income of the patients.[21] Monthly household income of less than RM 4,850 was categorised as B40, monthly income range from RM 4,850 to RM 10,959 categorised as M40 and monthly income of more than RM 10,959 was categorised in the T20 group.

Anthropometry

The body weight of the patients was measured to the nearest 0.1kg using a calibrated digital weighing scale (Tanita bathroom weighing scale Model HD-325, Tanita Corporation, Tokyo, Japan). The patients were weighed in light clothing, requested to remove any heavy objects which could contribute to the weight and step on the weighing scale with no support, stand evenly on both feet and look straight ahead. Patients' height was measured to the nearest 0.1cm using a stadiometer (Seca 213, Seca, Hamburg, Germany). The patients were requested to stand evenly on both feet. The buttocks, scapulae, and head were positioned in contact with the vertical backboard, and their head in a Frankfort plane position.

Body mass index (BMI) was calculated using the formula of weight (in kilogram) divided by the square of height (in meter). The cut-off point for the BMI is based on the Asia Pacific classification system: BMI <18.5kg/m^2 is categorised as underweight, BMI of 18.5 kg/m^2 – 22.9kg/m^2 as normal, BMI between 23kg/m^2 – 24.9kg/m^2 as overweight and BMI >25kg/m^2 as obese.[22] The body weight changes were obtained from the medical record of the patients or from patients self-report.

Body composition

The body composition data were measured using a body impedance analysis machine (SECA 8-point body impedance analysis machine mBCA 525, Seca, Hamburg, Germany). Patients were required to empty their bladder before the measurement of body composition. Patients need to lie in a supine position on a non-conductive surface, spread their arms and legs away from the body and lie still. The eight adhesive electrodes were placed at the extremities of the limbs. Fat mass, fat-free mass, and appendicular muscle mass were measured.

Handgrip strength

The handgrip strength (HGS) of the patients was assessed using a calibrated Jamar Hydraulic Hand

Dynamometer, which is expressed in KgForce (KgF). The patients held the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The patients were encouraged to squeeze the handgrip as hard as they could, the reading was measured based on the value shown by the peak hold needle. Measurements were repeated three times and the highest measurement was used to compare to the normative grip strength.[23]

Dietary intake

The dietary intake of the patients was collected using a 7-days diet history. Food album and household measurement tools were used to aid in the dietary intake assessment. The diet history was analysed using computer software (NutritionistPro, Axxya System LLC, Redmond USA). Energy, macronutrients and micronutrients of the diet were analysed based on the nutrient composition from the Nutrient Composition of Malaysian Food[24] and Singapore Energy and Nutrients Composition of Food.[25] For packaged and processed food, the food manufacturer's nutrition information label was used to calculate the nutrient content.

Definition of sarcopenia

Sarcopenia was defined based on the Asian Working Group for Sarcopenia's recommendation.[26] Patients who were categorised as both low HGS and low muscle mass were diagnosed with sarcopenia. Low HGS was defined as <28.0kgF for men and <18.0kgF for women. Low muscle mass was defined as appendicular muscle mass index (AMMI) of <7.0kg/m^2 for men and <5.7kg/m2 for women.[26]

Diagnosis of malnutrition

The AND/ASPEN malnutrition clinical characteristics were evaluated as follows: reduced energy intake, unintentional weight loss, muscle mass loss, fat mass loss, signs of oedema and reduced HGS. The presence at a minimum of two out of the six characteristics was considered as moderate or severe malnutrition, according to the proposed classification in the original AND/ASPEN statement.[18]

Statistical analysis

The descriptive data were presented as mean ± standard deviation (SD) or median, interquartile range (IQR) depending on the normality of the data. The prevalence of malnutrition in the sample is expressed as a percentage (95% CI). The data were analysed using IBM SPSS statistics version 20.

Results

Out of 256 potential patients approached in the hospital, 89 patients who consented to join the study were screened for their participation eligibility and were recruited.

Table I shows the sociodemographic and clinical characteristics of the patients. The majority of the patients were Malays (57.3%), followed by Chinese (24.7%) and Indians (18.0%). The mean age of the patients was 60±11 years old and 77 of them were married (86.5%). Almost 90% of the patients were from the lower-income group with a monthly household income of less than RM 4,850.

There was an almost equal proportion of patients with breast cancer (51.7%) and colorectal cancer (48.3%). Other co-morbidities including hypertension (51.7%), diabetes mellitus (34.8%) and cardiovascular disease (25.8%) were reported among the patients.

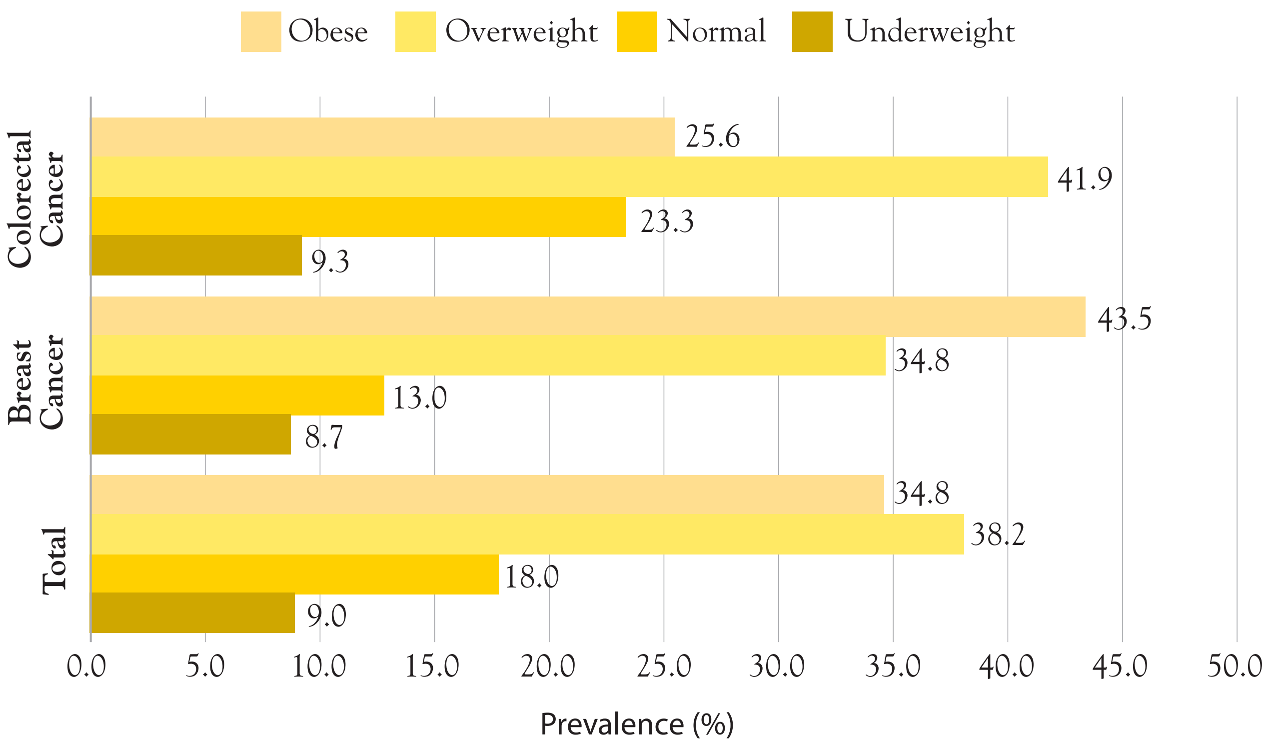
Table I: Sociodemographic and clinical data of the patients, based on the type of cancer

Characteristics	Total (N=89)	Breast Cancer (n=46)	Colorectal Cancer (n=43)
Age, years (mean ± SD)	60 ± 11	56 ± 12	62 ± 9
Sex			
Male	26(29.2)	0(0.0)	26(60.5)
Female	63(70.8)	46(100.0)	17(39.5)
Ethnicity			
Malay	51(57.3)	27(58.7)	24(55.8)
Chinese	22(24.7)	9(19.6)	13(30.2)
Indian	16(18.0)	10(21.7)	6(14.0)
Marital Status			
Single	4(4.5)	3(6.5)	1(2.3)
Married	77(86.5)	38(82.6)	39(90.7
Widow/Widower	5(5.6)	3(6.5)	2(4.7)
Divorced/Separated	3(3.4)	2(4.3)	1(2.3)
Education Level			
No formal education	4(4.5)	2(4.3)	2(4.7)
Primary	31(34.8)	14(30.4)	17(39.5)
Secondary	43(48.3)	21(45.7)	22(51.2)
College/University	11(12.4)	9(19.6)	2(4.7)
Employment Status			
Employed	28(31.5)	13(28.3)	15(34.9)
Unemployed	61(68.5)	33(71.7)	28(65.1)
Monthly Household Income*			
B40 (< RM 4,850)	80(89.9)	40(87.0)	40(93.0)
M40 (RM 4,850 – RM 10,959)	7(7.9)	5(10.9)	2(4.7)
T20 (> RM 10,959)	2(2.2)	1(2.2)	1(2.3)
Other Comorbidities			
Diabetes Mellitus	31(34.8)	19(41.3)	12(27.9)
Hypertension	47(52.8)	27(58.7)	20(46.5)
Cardiovascular Disease	23(25.8)	13(28.3)	10(23.3)
History of Chemotherapy			
Yes	6(6.7)	2(4.3)	4(9.3)
No	83(93.3)	44(95.7)	39(90.7)
History of Radiotherapy			
Yes	11(12.4)	2(4.3)	9(20.9)
No	78(87.6)	44(95.7)	34(79.1)

**Monthly household income categories were based on household expenditure survey report 2019*

The mean weight of the patients was 63.8±13.2kg and the mean height was 1.56±0.10m. The mean height of colorectal cancer patients was significantly higher than breast cancer patients (1.60±0.10m vs 1.53±0.06m, p<0.001), mainly due to the differences in sex characteristics of the patients. There was a low prevalence of weight loss among cancer patients, of which 79.8% of the patients did not experience any weight loss. Breast cancer patients had a significantly higher BMI than colorectal cancer patients (27.7±6.9kg/m^2 vs 24.8±4.7kg/m^2, p=0.024). Figure I shows the prevalence of BMI categories of the patients, based on the type of cancer. There is a high prevalence of patients categorised as overweight (38.2%) and obese (34.8%). Among breast cancer patients, 16 of them were categorised as overweight (34.8%) and 20 were categorised as obese (43.5%). For colorectal cancer patients, 18 of them were categorised as overweight (41.9%) and 11 were categorised as obese (25.6%).

Figure I: Body Mass Index (BMI) of the patients, based on the type of cancer



BMI categories was based on WHO classification of BMI for Asian population. Underweight = <18.5kg/m2, Normal = 18.5kg/m2 – 24.9kg/m2, Overweight = 25.0kg/m2 – 29.9kg/m2, Obesity = ≥30kg/m^2. [22]

The body composition data, HGS and prevalence of sarcopenia are shown in Table II. Overall, breast cancer patients were found to have a higher fat mass (28.65±10.27kg vs 20.51±8.13kg, p<0.001) and lower fat-free mass (36.93±7.06kg vs 42.87±10.00kg, p=0.002) in comparison with colorectal cancer patients. Eleven patients were categorised as being sarcopenic (12.4%) with 5 among breast cancer patients (10.9%) and 6 among colorectal cancer patients (14%).

Table II: Body composition data, handgrip strength and prevalence of sarcopenia of the patients, based on the type of cancer

Characteristics	Overall (N=89)	Breast Cancer (n=46)	Colorectal Cancer (n=43)
		Mean ± SD	
Fat Mass, kg	24.72±10.11	28.65±10.27	20.51±8.13
Fat Mass Index, kg/m^2	10.46±5.10	12.49±5.25	8.29±3.97
Fat Free Mass, kg	39.80±9.07	36.93±7.06	42.87±10.00
Fat Free Mass Index, kg/m^2	15.92±2.38	15.36±2.12	16.50±2.53
Appendicular Muscle Mass, kg	9.66±2.89	8.73±2.12	10.66±3.27
Appendicular Muscle Mass Index, kg/m^2	6.14±1.58	5.70±1.30	6.60±1.73
Handgrip Strength, kgF	28±8	25±7	30±10
		n(%)	
Sarcopenic*	**11(12.4)**	**5(10.9)**	**6(14.0)**

Data presented as mean±SD

**Sarcopenia is based on consensus by the Asian Working Group for Sarcopenia (AWGS), which meets both low HGS and low AMMI. Low HGS is defined as <28.0kgF for men and <18.0kgF for women, low AMMI is defined as <7.0kg/m^2 for men and <5.7kg/m^2 for women.*

The dietary intake of the patients is presented in Table III. The overall mean energy intake was 1259±472kcal with a macronutrient distribution of 52% from carbohydrates, 16% from protein and 32% from fat. The majority of patients had inadequate intake of micronutrients and a high percentage of patients did not meet the recommended intakes for calcium, thiamine and niacin in both groups of patients.

Table III: Dietary intake of the patients, based on the type of cancer

Nutrients	Overall (N=89)	Breast Cancer (n=46)	Colorectal Cancer (n=43)
		Mean ± SD	
Energy Intake			
Energy Intake, kcal	1259±472	1191±365	1332±559
Protein Intake			
Protein intake, g	50±23	47±17	54±29
Percentage energy intake, %	16±4	15±4	25±16
Carbohydrate intake			
Carbohydrate intake, g	165±63	161±45	170±77
Percentage energy intake, %	52±8	52±6	52±10
Fat Intake			
Fat intake, g	46±20	45±14	46±25
Percentage energy intake, %	32±7	33±5	31±9
Calcium Intake			
Calcium mg	444±371	379±218	514±478
Intake < RNI, n(%)	85(95.5)	46(100)	39(90.7)
Iron Intake			
Iron, mg	11±5	11±4	11±5
Intake < RNI, n(%)	56(62.9)	30(65.2)	26(60.5)
Thiamin Intake			
Thiamin, mg	1.0±2.7	0.6±0.3	1.3±3.8
Intake < RNI, n(%)	78(87.6)	43(93.5)	35(81.4)
Riboflavin Intake			
Riboflavin, mg	1.2±2.7	0.9±0.4	1.5±3.8
Intake < RNI n(%)	64(71.9)	35(76.1)	29(67.4)
Niacin Intake			
Niacin, mg	7.6±12.5	5.9±2.9	9.5±17.7
Intake < RNI, (%)	85(95.5)	45(97.8)	40(93.0)
Vitamin C Intake			
Vitamin C, mg	93±79	97±85	90±73
Intake < RNI, n(%)	45(40.6)	23(50.0)	22(51.2)
Vitamin A Intake			
Vitamin A, µg	742±555	768±606	714±500
Intake < RNI, n(%)	41(46.1)	20(43.5)	21(48.8)

Data presented as mean±SD and n(%)

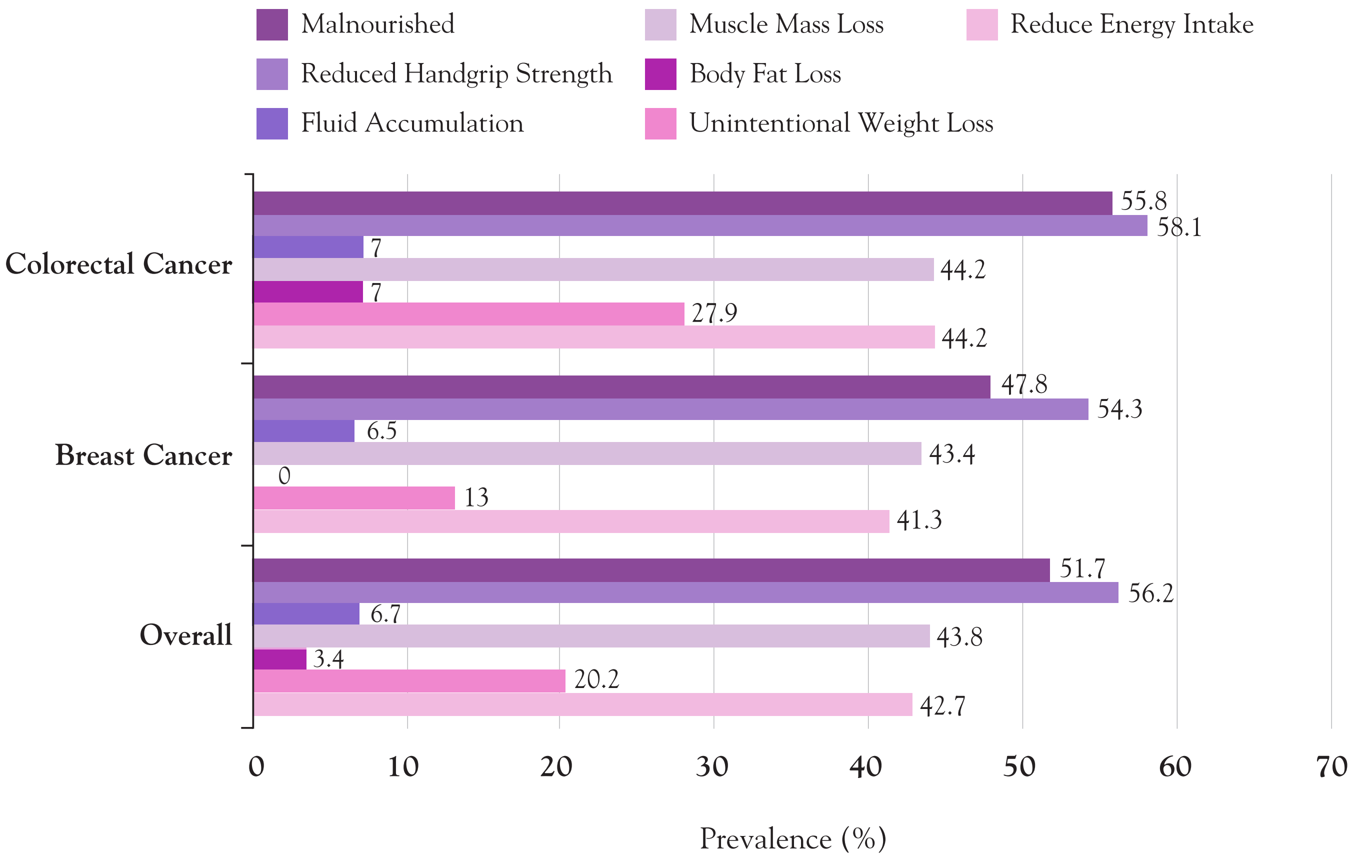
RNI: Recommended Nutrients Intake according to National Coordinating Committee on Food and Nutrition 2017.

The overall nutrition status of the patients based on AND/ASPEN malnutrition clinical characteristics is shown in Table IV. About 51.7% of the patients were classified as malnourished with an almost equal proportion among breast and colon cancers. The key malnutrition characteristics observed within the patients were reduced energy intake (42.7%), muscle loss (43.8%) and low HGS (56.2%). There was however no significant difference in the malnutrition characteristics between breast and colon cancer patients.

Table IV: Prevalence of malnutrition of the patients, based on the type of cancer

AND/ASPEN Malnutrition Clinical Characteristic	Overall (N=89)	Breast Cancer (n=46)	Colorectal Cancer (n=43)
		% (95% CI)	
Reduced Energy Intake	42.7 (32.3 – 53.6)	41.3 (27.0 – 56.8)	44.2 (29.1 – 60.1)
Unintentional Weight Loss	20.2 (12.4 – 30.1)	13.0 (4.9 – 26.3)	27.9 (15.3 – 43.7)
Body Fat Loss	3.4 (0.7 – 9.5)	0.0 (0.0 – 7.7)	7.0 (1.5 – 19.1)
Muscle Mass Loss	43.8 (33.3 – 54.7)	43.4 (28.9 – 58.9)	44.2 (29.1 – 60.1)
Fluid Accumulation	6.7 (2.5 – 14.1)	6.5 (1.4 – 17.9)	7.0 (1.0 – 19.1)
Reduced Handgrip Strength	56.2 (48.6 – 69.8)	54.3 (39.0 – 69.1)	58.1 (42.1 – 73.0)
Overall Nutrition Status	48.3	52.2	44.2
Well Nourished	(37.6 – 59.2)	(36.9 – 67.1)	(29.1 – 60.1)
Malnourished	51.7 (40.8 – 62.4)	47.8 (32.9 – 63.1)	55.8 (39.9 – 70.9)

Figure II: Prevalence of malnutrition of the patients, based on the type of cancer



Discussion

Our study found that almost one out of two breast and colorectal cancer patients undergoing elective surgery were malnourished based on AND/ASPEN malnutrition clinical characteristics tool even though the majority were overweight or obese. In addition, the malnourished patients had a poor dietary intake, muscle loss and poor handgrip strength (HGS).

The BMI of most patients was classified as being overweight or obese. This is not surprising as BMI is a risk factor for colorectal and breast cancers. With every 5kg/m^2 increase in the BMI, the risk of colorectal cancer would increase by 1.13 times and the risk of breast cancer would increase by 1.07 times.[27] A high body fat mass could also be one of the potential contributors to increased risk of breast cancer, which was reported by Schoemaker *et al.*[28]

It was also interesting to note that most patients did not experience unintentional weight loss at the point of diagnosis of cancer. Kroenke *et al.* conducted an analysis of BMI among colorectal cancer patients and they found no significant difference in BMI between pre-diagnosis and at the point of diagnosis.[29] A similar study conducted by Patel *et al.* among breast cancer patient and healthy subject in the United State of America found no significant difference in BMI between patients diagnosed with breast cancer and participants with no breast cancer was noticed.[30]

Our study also found that a majority of patients had low energy intakes of less than 25kcal/kg body weight and protein intakes of less than 0.8g/kg body weight. The low energy and protein intakes among cancer patients have been similarly reported by Menon *et al.* among newly diagnosed cancer patients on the east coast of Peninsular Malaysia. Low energy and protein intakes could be a result of under-reporting.[31] However, these patients could also be making changes to their dietary intake patterns intentionally. Yusof *et al.* found that there were changes in dietary patterns among colorectal cancer patients.[32] Conscious or intentional dietary intake pattern changes, such as reduced frequency of eating out, reduced oily food intake, reduced red meat, reduced high sugar food items and increased fruit and vegetable intake, were seen when the patients were diagnosed with cancer.[33]

Our study found that almost 50% of the patients were malnourished according to the AND/ASPEN malnutritional clinical characteristics. Other studies conducted in clinical settings showed the prevalence of malnutrition ranged from 26.8% to 72.6%, and was dependent on the type of disease or the condition of the study populations.[34–42] Hudson *et al.*, 2018 conducted a study on the prevalence of malnutrition in an overall clinical setting in the Hospital of the University of Pennsylvania using AND/ASPEN malnutritional clinical characteristics and reported that 66.88% of the patients were malnourished.[34] Another study conducted by Burgel *et al.* on the inpatients from 5 hospitals in Brazil, where the patients were mainly diagnosed with cancer, heart disease and lung and gastrointestinal disorder, reported that 34.6% of the patients met the malnutrition criteria of AND/ASPEN malnutrition clinical characteristics.[36] The high prevalence of malnutrition indicates the importance of nutrition screening and assessment to be done during diagnosis and preparation for anticancer treatments.

In our current study, the main contributing factors to malnutrition were poor dietary intake, low muscle mass and low HGS. The contributing factors for poor dietary intake could be due to under-reporting of the patients and changes in dietary pattern after cancer diagnosis. Low energy intake might further induce the depletion of body reservoirs, resulting in the unintentional weight loss of the patients. The weight loss would then impair the physical performance of an individual, and increase the odds ratio of overall morbidity and mortality rate after elective surgery.[43]

Muscle loss among patients diagnosed with cancer was also found to impact the prognosis of the disease. Among patients diagnosed with colorectal cancer, it was found that muscle loss after systemic chemotherapy is significantly associated with shorter progression-free survival and overall survival.[44–46] Other than that, muscle loss was also found to be associated with overall survival among metastatic colorectal cancer patients, independent of tumour mutational status and weight loss.[47]

Reduced HGS among cancer patients should not be neglected as well. It was found that reduced HGS is associated with impaired health-related quality of life. It was found that patients categorised as having reduced HGS were having poorer mobility, inability to conduct usual activity and higher risk of pain and discomfort.[48,49] In addition, patients diagnosed with cancer and having low HGS were found to have an associated increased odds ratio of postoperative complications, including infection and increased mortality rate.[50–52]

The present study had several limitations. The single centre recruitment and the small sample size of the current study limited its generalisation. The result should therefore be interpreted with caution. Recognising the barriers to recruit patients who were diagnosed with cancer as participation in a study might be perceived as an additional burden for the patients.[53,54] A multi-centre study should be considered in the future study to allow for a larger sample size recruitment and better comparison between types of cancer.

Conclusion

This study investigated the prevalence of malnutrition among breast and colorectal cancer patients by using AND/ASPEN malnutrition characteristics. Half of the patients were diagnosed as malnourished based on AND/ASPEN and it was mainly contributed by the symptoms of muscle loss, reduced food intake and reduced handgrip strength. Early detection of these symptoms and optimising nutrition status through nutritional intervention before conducting any cancer treatment might improve the prognosis of the disease.

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Making space for the older adventure traveller: The dawn of commercial space tourism

Jack Yassa[1,2], Shang Yuin Chai[1,2], Gerard T Flaherty[1,2,3]

'Galloping about the cosmos is a game for the young, Doctor.'
Captain James T Kirk
Star Trek II: The Wrath of Khan

Adventure tourism, including sojourns to high-altitude destinations, is no longer the preserve of younger travellers.[1] The recent completion of suborbital flights to the edge of space by 82-year-old American aviator, Wally Funk, and 90-year-old Star Trek actor, William Shatner, has heralded a new era in commercial space tourism, with 'Captain Kirk' (Shatner) becoming the oldest person to travel to space,[2] eclipsing Funk's short-lived record and the longstanding record held previously by John Glenn. Glenn returned to space in 1998 at the age of 77, nearly four decades after becoming the first American to orbit the Earth.

With global life expectancy projected to increase beyond 75 years by 2040, and the costs associated with space tourism expected to drop as the market inevitably expands,[3] the opportunity to engage in space tourism may become an appealing life goal for many older individuals. The ethical and environmental arguments against commercial space tourism are being actively debated.[3] Physicians who care for older patients, however, should have a basic familiarity with the unique physiologic challenges of space travel in this population.

Space tourists are likely to be older than the average astronaut and to have multiple medical comorbidities. The world's first space tourist was aged 60 years when he spent eight days orbiting the Earth as part of a mission to the International Space Station (ISS). His documented medical history was remarkable for the presence of moderately severe bullous emphysema, a spontaneous pneumothorax requiring pleurodesis, a lung parenchymal mass that was biopsied, and atrial and ventricular ectopy. His visit to the ISS passed off without medical complications, however.[4]

While suborbital space flights involve only minutes of weightlessness at altitudes of approximately 100 km above the Earth's surface, they do present significant vertical and horizontal acceleration *g* forces, which can reach 5*g* during launch. Most individuals with well-controlled medical conditions can tolerate these forces during the take-off and landing phases. Age-related blunting of baroreceptor reflexes, however, means that the older space tourist is more likely to experience syncope. The prolonged stasis associated with travel to low Earth orbit (200-400 km above the Earth) exposes the older traveller to a higher risk of thromboembolism. A centrifuge study commissioned by the Federal Aviation Administration reported a low incidence of cardiac symptoms and arrhythmias in older subjects with controlled medical comorbidities. Implanted cardiac devices performed well and were not damaged during the experimental exposure to suborbital spaceflight conditions.[5]

The well-established microgravity-induced changes in body composition, reduced bone density, muscle atrophy, and back pain are more likely to be an issue for older orbital tourists who spend protracted periods in a microgravity environment. Other clinical syndromes to which orbital tourists are susceptible include neurovestibular dysfunction, space intracranial hypertension, and an increased risk of cancer resulting from the effects of immunosuppression.[3] Table I summarises the most important effects of microgravity on cardiovascular and neuromuscular function.

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Table I: Physiologic effects of microgravity in older travellers (modified from Flaherty *et al.*[3])

Body System	Physiologic Effects
Musculoskeletal	• Replacement of skeletal muscle by adipose tissue • Transient decrease in limb volume • Decreased bone density • Decreased skeletal muscle mass • Bone loss-related hypercalciuria causing kidney stones
Neurological	• Impaired visuo-motor tracking • Impaired vestibulo-ocular reflex • Reduced visual acuity • Motion sickness
Cardiovascular	• Decreased plasma volume • Cephalad fluid redistribution • Increased heart rate, maximum at launch and re-entry • Decreased peripheral resistance • Orthostatic hypotension • Increased stroke volume and cardiac output • Increased central venous pressure during launch • Minimal decrease in exercise capacity • Post-flight anaemia caused by reduced haematopoiesis

While guidance exists to assist physicians in providing medical clearance for suborbital space tourists,[6] we believe that clinical recommendations need to be adapted to accommodate the needs of an older space tourist clientele. It would be of interest to seek the views of older individuals on this subject. To the best of our knowledge, no research exploring the views of the older generation towards the prospect of personal space flight participation has been undertaken. Whether space flight participation will remain the preserve of high net worth individuals or become more democratised in the future remains to be observed. Although there is a stringent process in place for the selection of astronauts for space missions, we anticipate that physicians who specialise in the care of older patients may be involved in counselling them about the biomedical challenges of space travel, particularly orbital travel in a microgravity environment. It seems likely in the near future that space travel will no longer be "a game for the young".

Conflict of interest: None declared.

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An inexpensive inguinal hernia teaching model

Ramji Narayanan

Medical students find the complex anatomy of the inguinal region and thus the logic and steps of inguinal hernia operations difficult to understand. Cadaveric dissection or scrubbing in on an inguinal hernia operation are arguably the best ways of learning surgical anatomy. Unfortunately, cadaveric dissection at the undergraduate level is becoming less common[1] and medical students may not always be allowed to scrub in on an operation.

Many teaching models[2,3] have been developed to aid the learning of applied inguinal anatomy. These have limitations, including lack of anatomical realism, cost and availability. This letter describes the construction and use of a model of the inguinal region to depict anatomy in a quasi-3-dimensional style. It uses cheap, easily procured materials.

Construction of the model

Materials:

1. *Faux leather sections in different colours*. These were procured from cut pieces discarded by an upholsterer.
2. *Plastic tubing*. Bits of heat-shrink tubing were used.
3. *Cling film*
4. *A piece of nylon netting as for example from a garlic net-bag*
5. *Yellow-coloured tissue paper*
6. *A piece of stiff, white cardboard* about 25 x 25 cm
7. *Glue and double-sided sticky tape*

Construction (Figures I and II):

The model depicted a life-size hemi-pelvis and the musculo-aponeurotic layers of the abdominal wall from the level of the arcuate line down to the inguinal ligament. A standard undergraduate anatomy text[4] was used as a guide. The model was assembled as follows:

1. A hemi-pelvis was sketched on a piece of white cardboard.
2. The femoral vessels were drawn as guides to the position of the mid-inguinal point and the internal ring (deep inguinal ring) (IR).
3. The proximal course of the inferior epigastric artery (IEA), from its origin to the medial border of the rectus abdominis muscle (RA), was simulated with a piece of tubing and glued into its anatomical position on the cardboard drawing.
4. Using the drawing as a guide, appropriately sized faux-leather pieces of different colours were cut to represent the transversalis fascia (TF), transversus abdominis (TA), internal oblique (IO), rectus abdominis (RA) and the external oblique aponeurosis (EO). Since the model extended only up to the arcuate line, the TA and IO and EO were all disposed to pass anterior to the RA muscle.
5. These layers were then placed in position and trimmed where required.
   a. The TF was placed first. Inferiorly, it was allowed to overlap the femoral vessels to show how it constitutes the anterior layer of the femoral sheath (FS).
   b. The tubing representing the IEA could be felt through the TF and was depicted on the TF by colouring the corresponding area pink.
   c. A small hole was cut out in the TF just lateral to the IEA to correspond to the IR.
6. After all the layers were in place, an oblique, V-shaped section was removed from the EO to simulate the external ring (superficial inguinal ring, ER).

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7. The EO was then cut from the ER obliquely up to the mid-inguinal point to simulate a surgical incision.
8. A detachable, indirect hernia sac (IH) with contained omentum was constructed from a bit of cling film and yellow tissue paper and placed in the inguinal canal, its "neck" shown to be emerging through the IR.
9. A piece of tubing representing the spermatic cord (SC) was placed medial to the sac while emerging from the IR and was distally positioned to pass through the ER.
10. Once all adjustments were made, the layers were glued onto the cardboard sheet laterally and medially using the drawing as a guide.
11. The EO was folded upon itself inferiorly from the anterior superior iliac spine to the pubic tubercle to simulate the inguinal ligament (IL).

Figure I: The model with the external oblique and its aponeurosis (EO). The aponeurosis has been slit from the external ring (ER) to the mid-inguinal point to show the spermatic cord (SC) and an indirect inguinal hernia sac (IH) in the inguinal canal. The transversalis fascia is shown continuing inferiorly as the anterior layer of the femoral sheath (FS)

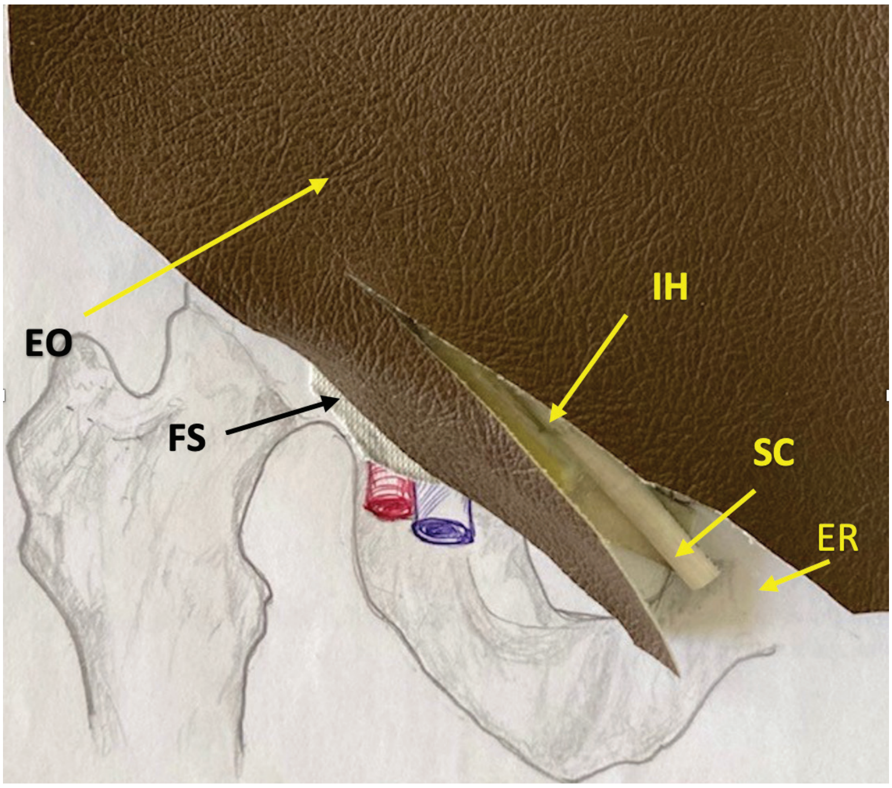
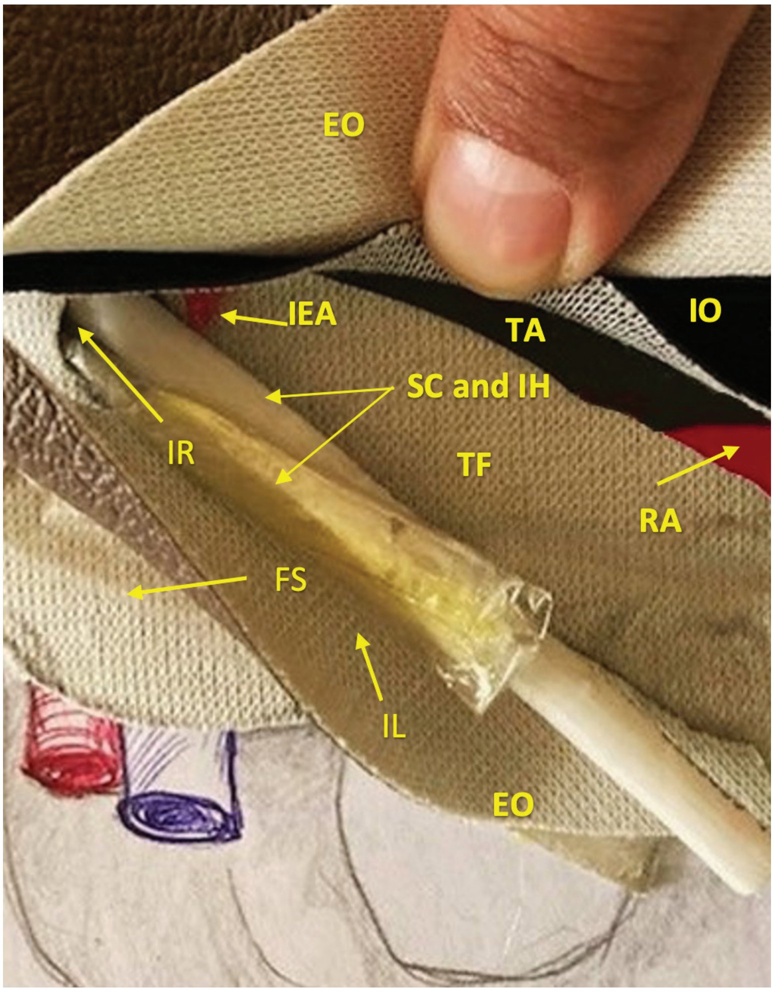


Figure II: Inguinal canal detail. Upon retracting the upper and lower external oblique (EO) aponeurotic flaps, the internal oblique (IO, inguinal ligament (IL), transversalis fascia (TF), internal ring (IR), spermatic cord (SC) and hernial sac with contained omentum (IH) are seen.

Retracting the IO reveals the transversus abdominis (TA). The rectus abdominis (RA, digitally colour-enhanced for clarity) is shown in the model only to aid understanding (it is not seen in the course of an open inguinal hernioplasty). The inferior epigastric artery (IEA) lies medial to the exit of the spermatic cord and hernial sac through the internal ring. The TF continues into the upper thigh as the anterior layer of the femoral sheath (FS).



The faux-leather material used for the fascio-aponeurotic layers was soft enough to allow handling. The edges of the "incision" made in the EO were capable of being retracted to reveal the inguinal canal and its contents. The arching IO could be seen and, when this was retracted, the TA was visible. While the RA was hidden from view, the TA and IO could be elevated to reveal the RA and demonstrate that the TA and IO pass anterior to the RA at this level.

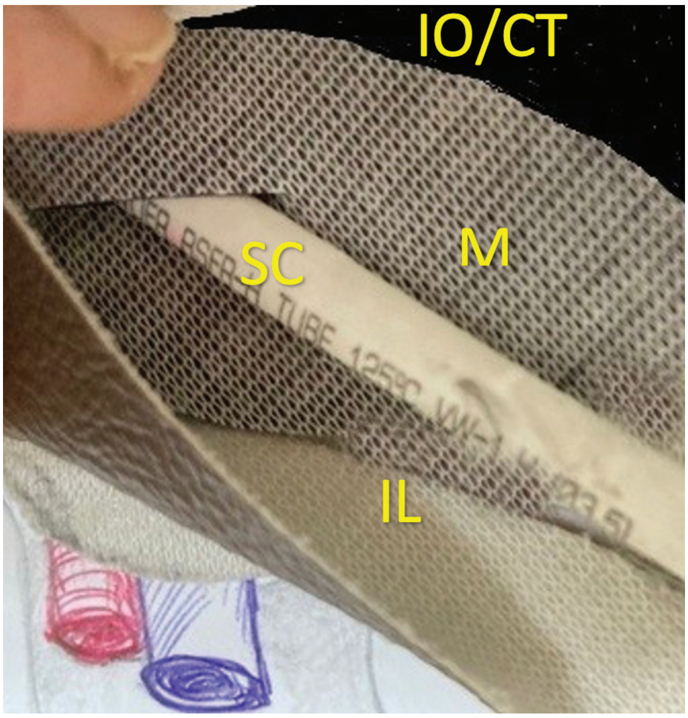
The model is nearly flat, smaller than an A4 size paper sheet and compact enough to be carried in a C4 size envelope.

Using the model

The student locates the mid-inguinal point using the femoral artery as a guide. The external ring is located and the inguinal incision is made. By retracting the EO flaps, the inguinal canal, its contents (sac and cord) are revealed. The formation of the inguinal ligament by the folded inferior free edge of the EO is demonstrated. Particular attention is paid to the TF and location of the IEA, the internal ring and the relationship of the sac to the cord. Next, the IO and TA are demonstrated, mentioning how, in a significant percentage of the population, these are fused medially to form the conjoined tendon. The indirect hernia sac emerging from the internal ring and its relationship to the cord may be appreciated at this stage. Although this model shows only an indirect hernia, it is easy to demonstrate the location of a direct hernia in Hesselbach's triangle using the IEA as a guide.

The essential steps of a Lichtenstein procedure[5] for an inguinal hernia are then demonstrated. In the model, the sac can be detached to simulate a herniotomy. The rationale for imbrication of the TF in the repair of a *direct* hernia is explained. The placement of a mesh is then shown (Figure III), as is its anchoring to the TA/conjoined tendon superiorly and the inguinal ligament inferiorly. The relationship of the SC to the mesh is also shown.

Figure III: Mesh placement in a Lichtenstein repair. The mesh (M) is fixed in position, fixed to the internal oblique/conjoined tendon (IO/CT) superiorly and the inguinal ligament (IL) inferiorly, and slit laterally to accommodate the cord (SC)



Discussion

The purpose of this simple model is not to teach the technical details of inguinal hernia repair to a trainee surgeon for which a more appropriate model[3] is available but to assist medical students in understanding the anatomy of the inguinal region and the basic steps of a popular technique[5] of inguinal hernioplasty. To that end, the model was kept simple and many details, such as the three nerves encountered in the inguinal canal at surgery, were omitted. Likewise, the pectinate ligament (Cooper's ligament) has not been shown, rendering the model inadequate to explain procedures that use this structure. These are deficiencies that can be easily incorporated in improved models without over-compromising simplicity.

The model has been, and continues to be, used for teaching senior medical students. It received an enthusiastic response and informal feedback has been very positive, clearly suggesting that it now deserves to be objectively evaluated as a teaching aid.

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