# Public Perceptions on the Use of the Physical Activity Readiness Questionnaire

Anantharaman Venkataraman * , Ian Zhirui Hong , Lisa Cuiying Ho , Tess Lin Teo , Stefanie Hwee-Chee Ang

Posted Date: 7 May 2024

doi: 10.20944/preprints202405.0306.v1

Keywords: self-administered pre-participation survey; physical activity; PAR-Q+, co-morbidities; feedback

*Article*

# Public Perceptions on the Use of the Physical Activity Readiness Questionnaire

**Anantharaman Venkataraman [1,*], Ian Zhirui Hong [1], Lisa Cuiying Ho [2], Tess Lin Teo [1] and Stefanie Hwee-Chee Ang [3]**

[1] Department of Emergency Medicine, Singapore General Hospital, Emergency Medicine Academic Clinical Program, Duke-NUS Academic Medical Centre, Outram Road, Singapore 169608; anantharaman@singhealth.com.sg (A.V.); ian.hong.zr@gmail.com (I.Z.H.); tess.teo.lin@singhealth.com.sg (T.L.T.)

[2] Department of Orthopaedic Surgery, Sengkang General Hospital, 110 Sengkang East Way, Singapore 544886; ho.lisa.ho@gmail.com

[3] Sport Cares, Sport Singapore, 3 Stadium Drive, Singapore 397630; Stefanie_ANG@sport.gov.sg

* Correspondence: anantharaman21051@gmail.com

**Abstract:** Self-administered pre-participation screening for physical activity (PA) requires an instrument that should be easily used and identify individuals at high risk. The Physical Activity Readiness Questionnaire (PAR-Q+) has been used for many years. Its ease of use and ability to identify those not fit to undergo PA has not been assessed. This study was to determine the rates of the PAR-Q+ in identifying adults who may not be fit for moderate or intense PA and obtain feedback on the use of this tool. A public on-line voluntary survey on the PAR-Q+ was carried out obtaining participants' bio-characteristics, them completing the PAR-Q+ form and providing feedback. With 1019 participants, about 57.8% engaged in at least 150 minutes of PA weekly. This decreased with increasing number of co-morbidities. Increasing age was associated with more co-morbidities. About 33.1% of the participants using the PARQ+ would have required further medical evaluation. Only 3 of the 7 main PAR-Q+ questions were easily understood. Difficulties were encountered with 39 of the 44 follow-up questions, especially amongst those with co-morbidities. The large number of technical terms was also a source of concern. The PAR-Q+ would need extensive simplification before it may be recommended for use.

**Keywords:** self-administered pre-participation survey; physical activity; PAR-Q+, co-morbidities; feedback

## 1. Introduction

While exercise reduces health risks in the medium and long term, the risk of sudden death is transiently increased during or immediately after physical activity (PA). There have been many instances worldwide where sports enthusiasts performing either moderate or intense PA have sustained cardiac arrest or other significant physical injuries during or immediately after the activity. Because of the need to identify those likely to sustain such injury and take preventive measures, a Physical Activity Readiness Questionnaire (PAR-Q) for use by all persons wishing to increase their level of PA was developed in Canada in 1970 and endorsed by Fitness Canada and the American College of Sports Medicine. This tool has been used extensively in many countries world-wide [1]. This document has undergone multiple revisions since then, the latest version being the 2021 PAR-Q+ [2].

In 2007, following the collapse and death of a 17-year old triathlete in Singapore, a Sports Safety Committee recommended the adoption of the PAR-Q or its appropriately amended version as the principal pre-participation PA readiness tool for the country [3].

 doi:10.20944/preprints202405.0306.v1



The current version of the PARQ+ is a four-page document to be completed by the exercise participant. The participant would be required to answer 7 questions on page 1 of the PAR-Q+. A NO answer to all of the questions, clears the participant for unrestricted PA following the general guidelines for healthy asymptomatic populations [4–6]. A participant answering YES to 1 or more of the questions, would need to complete pages 2 and 3, which contain follow-up questions on specific chronic medical conditions to either clear the respondent or refer to an online ePARmed-X+ to be completed by a medical practitioner. Advice is also provided on developing a safe and effective PA plan, including recommendations appropriate for lower-risk individuals with established chronic medical conditions. At the end of the ePARmed-X+ process by the medical practitioner, the participant might be cleared for unrestricted or partially-restricted PA participation.

Over the years, however, injuries during moderate and intense sports continued to occur, and the frequency of use of the PAR-Q or its variations as a pre-participation tool by those engaging in sporting activities has been low. In Canada, too, a new tool, the Get Active Questionnaire (GAQ) had been proposed to replace the PAR-Q+ [7].

With concern at the increasing length and complexity for self-administering pre-participation screening programmes in the local and other populations [8] and the continuing occurrence of adverse outcomes from moderate to intense PA, the authors, a sub-group of the Sport Safety Workgroup, undertook a review of pre-participation screening procedures with a view to reconsider the use of such tools by sports participants in the country.

The objectives of this study were to determine the rates of identifying adults for further medical evaluation prior to participating in moderate or high-intensity PA or increasing their PA intensity when using the PAR-Q+, its potential ability to identify those likely to sustain adverse events, and to obtain feedback from a wide section of society on the use of this tool.

## 2. Materials and Methods

This study of the use of the PAR-Q+ was one of three surveys, each looking at a separate identified PA pre-participation questionnaires. The PAR-Q+ arm was included in the review owing to it having been the first major tool recommended by Sport Singapore for at least fourteen years and generally used in many countries around the world. The study was conducted as a public survey.

Prior to doing the survey, participants were provided with basic information on the potential need for PA pre-participation screening and the need for a locally-relevant questionnaire. Formal consent to participate in the study was then obtained. Upon recruitment, potential participants were randomized to one of the three available such questionnaires, one of which was the PAR-Q+. Participants were then asked to complete three sections. The first was on personal bio-characteristics, including age, gender, height, weight, ethnic group, occupation, social habits such as cigarette smoking and frequency and duration of their PA habit. The second section was the completion of the PAR-Q+ by the participant. The third was a questionnaire on the participant's feedback addressing their ease or otherwise in understanding each of the seven questions and the follow-up questions that followed in the event of the presence of a 'Yes' answer, and also on the use of technical terms in and the length of the questionnaire. The feedback was on a 5-point Likert scale. The participants were also asked whether the questionnaire needed additional items of information and their preferred frequency for completion of the PAR-Q+.

The study was powered to show a 10% difference in mean values with a standard deviation of 25% using $\alpha = 0.50$ and $p = 0.05$. The minimum required for a comparison of each group was 293. However, with the need to consider at least three subgroups of respondents within each arm of the study (by age-group, occupational status and presence of co-morbidities), we multiplied this number by 3 giving a total of 879. With expectation of at least 10% incomplete survey responses, the minimum numbers required per study arm was increased to 1,000.

The study was conducted via an online survey platform, SoGo Survey, marketed by qualtricsXM.

The survey was open to any interested member of the public above the age of 21 years. Publicity about the study was carried out through various national sports organisations, community grassroot

 doi:10.20944/preprints202405.0306.v1



organisations such as the Peoples Association, governmental agencies such as the Health Promotion Board, professional groups like the Academy of Medicine and institutions of higher learning. Participation was voluntary and participants had to agree to participate in order to proceed.

The study was approved by the Institution Review Board of the Singapore Sport Institute.

*Data Analysis*

All data collected were anonymized and transferred automatically to a Microsoft Excel data base. Analysis was carried out using IBM SPSS Statistics 21.

For comparative analysis, patients were divided into three age groups (viz. young adults aged 21 to 39.9 years, middle-aged adults of 40 to 59.9 years and elder adults of 60 years and above). The participant's Body Mass Index (BMI) was calculated and patients grouped by BMI using the Asian BMI scale suggested by the World Health Organisation [9]. Participants were also grouped into 10 main occupational codes based on the International Labour Organisation classification of Occupational Codes[10]. They were then further re-grouped into three groups, Group 1 being those in managerial and professional occupations, Group 2 for those with administrative and clerical duties and Group 3 for the retired, unemployed, housewives, manual workers and military personnel. Based on their declared level of current PA, they were also grouped into those with low PA (<150 minutes per week), moderate PA (150 – 299 minutes per week), high PA (300 – 449 minutes per week) and very high PA (≥450 minutes per week).

The authors considered the influence of satisficing in feedback data entry in this on-line survey. We considered five types of satisficing behaviours amongst the survey respondents, viz. primary bias, acquiescence bias, early termination, non-response and straight-lining. The satisficing analysis was done as per methods suggested by Barge, Vriesema and Gehlbach [11,12]. The analysis suggested an estimate of 62% occurrence of various forms of satisficing, especially of the straight-line type. We initially removed the apparently satisficed data from the third section's feedback analysis, calculated the means of the Likert scores and used these to obtain four groups of levels of difficulty. This resulted in the use of Likert mean score of ≥ 4.51 to suggest ease of answering the question, 4.01-4.50 as slight difficulty, 3.51-4.00 as moderate difficulty and ≤ 3.50 as significant difficulty.

Descriptive statistics were used for nominal and ordinal data. Non-parametric comparisons were made using independent samples Kruskal-Wallis test and Mann-Whitney U test, as appropriate. Chi-square tests were used for parametric data comparisons and ANOVA for comparisons between groups.

## 3. Results

A total of 1020 persons were randomised to the PAR-Q+ study arm. Of these 1 was omitted from further analyses because of extensively incomplete data. Analysis was based on the remaining 1019 responses.

### *3.1. Participant Characteristics (Table 1)*

Males formed 60.9% of respondents. The mean age of participants was 46.9 ± 12.1 years. Only 6.4% gave a history of cigarette smoking. The ethnic breakdown of the participants was not significantly different from that of the general Singapore population. Amongst all study participants, 57.8%. reported exercising for at least 150 minutes per week Participants from occupational codes in Group 1 constituted 35.9% of the population surveyed, Group 2 41.2% and Group 3 22.9%.

The BMI was higher in the 21-39.9 and 40-59.9 age groups compared to those over 60 years (24.8 vs 23.8, p=0.012). About 43.4% had at least one illness. Participants' age was directly related to presence of co-morbidities, (p = 0.00). Those in the older age groups spent more time on PA (292 minutes vs 207 minutes for those < 60 years old, p=0.00). Those with co-morbidities spent 210 minutes per week on PA versus 233 minutes for those without known co-morbidities (p = 0.075). There was a decrease in PA duration with increasing numbers of co-morbidities (P=0.014).

 doi:10.20944/preprints202405.0306.v1



**Table 1.** Characteristics of Study Participants.

| **Participant Characteristic** | **Data** | **Based on June 2022 Singapore population data (where available)** |
|---|---|---|
| **Gender (%)** | | |
| Male | 621 (60.9%) | 48.8% |
| Female | 398 (39.1%) | 51.2% |
| **Age (mean ± sd[1])** | 46.9 ± 12.1 years | 47.8 years |
| **Age Distribution** | | |
| 21-39.9 years | 298 (29.2%) | 35.6% |
| 40-59.9 years | 539 (52.9%) | 38.0% |
| 60 -80.0 years | 182 (17.9%) | 26.4% |
| **Cigarette Smoker (%)** | | NA |
| Yes | 65 (6.4%) | |
| No | 954 (93.6%) | |
| **Basal Metabolic Index** | | NA |
| Very Low (<18.5) | 36 (3.5%) | |
| Low (18.5-22.9) | 344 (33.8%) | |
| Moderate (23.0-27.4) | 430 (42.2%) | |
| High (27.5 – 32.9) | 170 (16.7%) | |
| Very High (> 33.0) | 39 (3.8%) | |
| **Ethnic Groups** | | |
| Chinese | 847 (83.1%) | 75.3% |
| Malay | 65 (6.4%) | 12.8% |
| Indian | 83 (8.1%) | 8.7% |
| Others | 24 (2.4%) | 3.2% |
| **Occupational Groups (by ILO[2])** | | NA |
| Occupation Groups 1-2 (Managers and Professional groups) | 366 (35.9%) | |
| Occupation Groups 3-5 (Clerical, administrative and executives) | 420 (41.2%) | |
| Occupation Groups, 7-9, 0 (Manual, Retired, Homebased, Military) | 233 (22.9%) | |
| **Duration of Physical Activity per week (minutes)** | | NA |
| 0 – 149 minutes | 430 (42.2%) | |
| 150 – 299 minutes | 312 (30.6%) | |
| 300 – 449 minutes | 158 (15.5%) | |
| ≥ 450 minutes | 119 (11.7%) | |
| **Age Group of Respondents with co-morbidities** | | NA |
| No co-morbidities = 577 (56.6%) | 45.2±11.6 years | |
| With co-morbidities = 442 (43.4%) | 50.7±12.0 years | |
| Proportion of co-morbidities by age group: | | |
| Age Group 21-39.9 years | 93 / 298 (31.2%) | |
| Age Group 40 – 59.9 years | 236 / 539 (43.8%) | |
| Age Group ≥ 60 years | 110 / 182(60.4%) | |

 doi:10.20944/preprints202405.0306.v1



| | | |
|---|---|---|
| **By number of co-morbidities** | | NA |
| 1 co-morbidity | 321/1019 (31.5%) | |
| 2 co-morbidities | 101/1019 (9.9%) | |
| 3 or more co-morbidities | 20/1019 (2.0%) | |

[1] sd = standard deviation; [2]ILO = International Labour Organisation.

*3.2. Participants' Responses to the Seven PAR-Q+ Questions and Their Follow-Up Questions (Table 2)*

3.2.1. PAR-Q+ Question 1 (Has Your Doctor Ever Said That You Have a Heart Condition or High Blood Pressure?)

For this first question 20.9% said Yes. Increasing age correlated positively with a higher incidence of hypertension or heart problems (p=0.00). Of these, 37.6% had difficulty controlling their condition with medications. There was no significant difference (p=0.069) in duration of PA in those with or without hypertension or heart disease.

Irregular heart beat requiring medical management was reported by 18.2% in this group. They showed no difference in the duration of PA versus those without an irregular heart rhythm (p=0.980). Only 3 patients had chronic heart failure and 2 patients with coronary artery disease did not do any physical exercise in the previous two months.

Hypertension was noted by 146 (68.6%) participants from this group, of whom 38.4% had difficulty in controlling it with medications or other therapies and 28 (19.2%) had a blood pressure ≥ 160/90 mm Hg with or without medication. Amongst these two latter groups, there was no significant difference in the duration of PA per week.

3.2.2. PAR-Q+ Question 2 (Do You Feel Pain in the Chest at Rest, during Your Daily Activities of Living or When You Do Physical Activity?)

For the second question 23 (2.3%) reported chest pain either at rest or during PA. The chest pain group spent an average of 99.1±113.3 minutes per week on PA versus 226.4±214 minutes for those without chest pains (p=0.00). All chest pain patients reported having high blood pressure.

Only 5 of the chest pain participants reported having a respiratory illness such as chronic obstructive pulmonary disease, bronchial asthma or pulmonary hypertension. These spent less time on PA than those without respiratory disease (median 20 vs 90 minutes, p=0.227). Another 4 had bronchial asthma with significant limitation to their weekly PA duration. Amongst all patients with respiratory disease, the duration of PA averaged 178 minutes vs 233 minutes for those without co-morbidities (p=0.029)

3.2.3. PAR-Q+ Question 3 (Do you Lose Balance Because of Dizziness or Have You Lost Consciousness in the Last 12 Months?)

For the third question 33 (3.2%) said Yes. There was no significant difference in age or PA level in those with or without dizziness or loss of consciousness.

Only 4 of these 33 patients reported a stroke or transient ischaemic attack previously, 4 had experienced a blackout, fainting spell or loss of consciousness as a result of head injury within the previous 12 months and 9 (27.3%) exhibited low blood pressure significant enough to cause dizziness, light headedness or fainting. These did not significantly affect the duration of PA they had per week.

3.2.4. PAR-Q+ Question 4 (Have You Ever Been Diagnosed with Another Chronic Medical Condition Other than Heart Disease or High Blood Pressure?)

For the fourth question 129 (12.7%) said Yes. Those with chronic medical conditions were older (54.8 vs 46.5 years, p = 0.00). Hyperlipidemia and diabetes mellitus were the commonest diseases reported. Only 4 reported kidney problems without these significantly affecting their exercise

 doi:10.20944/preprints202405.0306.v1



duration. The medical conditions, per se, did not generally limit their weekly PA duration, unless they had multiple co-morbidities.

**Table 2.** Participants' Response to PAR-Q+.

| | | |
|---|---|---|
| **1.** | **Par-Q+ Question 1** | |
| | a. Numbers answering Yes to Question 1 | 213 (20.9%) |
| | b. Numbers with Heart or Cardiovascular Condition | 66 |
| | i. Difficulty controlling condition with medications or physician-prescribed therapies | 24 |
| | ii. Irregular heart beat that requires medical management | 12 |
| | iii. Chronic Heart failure | 3 |
| | iv. Diagnosed coronary artery disease and no regular physical activity last 2 months | 2 |
| | c. Numbers with high blood pressure | 146 |
| | i. Difficulty controlling condition with medications or physician therapies | 56 |
| | ii. Resting blood pressure ≥ 160/90 mm Hg | 28 |
| | d. Numbers answering No to all follow-up questions | 22 |
| **2.** | **PAR-Q+ Question 2** | |
| | a. Numbers answering Yes to Question 2 | 23 (2.3%) |
| | b. Numbers with a Respiratory Disease | 5 |
| | i. Difficulty controlling condition with medications or physician-prescribed therapies | 1 |
| | ii. Ever had low blood oxygen at rest or during physical activity and doctor said requires supplemental oxygen | 0 |
| | iii. If asthmatic, any symptoms of chest tightness, wheezing, laboured breathing, consistent cough > 2 days/week or required rescue medication > twice last week | 0 |
| | iv. High blood pressure in blood vessels of lungs | 0 |
| | c. Numbers answering No to all follow-up questions | 18 |
| **3.** | **PAR-Q+ Question 3** | |
| | a. Numbers answering Yes to Question 3 | 33 (3.2%) |
| | b. Numbers who have had a stroke | 4 |
| | i. Difficulty controlling condition with medications or physician-prescribed therapies | 2 |
| | ii. Impairment in walking / mobility | 0 |
| | iii. Stroke last six months | 1 |
| | c. Numbers experienced blackout, fainted, lost consciousness with head injury or diagnosed consussion within last 12 months | 4 |
| | d. If having low resting blood pressure significant enough to cause dizziness, light headedness, and /or fainting | 9 |
| | e. Any epilepsy or neurological condition | 2 |

 doi:10.20944/preprints202405.0306.v1



| | | |
|---|---|---|
| | f. Numbers answering No to all follow-up questions | 21 |
| **4.** | **PAR-Q+ Question 4** | |
| | a. Numbers answering Yes to Question 4 | 129 (12.7%) |
| | b. Numbers with kidney problems | 4 |
| | c. Any medical condition not listed above | 102 |
| | d. Having 2 or more medical conditions | 41 |
| | e. Numbers answering No to all follow-up questions | 0 |
| **5.** | **PAR-Q+ Question 5** | |
| | a. Numbers answering Yes to Question 5 | 203 (19.9%) |
| | b. Any metabolic conditions (including Type 1 Diabetes, Type 2 Diabetes, Pre-diabetes)<br>i. Difficulty in controlling blood sugar levels<br>ii. Often suffering from signs and symptoms of hypoglycemia<br>iii. Any signs / symptoms of diabetes complications<br>iv. Other metabolic conditions | 52<br>17<br>3<br>5<br>4 |
| | c. Planning to engage in unusually high or vigorous intensity exercises in near future | 74 |
| | d. Any cancer of any kind<br>i. Does Cancer diagnosis include lung, multiple myeloma, head and / or neck<br>ii. Currently receiving cancer therapy | 6<br>2<br>1 |
| | e. Any medical condition not listed above | 87 |
| | f. Currently living with 2 more more medical conditions? | 111 |
| | g. Numbers answering No to all follow-up questions | 1 |
| **6** | **PAR-Q+ Question 6** | |
| | a. Numbers answering Yes to Question 6 | 172 (16.9%) |
| | b. Any arthritis, osteoporosis or back problems<br>i. Difficulty controlling condition with medications or physician-prescribed therapies<br>ii. Any joint problems causing pain, recent fracture or fracture from osteoporosis / cancer, diaplaced vertebra and/or spondylolysis<br>iii. Any steroid injections or taken steroid tablets for maore than 3 months | 67<br>6<br>25<br><br>1 |
| | c. Any spinal cord injury<br>i. Difficulty controlling condition with medications or physician-prescribed therapies<br>ii. Any sudden bouts of Autonomic Dysreflexia | 5<br>0<br>0 |
| | d. Numbers answering No to all follow-up questions | 105 |
| **7.** | **PAR-Q+ Question 7** | |
| | a. Numbers answering Yes to Question 7 | 10 (1.0%) |
| | b. Any Mental Health Problems of Learning Difficulties?<br>i. Difficulty controlling condition with medications or physician-prescribed therapies<br>ii. Any Down Syndrome and back problems affecting nerves or muscles? | 1<br>0<br>0 |

 doi:10.20944/preprints202405.0306.v1



| | | |
|---|---|---|
| | c. Numbers answering No to all follow-up Questions | 9 |

3.2.5. PAR-Q+ Question 5 (Are You Taking Prescribed Medications for a Chronic Medical Condition?)

For the fifth question 203 (19.9%) said 'Yes'. Of these 52 had diabetes mellitus, 6 had a cancer and 87 some non-listed medical condition. Those with at last two medical conditions exercised less (192 vs 227 minutes, p=0.033). About 32.7% of diabetics had problems with sugar control, though this did not specifically, statistically, decrease their exercise duration (p=0.075). Those with diabetes complications (9.6% with either hypoglycaemia or target organ damage) tended to exercise for a longer duration (median 240 vs 120 minutes), though this difference was not statistically significant (p= 0.629). The 4 participants with other metabolic conditions, (pregnancy-related diabetes, chronic kidney disease and liver problems) had no significant differences in their PA duration (p=0.159).

For all 74 who were planning to engage in unusually high or vigorous intensity exercise in the near future, their current level of PA did not differ from those without such plans (p=0.949).

Only 6 respondents reported cancers. Their exercise duration did not differ from those without cancers (p=0.944)

3.2.6. PAR-Q+ Question 6 (Do You Currently Have, or Have Had within the Past 12 Months, a Bone, Joint, or Soft Tissue (Muscle, Ligament, or Tendon) Problem That Could Be Made Worse by Becoming More Physically Active?)

For this sixth question 172 (16.9%) said Yes. Of these 18.6% had upper limb problems, 54.7% had lower limb problems, 12.2% had problems with the trunk and 14.5% non-specific aches and pains. There was no significant difference in the PA levels of these four groups of participants (p=0.751). Up to 39.0% of these persons had back and joint pains which had no impact on PA duration (p=0.477). There was no significant age difference between those with or without joint problems.

Only 6 (0.5%) reported difficulty in controlling their condition with medications or other physician-prescribed therapies. While those with difficulty generally exercised less (94 vs 186 minutes), this did not reach statistical significance (p=0.326). Up to 37.3% of those with joint problems reported pain, or a recent fracture caused by osteoporosis or cancer, displaced vertebra or spondylolysis. Amongst such respondents, 1.5% required steroid injections. Only 2.9% reported a history of spinal cord injury which did not significantly impact on their duration of PA (p=0.616). None exhibited autonomic dysreflexia.

3.2.7. PAR-Q+ Question 7 (Has Your Doctor Ever Said That You Should Only Do Medically Supervised Physical Activity?)

For the seventh question 1.0% reported 'Yes'. Even then there was no significant difference in PA levels (p=0.916). Only 10.0% of these (or 0.1% of all respondents) reported having any mental health problems or learning difficulties. None reported Down's syndrome and back problems.

3.2.8. Participants Requiring Further Referral

Overall, 442 (43.4%) of the participants said Yes to at least one question. Of these, 105 said No to all the follow-up questions. Based on the criteria for referral, at least 337 (33.1%) of this cohort would have required referral to a doctor or qualified exercise professional for the use of the ePARmed-X+ or further evaluation. When distributed by age this would be 15.4% of those from age 21 – 39.9 years,34.5% of those from 40 - 59.9 years, and 57.2% of those aged 60 years and above. If only those who had difficulty in controlling their symptoms were considered (though this was not the basis for the PARQ+ referral for medical evaluation) 111 (10.9%) would likely have required referral to a medical practitioner for further evaluation.

 doi:10.20944/preprints202405.0306.v1



*3.3. Participants Feedback on the PAR-Q+*

3.3.1. Level of Ease in Understanding the PAR-Q+ Questions

The level of ease in understanding the main questions or the follow-up questions, where applicable, and based on the revised Likert scores, after addressing satisficing by survey participants, is shown in Table 3. Of the main 7 questions, 4 were noted to be easily understood and 3 with slight difficulty. The follow-up question that consistently demonstrated moderate difficulty for 5 of the 7 main questions was "Do you have difficulty controlling your condition with medication or other physician-prescribed therapies?". The question that generated the overall lowest mean Likert score was "Do you have a resting blood pressure ≥160/90 mm Hg with or without medication?". Out of the 44 follow-up questions 12 were easy to understand, 24 were encountered with slight difficulty, 8 with moderate difficulty and none with significant difficulty.

Generally, ease of understanding the questions was lower amongst those with co-morbidities, except for Question 1.

**Table 3.** Feedback on PARQ+ Questions.

| Main PARQ+ Question and Follow-up Questions | | Ease of Understanding question (Mean Likert score ± SD) – non-satisficing participants | | p value | Whether No Difficulty, Slight Difficulty, Moderate Difficulty, Significant Difficult |
|---|---|---|---|---|---|
| | | No co-morbidities | With co-morbidities | | |
| **1.** | **Has your doctor ever said that you have a heart condition or high blood pressure?** | **4.74±0.65** | **4.72±0.63** | **0.489** | **No Difficulty** |
| | a. Do you have a heart of cardiovascular condition? This includes coronary artery disease, heart failure, diagnosed abnormality of heart rhythm | 4.34±1.06 | 4.58±0.93 | 0.188 | Slight difficulty |
| | i. Do you have difficulty controlling your condition with medication and other physician-prescribed therapies? | 4.08±1.16 | 3.27±1.56 | 0.235 | Significant Difficulty |
| | ii. Do you have an irregular heart rhythm that requires medical management? (e.g. atrial fibrillation, premature ventricular contraction) | 4.50±1.04 | 4.60±0.89 | 0.857 | No Difficulty |
| | iii. Do you have chronic heart failure? | 4.27±1.20 | 3.50±2.12 | 0.587 | Significant Difficulty |
| | iv. Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months? | 4.09±1.31 | NA | NA | Slight Difficulty |
| | b. Do you have high blood pressure? | 4.81±0.51 | 4.85±0.49 | 0.768 | No Difficulty |
| | i. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? | 4.20±1.18 | 3.30±1.74 | 0.049 | Significant Difficulty |
| | ii. Do you have a resting blood pressure ≥160/90 mm Hg with or without medication? | 4.14±1.30 | 4.20±1.48 | 0.647 | Slight Difficulty |
| **2.** | **Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?** | **4.66±0.78** | **4.40±1.34** | **0.855** | **Slight Difficulty** |
| | a. Do you have respiratory disease? This includes chronic obstructive pulmonary disease, asthma, pulmonary high blood pressure. | 3.75±0.84 | NA | NA | Moderate Difficulty |
| | i. Do you have difficulty controlling your condition with medication or other physician-prescribed therapies? | NA | NA | NA | |



doi:10.20944/preprints202405.0306.v1

| | | | | | |
|---|---|---|---|---|---|
| | ii. Has your doctor ever said your blood oxygen level is low at rest or during exercise and / or that you require supplemental therapy? | NA | NA | NA | |
| | iii. If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 2 days/week) or have you used your rescue medication more than twice in the last week? | NA | NA | NA | |
| | iv. Has your doctor ever said that you have high blood pressure in the blood vessels of your lungs? | NA | NA | NA | |
| **3.** | **Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? Please answer NO if your dizziness was associated with over-breathing (including during vigorous exercise)** | **4.59±0.83** | **4.45±1.04** | **0.760** | **Slight Difficulty** |
| | a. Have you had a stroke? This includes Transient Ischaemic Attack or Cerebrovascular event. | 4.44±0.88 | NA | NA | Slight Difficulty |
| | i. Do you have difficulty controlling your condition with medication or other physician-prescribed therapies? | NA | NA | NA | |
| | ii. Do you have any impairment in walking or mobility? | NA | NA | NA | |
| | iii. Have you experienced a stroke or impairment of nerves or muscles in the past 6 months? | NA | NA | NA | |
| | b. Have you experienced a black-out, fainted, or lost consciousness as a result of a head injury within the last 12 months OR have you had a diagnosed concussion within the last 12 months? | 4.50±0.97 | NA | NA | Slight Difficulty |
| | c. Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light headedness, and / or fainting? | 4.20±0.92 | 4.50±0.71 | 0.758 | Slight Difficulty |
| | d. Do you have a medical condition such as epilepsy or a neurological condition? | 4.80±0.42 | NA | NA | No Difficulty |
| **4.** | **Have you been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)?** | **4.68±0.67** | **4.55±0.84** | **0.313** | **No Difficulty** |
| | a. Do you have kidney problems? | 4.80±0.46 | NA | NA | No Difficulty |
| | b. Do you have a medical condition that has not been listed above? | 4.78±0.67 | 4.42±1.09 | 0.711 | Slight Difficulty |
| | c. Do you currently live with two or more medical conditions? | 4.56±0.96 | 4.67±0.71 | 0.942 | No Difficulty |
| **5.** | **Are you currently taking prescribed medications for a chronic medical condition? Please list conditions and medications** | **4.76±0.61** | **4.76±0.57** | **0.910** | **No Difficulty** |



doi:10.20944/preprints202405.0306.v1

| | | | | | |
|---|---|---|---|---|---|
| | a. Do you have any metabolic conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes. | 4.66±0.68 | 4.55±0.82 | 0.944 | No Difficulty |
| | i. Do you often have difficulty in controlling your blood sugar levels with foods, medications, or other physician-prescribed therapies? | 4.00±1.41 | 4.00±1.73 | 1.000 | Moderate Difficulty |
| | ii. Do you often, suffer from signs and symptoms of low blood sugar (hypoglycemia) following exercise and/or during activities of daily living? Signs of hypoglycemia may include shakiness, nervousness, unusual irritability, abnormal sweating, dizziness or light-headedness, mental confusion, difficulty speaking, weakness and sleepiness. | 4.20±1.32 | NA | NA | Slight Difficulty |
| | iii. Do you have signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, OR the sensation in your toes and feet? | 4.11±1.36 | NA | NA | Slight Difficulty |
| | b. Do you have other metabolic conditions (such as current pregnancy-related diabetes, chronic kidney disease, or liver problems)? | 4.48±0.95 | NA | NA | Slight Difficulty |
| | c. Are you planning to engage in what for you is unusually high (or vigorous) intensity exercise in the near future? | 4.69±0.65 | 4.71±0.53 | 0.800 | No Difficulty |
| | d. Do you currently have Cancer of any kind? | 4.84±0.49 | NA | NA | No Difficulty |
| | i. Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of the plasma cells), head, and/or neck? | NA | NA | NA | |
| | ii. Are you currently receiving cancer therapy (such as chemotherapy or radiotherapy)? | NA | NA | NA | |
| | e. Do you have a medical condition that has not been listed above? | 4.75±0.64 | 4.76±0.55 | 0.876 | No Difficulty |
| | f. Do you currently live with two or more medical conditions? | 4.65±0.78 | 4.75±0.65 | 0.569 | No Difficulty |
| **6.** | **Do you currently have (or have within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active?** | **4.44±0.96** | **4.41±1.05** | **0.803** | **Slight Difficulty** |
| | a. Do you have Arthritis, Osteoporosis, or Back Problems? | 4.91±0.38 | 4.64±0.70 | 0.052 | No Difficulty |
| | i. Do you have difficulty controlling your condition with medication or other physician-prescribed therapies? | 4.41±1.10 | NA | NA | Slight Difficulty |
| | ii. Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g. spondylolisthesis), and/or spondylolysis / pars defect (a crack in the bony ring on the back of the spinal column) | 4.19±1.28 | 4.13±1.12 | 0.908 | Slight Difficulty |



doi:10.20944/preprints202405.0306.v1

| | | | | | |
|---|---|---|---|---|---|
| | iii. Have you had steroid injections or taken steroid tablets regularly for more than 3 months? | 4.74±0.69 | 4.65±0.78 | 0.536 | No Difficulty |
| | b. Do you have a spinal cord injury? (This includes Tetraplegia and Paraplegia) | 4.65±0.94 | 3.50±2.12 | 0.000 | Significant Difficulty |
| | i. Do you have difficulty controlling your condition with medication or other physician-prescribed therapies? | 4.00±1.41 | NA | NA | Moderate Difficulty |
| | ii. Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)? | 4.50±0.71 | NA | NA | Slight Difficulty |
| **7.** | **Has your doctor ever said that you should only do medically supervised physical activity?** | **4.78±0.57** | **NA** | **NA** | **No Difficulty** |
| | a. Do you have any Mental Health Problems or Learning Difficulties? This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome. | 4.61±0.75 | NA | NA | No Difficulty |
| | i. Do you have difficulty controlling your condition with medication or other physician-prescribed therapies? | 4.65±0.76 | NA | NA | No Difficulty |
| | ii. Do you have Down Syndrome AND back problems affecting nerves or muscles? | 4.64±0.78 | NA | NA | No Difficulty |



doi:10.20944/preprints202405.0306.v1

 doi:10.20944/preprints202405.0306.v1



The rate of comments obtained from the survey (Table 4) varied from 11.0% for Question 2 to 24.1% for Question 1. For the first six questions, participants who answered 'Yes' to the main question raised more queries, with this trend being statistically significant for Questions 1, 3, 4 and 6. For Question 7, none of the 10 participants who answered 'Yes' raised any comments. The common comments and suggestions received from the participants are summarised in this table.

**Table 4.** Comments, Queries and Suggestions by Participants on each of the PARQ+ and follow-up questions.

| PAR-Q+ Question and follow-up questions | Total numbers of Queries and Comments | Number (%) of queries by Participants who answered 'Yes' | Number (%) of queries by Participants who answered 'No' | P value |
|---|---|---|---|---|
| 1 | 246 | 70/213 (32.9%) | 176/806 (21.8%) | 0.001 |
| 2 | 152 | 5/23 (21.7%) | 147/996 (14.8%) | 0.432 |
| 3 | 165 | 14/33 (42.4%) | 151/986 (15.3%) | 0.000 |
| 4 | 112 | 23/129 (17.8%) | 89/890 (10.0%) | 0.008 |
| 5 | 136 | 33/202 (16.3%) | 103/817 (12.6%) | 0.167 |
| 6 | 134 | 41/172 (23.8%) | 93/847 (11.0%) | 0.000 |
| 7 | 89 | 0/10 (0.0%) | 89/1009(8.8%) | 0.326 |

| PAR-Q+ Question and Follow-Up Questions | Common Comments |
|---|---|
| 1 | • Questions were very wordy with lots of technical terms which are difficult to understand<br>• Not sure what is meant by difficulty controlling your condition with medication or other physician-prescribed therapies<br>• Should not have two elements in one question, e.g. have diagnosed coronary artery disease, and not participated in regular physical activity in last 2 months<br>• Not sure about BP reading of 160/90 mm Hg as most of us do not regularly check our BP.<br>• What is a qualified exercise professional? |
| 2 | • Questions very wordy with lots of technical terms that difficult to understand<br>• Question such as "If asthmatic, do you have chest tightness, wheezing, laboured breathing, consistent cough, or have used rescue medication at least twice over the last 2 months" is confusing, too long and can be broken up into a few sentences with simpler language.<br>• Is childhood asthma considered as having asthma?<br>• Chest pain can be due to heart or lung problems. Should this be asked as part of Question 1? |

 doi:10.20944/preprints202405.0306.v1



| | |
|---|---|
| | • What is "high blood pressure in the lungs"?<br>• Replace "rescue medication" with "inhalers" which is more easily understood.<br>• At what reading is oxygen low at rest? |
| 3 | • Long sentences with multiple issues need to be broken up into smaller statements, e.g. "Do you lose balance because of dizziness?" and "Have you lost consciousness in the last 12 months?" should be two different questions.<br>• What is Transient Ischaemic Attack? Need to explain in lay terms.<br>• What is a cerebrovascular event? Please explain in lay terms<br>• How low should blood pressure (BP) be to be reported as low BP? What are low BP symptoms?<br>• What does impairment in nerves or muscles mean?<br>• The question "Do you have a medical condition such as epilepsy or a neurological condition?" is confusing and should be replaced with a simpler question such as "Do you have a neurological condition such as epilepsy?". |
| 4 | • Please list examples of chronic medical conditions that we should declare.<br>• Questions generally long. Should be shortened. Too many medical terms. Use layman terms.<br>• What are chronic medical problems? Please define. Would diabetes, high cholesterol, gastritis, asthma, food allergy, eczema, kidney stones, urinary infection, thyroid problem, scoliosis, hepatitis B carrier all quality to be chronic medical problems?<br>• Why only exclude heart disease and high blood pressure? Why not exclude stroke, dizziness and other conditions covered in previous questions?<br>• How will stating my medical problems help me decide whether to go and see a medical practitioner or qualified exercise professional before I change my level of physical activity? |
| 5 | • Again asking about medical conditions – seems a repetition of previous questions<br>• Questions too long-winded and too many medical terms. The longer the question, the more difficult it is to understand. Keep the questions short.<br>• To list medications is not easy. Medication names are difficult to remember. Can be omitted?<br>• Omit questions abut sub-type of cancer. Is this important?<br>• Instead of listing cancer types, just state cancer above the waist<br>• Do not understand the term multiple myeloma<br>• Low blood sugar questions is too long<br>• Need to define what is unusually high or vigorous intensity exercise |

 doi:10.20944/preprints202405.0306.v1



| | |
|---|---|
| | • Not too sure what metabolic conditions mean. Is it just diabetes? How about thyroid and problems with other glands?<br>• Be specific about sensation in the toes and foot – is it numbness, stiffness, pain or itchiness? |
| 6 | • Too much use of medical jargon makes this and follow-up questions challenging, unfriendly. 4 out of 8 questions in this section have jargon. Don't understand bulk of medical terms.<br>• When the word "recent" is mentioned, what is the time-line?<br>• Long sentences can be shortened and simplified, e.g. Q6 can be read as "In the last 12 months have you had bone, joint or muscle problems that can become worse with physical activity?".<br>• What does "difficulty in controlling your condition" mean? Is it no more pain or less pain?<br>• Many older folks have knee pains. Is the PAR-Q+ intended to exclude such persons from physical activity?<br>• Does spinal cord injury equal back pain?<br>• There are too many follow-up questions. Reduce the number. |
| 7 | • Not sure how a person with Learning Difficulties, Alzheimer's Down's Dementia, Depression, Anxiety Disorder, etc reliably complete the PARQ+, unless with help of a supervisor.<br>• Some questions are too long and with multiple medical jargon. Need simplification.<br>• What does medically supervised physical activity mean? Does a doctor need to be present each time for the activity?<br>• Do mental health problems also refer to those with ADHD, Autism, Asperger's, Bipolar disorder. Social anxiety, OCD, etc.? |
| Additional suggestions | • Was participant ill or received vaccination during the 2 weeks before planned exercise?<br>• Has any member of the family suffered sudden cardiac death or collapsed while exercising?<br>• Any recent injury / surgery within last 3 months that would affect planned physical activity?<br>• Did participant get a good night sleep before the planned physical activity?<br>• Do you practice self-check, e.g. any dizziness, chest discomfort or unusual shortness of breath, before any moderate or intensive physical activity?<br>• To include advisory in the pre-participation questionnaire to include the following: |

 doi:10.20944/preprints202405.0306.v1



| | |
|---|---|
| | 1. Advice for menopausal or aging women who wish to start exercising<br>2. Whether have seen a doctor in the last 12 months for a medical check-up?<br>3. To ensure sufficient hydration before exercising<br>4. Advice on warming up prior to exercise<br>5. Rate your willingness to start exercising<br>6. To provide recommendations on levels of exercise (by minutes per week)<br>7. What to do if not feeling well during exercise |

3.3.2. Questionnaire Length

Overall, 40.0% of the participants said that the questionnaire length was just right, 50.1% felt it was too long and 9.9% that it was short. Though more of those with co-morbidities felt that the questionnaire was too long, the difference was not statistically significant (p=0.164). However, there were many recommendations from the participants to shorten the length of the PAR-Q+ questions.

3.3.3. Use of Technical Terms

Up to 46.0% of participants felt that the amount of technical terms used was just right, 46.9% felt that there were too many technical terms used and the remaining 7.1% felt more terms could be added. Most of those who mentioned about excessive use of medical jargon commented on the lack of understanding of these terms by themselves and, by extension, the general members of the community. There was no significant difference in the feedback by occupational groups. However, those with co-morbidities preferred less technical terms (p=0.002)

3.3.4. Suggested Frequency for Completion of the PAR-Q+ Form

The proportion of participants who preferred the PAR-Q+ to be used by exercise participants not more than once annually was 61.9%, while 25.7% preferred it to be carried out once every six months and the remaining 12.4% as frequently as needed. There was no significant difference in the preference by numbers of co-morbidities (p=0.883) or by age-group (p=0.384)

## 4. Discussion

This study was performed to determine the likelihood of exercise participants needing referral for medical evaluation by using the PAR-Q+ if they were to increase their level of involvement in physical activity, to assess their difficulty in the use of this tool and obtain feedback on this. The participants came from a broad age-spectrum of the adult population and from different walks of life. Their feedback should be taken into account when considering implementation of the PAR-Q+ in adult populations working and living in similar urban environments around the world. Language has not been a major issue in this survey since most Singaporeans, in spite of their varied ethnic background, were brought up with the English language as their main medium of education and the main business language in working life.

Expectedly, our study demonstrated that co-morbidities generally increased with age. Any pre-participation tool should identify those who are at increased risk. At the same time, the need for every person with a co-morbidity to undergo a medical assessment before exercising is a disincentive to exercise, which is not the intention of such questionnaires. The questionnaire should identify those who are especially prone to an acute adverse event, such as cardiovascular collapse or an acute injury. In this study, based on the PARQ+ criteria for referral to a medical practitioner for use pf the ePARmedex, 33.1% would have required further work-up. Such large numbers would overtax the health resources of any system. The question arises whether the PAR-Q+ can be more discriminating in identifying the truly at-risk persons. If only those who were unable to control their symptoms with their current therapies were referred for medical evaluation, the proportion would have decreased to

 doi:10.20944/preprints202405.0306.v1



10.9% of the population surveyed, which would be less likely to tax the healthcare resources anywhere near as much.

When the PARQ was originally introduced in Canada, it excluded about 20% of the adult population [13] and especially 55% of those aged ≥60 years [14]. With multiple revisions of the PAR-Q+ and subsequent referral to a physician for an ePARmed-X+ evaluation, the exclusion rate has been further decreased [15]. What is not known, however, is the proportion of the adult population, and especially those above the age of 60 years who are to be referred for the ePARmed-X+. Even a 20% referral rate after a self-administered tool may seem excessive. The high referral rate seen in our study may also be owing to a difficulties in understanding and interpretation of the questions in the PAR-Q+, especially by those who were symptomatic.

The feedback suggests that participants with co-morbidities found more difficulties in understanding the questions than those who answered No to the various PAR-Q+ and follow-up questions. A self-administered pre-participation questionnaire should identify those who matter most, viz. those whose morbidities should be picked up and should have the least problems in understanding the questions. There will be a need to review the phraseology of the main PAR-Q+ and follow-up questions to address this concern. In a warm and humid environment, moderate to severe PA can result in some degree of dehydration and sometimes heat-related illnesses, such as heat exhaustion and heat-stroke, especially for individuals unwell for a few days or had lack of sleep or acclimatization prior to participating in such an activity. This factor has not been addressed in the PARQ+.

Increased PA brings on numerous health benefits, including better control of blood sugar and cholesterol, and other metabolic disorders, less risk of premature disability and death from cardio-cerebrovascular disease, and improvement in physical fitness levels in a wide variety of persons. A high referral rate for medical evaluation may be a disincentive for those with an initial intention of improving their level of physical and medical fitness. A slight increase in risk for adverse events may occur with increased PA, at least initially, and precautions would need to be considered to lower these risks, especially in persons unaccustomed to regular exercise. Pre-participation screening is an important component in becoming physically more active. It helps to identify individuals who are at-risk of sudden death or injury.

*Limitations of the Study*

This study did not examine the reliability of the PAR-Q+ in minimizing the likelihood of adverse events during moderate to intense PA in the community. Such an objective would require a prospective long-term effort involving large numbers of community participants using this tool and monitoring of adverse outcomes after PA. This study also did not address the validity of the use of the seven main questions in the PAR-Q+ in pre-identifying persons at risk. The authors accepted the arguments put forth by the team that drew up the seven main and other follow-up questions that these were evidence-based. The public survey that we conducted could not have addressed the issues of reliability and validity.

## 5. Conclusion

Self-administered, pre-participation screening for PA is currently not systematically implemented in most jurisdictions. Our study suggests that if we were to adopt the PAR-Q+ nation-wide as the primary self-administered pre-participation screening tool for PA, about one-third of the adult population would require evaluation by an ePARmed-X tool for detailed medical evaluation. The logistical implications of this can be mind-boggling. For the participants, this may be a disincentive to get physically active. The feedback from the potential PA participants suggests that if we were to use the PAR-Q+, it should require significant simplification before being recommended.

**Author Contributions:** The study was conceived by VA. The study design was by the team of SHCA, VA, IRH, LCH and TLT. The study was led by SHCA. Analysis of results was conducted by VA, IRH, LCH, TLT and SHCA. The initial manuscript was prepared by VA and LRH and reviewed by VA, IRH, LCH, TLT and SHCA.

**Funding:** This research received no external funding

**Institutional Review Board Statement:** The study was approved by the Institution Review Board of the Singapore Sport Institute.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The raw data which forms the basis for the Tables in this manuscript is available at https://www.dropbox.com/scl/fo/rx672w1j9w34sk85s2wr9/ADDM-_neBU7-MsbvLpnXemU?rlkey=eoahg15r9cxj2tccul4srbr0j&dl=0 .

**Conflicts of Interest:** The authors declare no conflicts of interest.

## References


1. Thomas S, Reading J, Shephard RJ. Revision of the Physical Activity Readiness Questionnaire (PAR-Q). *Canadian Journal of Sport Science*. **1992**;17:4 338-345.
2. PAR=Q+. The Physical Activity Readiness Questionnaire for Everyone. PAR-Q+ Collaboration. https://eparmedx.com/?page_id=75. Last accessed 17 December 2022.
3. Sports Safety Committee. Overview and Recommendations for Sports Safety in Singapore - A Report by the Sports Safety Committee. 2007. https://www.sportsingapore.gov.sg/files/Sport%20Education/Sport%20Safety/Sports_Safety_Committee_26SEPO7.pdf . Last accessed 26 June 2023
4. Tremblay MS, Warburton DE, Janssen I, Paterson DH, Latimer AE, Rhodes RE, et al. New Canadian physical activity guidelines. *Appl Physiol Nutr Metab.* **2011**;36(1):36-46 (Eng), 47-58 (Fr).
5. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. *Int J Behav Nutr Phys Act.* **2010**;7:39.
6. Warburton DER, Katzmarzyk PT, Rhodes RE, Shephard RJ. Evidence-informed physical activity guidelines for Canadian adults. *Appl Physiol Nutr Metab.* **2007**;32(Suppl 2E):S16-68.
7. Canadian Society for Exercise Physiology. Get Active Questionnaire. 2017. https://csep.ca/2021/01/20/pre-screening-for-physical-activity/#post/0. Accessed 16 Jan 2023
8. Sport Singapore. Sport Safety Committee Report March 2019. https://www.sportsingapore.gov.sg/files/Sport%20Education/Sport%20Safety/2019_Sports_Safety_Committee_Report_30Oct19(4).pdf . Last accessed 23 June 2023
9. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet.* **2004** Jan 10;363(9403):157-63. doi: 10.1016/S0140-6736(03)15268-3.
10. Barge, S., Gehlbach, H. Using the Theory of Satisficing to Evaluate the Quality of Survey Data. *Res High Educ.* **2012**. 53, 182–200. https://doi.org/10.1007/s11162-011-9251-2
11. International Labour Organisation. Department of Statistics. International Standard Classification of Occupations (ISCO). https://ilostat.ilo.org/resources/concepts-and-definitions/classification-occupation/. Last accessed 2 June 2023
12. Scott B, Gehlbach H. Using the Theory of Satisficing to Evaluate the Quality of Survey Data. *Research in Higher Education*. **2012**. 53 (2): 182-200. doi:10.1007/s11162-011-9251-2. http://dx.doi.org/10.1007/s11162-011-9251-2.
13. Vriesema, C. C., & Gehlbach, H. Assessing survey satisficing: The impact of unmotivated questionnaire responding on data quality. *Educational Researcher*, **2021**. 50(9), 618–627. https://doi.org/10.3102/0013189X211040054
14. Shephard, R.J., Cox, M.H., & Simper, K. An analysis of "Par-Q" responses in an office population. *Canadian Journal of Public Health*, **1981**. 72, 37-40.
15. Shephard, R.J., Mahoney, A., Flowers, J.F., & Benidge, M.E. On the preliminary screening of elderly exercise volunteers. *Canadian Journal on Aging*, **1984**. 3, 91-98.
16. Bredin SS, Gledhill N, Jamnik VK, Warburton DE. PAR-Q+ and ePARmed-X+: new risk stratification and physical activity clearance strategy for physicians and patients alike. *Can Fam Physician*. **2013** Mar;59(3):273-7. PMID: 23486800; PMCID: PMC3596208.