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INTERNATIONAL LAUNCH OF THE PAR-Q+ AND ePARmed-X+
Validation of the PAR-Q+ and ePARmed-X+

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Abstract

The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) and the electronic Physical Activity Readiness Medical Examination (ePARmed-X+) were created recently to reduce the barriers to physical activity participation for individuals with and without established chronic disease. Our primary purpose was to provide preliminary evidence on the effectiveness of these new forms for pre-participation screening and risk stratification. In particular, we sought to examine the new PAR-Q+ (and ePARmed-X+) risk stratification strategy in comparison to the previous PAR-Q. The new PAR-Q+ and ePARmed-X+ risk stratification and pre-participation strategy reduced significantly the number individuals that were sent for medical referral in comparison to the PAR-Q (i.e., 0.8% vs. 15%, respectively). The reliability of the PAR-Q+ over a three month period was high (r = 0.99). Moreover, the new strategy demonstrated high sensitivity (0.90 (95% CI = 0.77-0.96)) and specificity (1 (95% CI = 0.99-1)) for determining those with and without hypertension, respectively. In conclusion, our preliminary evaluation of the new PAR-Q+ and ePARmed-X+ risk stratification and pre-participation strategy in comparison to the PAR-Q reveals that the new process reduces greatly the barriers to physical activity participation, with a high reliability, sensitivity, and specificity of measurement. **Health & Fitness Journal of Canada 2011;4(2):38-46.**

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Introduction

The Physical Activity Readiness Questionnaire (PAR-Q) has been used successfully by millions of people worldwide reducing greatly the barriers to becoming more physically active (Shephard, 1994; Warburton et al., 2011d; Warburton et al., 2011e). Various agencies (such as the American College of Sports Medicine) have recognized the PAR-Q screening procedure for apparently healthy individuals. However, as acknowledged in this issue (Warburton et al., 2011e) and elsewhere (Shephard, 1994) the purposely conservative nature of the PAR-Q and its restrictions based on age and chronic disease status have introduced barriers to physical activity participation for certain individuals that may not be warranted.

In the general population, it is not uncommon for the PAR-Q to exclude 10-30% of participants (particularly those between the ages of 60-69 years). By design, the PAR-Q is particularly prohibitive for individuals with established chronic disease as there is direct referral to a physician for those that answer YES to one or more of the seven screening questions. For many practices or laboratories, the usage of the PAR-Q has been viewed as somewhat restrictive in the facilitation of physical activity participation. For instance, in one investigation (Bull et al., 1999) the PAR-Q

excluded 70% of 882 primary care patients, although the authors considered that many of these individuals would have benefited from engaging in 30 min of daily moderate intensity physical activity.

The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) and the electronic Physical Activity Readiness Medical Examination (ePARmed-X+) were created recently to reduce the barriers to physical activity participation for individuals with and without established chronic disease. The purpose of this current paper was to provide preliminary evidence on the effectiveness these new forms for pre-participation screening. In particular, we sought to examine the new PAR-Q+ (and ePARmed-X+) risk stratification and pre-participation screening strategy in comparison to the PAR-Q. We hypothesized that the new strategy would reduce greatly the number of individuals referred to a physician.

Methods

The PAR-Q+ was formulated, designed, and written by a team of investigators from the PAR-Q+ Collaboration (specifically, Dr. Darren Warburton, Dr. Norman Gledhill, Dr. Veronica Jamnik, and Dr. Shannon Bredin) relying on evidence-based best practice recommendations emanating from recent systematic reviews of the literature, evidence-based clinical practice guidelines, and current research practice. It is important to highlight that the authors made use of the Delphic process in the development of the new PAR-Q+ and ePARmed-X+. This was consistent with the procedures employed by the authors of the PAR-Q (Shephard, 1994).

The Delphic process was conducted over a 2-year period including evaluations from leading international authorities and qualified exercise professionals and other allied health professionals from Hong Kong (China), the United States, the United Kingdom, and Canada. A draft version of the PAR-Q+ was created in 2009 and more formal version was released in 2010 at the 3rd International Congress on Physical Activity and Public Health (Toronto, Ontario) (Warburton et al., 2010). In April 2011, the public release of the 2011 PAR-Q+ was made in this journal (Warburton et al., 2011c). It is anticipated that this process will continue as future versions of the PAR-Q+ are created and made available. The new PAR-Q+ and ePARmed-X+ should therefore be considered to be dynamic and living documents that change as the evidence-base changes.

Qualified exercise professionals utilized the PAR-Q+ and ePARmed-X+ extensively with apparently healthy individuals (of all ages), at-risk individuals, and persons with established chronic medical conditions in several research trials (Burr et al., 2011; Flesher et al., 2011; Foulds et al., 2011) under the supervision of Drs. Warburton and Bredin. This process was instrumental in the evaluation and ongoing revision of the PAR-Q+ and ePARmed-X+.

Similar to the PAR-Q and its revisions, (Shephard, 1994) the primary objective was to increase the specificity of the new PAR-Q+ measure (i.e., the percentage of individuals who are correctly identified as not having a condition that would preclude them from becoming more physically activity) without reducing unduly its sensitivity (i.e., the percentage of individuals who are not ready for increased physical activity participation who are correctly detected).

Comparison of the PAR-Q to the new PAR-Q+ and ePARmed-X+ clearance strategy

The current PAR-Q and new PAR-Q+/ePARmed-X+ clearance strategies were compared directly in 489 adult participants (54% men (n = 263); 46% women (n = 226)) with a group mean age of 44.1 ± 9.5 yr. The age range was 19 – 69 yr.

Comparisons were made between those individuals that would be cleared for physical activity participation using both screening strategies and the number of positive responses to the first page of the PAR-Q and PAR-Q+. The participants were required to complete paper versions of both the current PAR-Q+ and PAR-Q, and, where necessary, utilized the online ePARmed-X+. The final recommendation for each participant was recorded from the PAR-Q and PAR-Q+/ePARmed-X+ clearance strategies. The potential outcomes for the PAR-Q included: 1) clearance to become more physically active, or 2) referral to a physician for further evaluation. Whereas, the PAR-Q+/ePARmed-X+ strategy allowed for the following outcomes: 1) clearance to become more physically active, 2) clearance to exercise under the guidance of a qualified exercise professional with advanced training, or 3) referral to a physician for further evaluation.

A qualified exercise professional was available in instances wherein the PAR-Q+/ePARmed-X+ clearance strategy recommended further evaluation by a qualified exercise professional. This provision allowed for the direct clearance of participants that were referred to a qualified exercise professional. This is consistent with the new risk stratification and clearance strategy of the PAR-Q+.

The relationship between the seven questions from Page 1 of the PAR-Q and Page 1 of the PAR-Q+ was also determined using Spearman rank correlation.

In addition, the participants had direct measures of aerobic fitness (6 min walk (Burr et al., 2011) or Leger 20 m shuttle (Leger et al., 1988)), waist circumference (cm), body mass (kg), standing height (cm), and resting blood pressure (via an automated blood pressure device (VSM MedTech BPM-100)).

Body mass index (BMI) was calculated using height and weight ($kg \cdot m^{-2}$). Participants were categorized according to their aerobic fitness, BMI, waist circumference, and blood pressure. Those individuals with high blood pressure values (i.e., > 140/90 mmHg) who were not previously diagnosed with hypertension were also referred to a family physician for confirmation of the presence of high blood pressure.

Sensitivity and Specificity Calculations of PAR-Q+ with Respect to Hypertension

We evaluated the prevalence of hypertension (via direct measure and self-report (including confirmed diagnosis of blood pressure and/or blood pressure lowering medication usage)). Using the confirmed hypertension prevalence rate and the responses of the participants, we calculated the sensitivity and specificity of the PAR-Q+ with specific reference to hypertension.

Test/Re-Test Reliability of the PAR-Q+

The test/re-test reliability of the PAR-Q+ was determined in a subset of the participants (n = 145). These participants were asked to complete the PAR-Q+ at two time periods (separated by three months). A Spearman rank correlation coefficient was derived to evaluate the reliability of the PAR-Q+.

Written informed consent was obtained from all participants. The

University of British Columbia provided ethical approval. All research was conducted in accordance with the *Declaration of Helsinki*.

Results

The participant demographics are presented in Table 1. In the participants, 8% had high blood pressure (i.e., > 140/90 mmHg), 67% had low aerobic fitness levels for their age and gender (based on the recommendations of Gledhill and Jamnik, 2003), 73% were overweight or obese (based on BMI), and 70% had waist circumference values above recommended (Figure 1).

Table 1: Participant characteristics.

Measure	Mean ± SD
Age (yr)	44.1 ± 9.5
Height (cm)	169.4 ± 9.8
Weight (kg)	78.6 ± 20.2
Body Mass Index (kg·m^{-2})	27.2 ± 5.6
Waist Circumference (cm)	88.3 ± 14.6
Maximal Aerobic Power (mL·kg^{-1}·min^{-1})	35.1 ± 7.2
Blood Pressure (mmHg)	120/76 ± 13/10

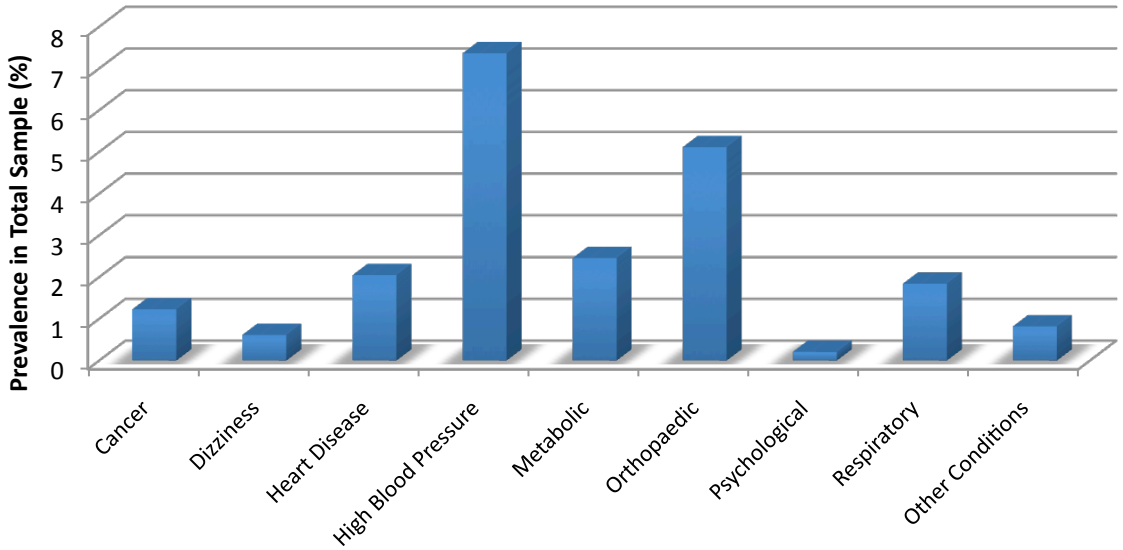
Comparison of the PAR-Q and PAR-Q+

There was a strong relationship between the responses (to the first seven questions) on the PAR-Q and the new PAR-Q+ (r = 0.80). In this cohort (n = 489), 15.1% of the participants answered YES to one or more of the seven PAR-Q questions and as such would have been referred directly to a physician for further medical evaluation. In comparison, 21.7% (n = 106) of the participants answered YES to the first page of the PAR-Q+.

Many of the individuals (9.8%) who responded YES to Page 1 of the PAR-Q+ answered positively to the first question related to heart disease and hypertension (Table 2; Figure 2). The majority of these individuals were living with high blood pressure (as determined via self-report through the PAR-Q+). Orthopaedic conditions (in particular arthritis and osteoporosis) were also identified frequently by the participants (as captured by the questions related to joint issues and the current treatment of a chronic medical condition other than heart disease and hypertension).

The higher YES response rate of the first page of the PAR-Q+ versus the PAR-Q

Figure 2: Prevalence of self-reported medical conditions (n = 489).



was related to the increased capacity of the PAR-Q+ to capture those individuals with or taking medications for other chronic conditions (Table 2). For instance, the PAR-Q+ identified a further 9.2% of individuals that had a chronic medical condition that was not heart disease or hypertension.

were referred to a physician for further medical evaluation. The reasons for referral were excessive blood pressure (n = 3) and congenital heart defect (n =1). The PAR-Q+ referral rate to physicians was markedly and significantly lower than that seen with the PAR-Q (0.8 vs. 15.1%, respectively).

Table 2: Number and percentage of respondents answering YES or NO to the new PAR-Q+ (n = 489).

YES n (%)	NO n (%)	PAR-Q+ Questions	
48 (9.8)	441 (90.2)	1	Has your doctor ever said that you have a heart condition OR high blood pressure?
3 (0.6)	486 (99.4)	2	Do you feel pain in your chest at rest, during your daily activities of living OR when you do physical activity?
5 (1.0)	484 (99.0)	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).
45 (9.2)	444 (90.8)	4	Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)?
63 (12.9)	426 (87.1)	5	Are you currently taking prescribed medications for a chronic medical condition?
27 (5.5)	462 (94.5)	6	Do you have a bone or joint problem that could be made worse by becoming more physically active? Please answer NO if you had a joint problem in the past (e.g., knee, ankle, shoulder, or other) that does not limit your current ability to be physically active.
0 (0.0)	489 (100.0)	7	Has your doctor ever said that you should only do medically supervised physical activity?

Using pages 2 and 3 of the PAR-Q+, 63.2% (n = 67) of the individuals that responded YES to one or more questions on Page 1 of the PAR-Q+ were cleared for physical activity participation without further referral to the ePARmed-X+ or a qualified exercise professional. The remaining 36.8% (n = 39) were referred to the ePARmed-X+. This represented 8.0% of the entire cohort (n = 489) being referred to the ePARmed-X+.

At the end of the ePARmed-X+ risk stratification and clearance strategy, four people out of 489 (0.8%) participants

Sensitivity and Specificity of the PAR-Q+ in relation to Hypertension

By design, the specificity of the test for correctly identifying those healthy individuals without hypertension was high (i.e., 1 (95% CI = 0.99-1)). Specifically, in our 489 participants no participant incorrectly identified themselves as having hypertension (i.e., there were no false positives). The sensitivity (recall rate) was 0.90 (95% CI = 0.77-0.96)) such that the PAR-Q+ was effective in correctly identifying persons living with hypertension. The four false

negatives involved individuals who were previously unaware of having high blood pressure, but through this study had directly assessed confirmation of high blood pressure (via a qualified exercise professional and a physician).

Reliability of the PAR-Q+

In the 145 participants that completed the PAR-Q+ on repeat occasions (separated by a three month period) there was remarkable reliability of the responses to the PAR-Q+ (r = 0.99). In 100% of the cases, the participant was provided the same recommendation at the end of the PAR-Q+ process (i.e., at baseline and three months later).

Table 3: Number of participants answering YES to one or more questions on the PAR-Q+ and PAR-Q (n = 489).

Number of YES responses	PAR-Q+ n (%)	PAR-Q n (%)
1 or more	106 (21.7)	74 (15.1)
2 or more	62 (12.7)	9 (1.8)
3 or more	18 (3.7)	2 (0.4)
4 or more	5 (1.0)	1 (0.2)
5 or more	0 (0)	0 (0)

Discussion

The PAR-Q has been used with success for over 35 years. With respect to the PAR-Q process, it is difficult to clearly ascertain its sensitivity (i.e., the percentage of individuals who are not ready for increased physical activity participation who are correctly detected) and specificity (i.e., the percentage of individuals who are correctly identified as not having the condition) (Shephard, 1994). However, more than 35 years of usage (by millions of individuals on an annual basis) would indicate that the sensitivity of the PAR-Q process is quite good, with limited evidence of adverse events in individuals that complete the PAR-Q clearance process. For example, the laboratories of Drs. Norman Gledhill and Roni Jamnik have collectively evaluated more than 60,000 fire fighter applicants using the PAR-Q without a major adverse event (*unpublished documented observations*). However, as acknowledged in this series of articles a significant proportion of participants do not pass the PAR-Q screening by responding positively to one or more of the seven questions (Shephard, 1994). This problem appears to be even greater for those aged 60-69 yr. Shephard (1994) estimated that approximately 20% of participants fail the original PAR-Q screening test, and as many as 55% of older participants are screened out.

As outlined by Shephard (1994) subsequent examination of the medical records, blood pressure readings, and/or electrocardiograms in positive responders indicated that many of the exclusions were unnecessary (false positive). Accordingly, revisions to the PAR-Q were promoted and incorporated by Dr. Roy Shephard (one of the original reseachers responsible for the development of the PAR-Q) (Shephard et al., 1991) that served to reduce the number of individuals who were "screened out" from 17% to 12% (Shephard, 1994). Moreover, 7% of those who originally made a positive response to the PAR-Q were cleared by the revised PAR-Q; however, 2% of new candidates were also cautioned about engaging in physical activity (Shephard, 1994; Shephard et al., 1991).

We revealed noteworthy findings in the current analyses supporting a marked reduction in the barriers to physical activity participation for apparently healthy individuals and persons living with chronic medical conditions. We

found that the new PAR-Q+ and ePARmed-X+ strategy reduced markedly the numbers of participants referred to a physician. Simply stated, less than 1% of the participants were referred to a physician using the PAR-Q+ strategy in comparison to approximately 15% when using the PAR-Q.

The new PAR-Q+ and ePARmed-X+ will likely lead to even greater reductions in the referral rate to physicians than observed in the current trial. For instance, in the direct comparison of the PAR-Q to the PAR-Q+ we did not include participants from outside of the PAR-Q age range. In the real world application of the PAR-Q these individuals would have been referred directly to a physician and often end up being considered false positives. The removal of the age barriers to the PAR-Q+ will cut down markedly on the number of false positives that are related to age alone (i.e., individuals older than 69 yr that are sent directly to a physician with the PAR-Q). This is supported by the previous findings of Shephard (1994). Moreover, the PAR-Q+ will reduce the barriers to physical activity participation for young children (i.e., those below 15 yr). For instance, sport camps are often met with the issue of finding a suitable pre-participation clearance tool for children under the age of 15 yr (the lower age limit of the current PAR-Q). Many camps are left with the difficult decision of not using a pre-participation screening form or hiring physicians that clear all camp entrants below the age of 15. In these instances, the exercise clearance of children becomes a significant and costly barrier to participation. The PAR-Q+ overcomes these barriers by having no age restriction making it suitable for all ages.

Our rates of hypertension (i.e., 8%) are somewhat lower than the prevalence rates demonstrated in the general population (Wilkins et al., 2010). For instance, Wilkins and colleagues (2010) revealed recently that roughly 19% of adult Canadians (5 million) live with high blood pressure and another 20% live with pre-hypertension. It is likely that a form of healthy participant bias limited the current investigation. The application of the PAR-Q+ to the general population (including persons living with varied medical conditions) will likely demonstrate further the capacity of this new risk stratification and pre-exercise clearance strategy to reduce the barriers for physical activity participation for all individuals. For instance, in this investigation we demonstrated that persons living with hypertension are often cleared by the PAR-Q+ strategy without seeing a physician. Considered in the context of roughly 20% of the Canadian population living with hypertension, this new strategy has a remarkable potential for reducing barriers to physical activity participation on a population basis.

The sensitivity and specificity of the PAR-Q+ in persons with and without established hypertension was extremely good (0.90 and 1, respectively). Moreover, the reliability of the measure was exceptionally good ($r = 0.99$). These findings support collectively the utility and potential of the new PAR-Q+ and ePARmed-X+ risk stratification and pre-participation clearance strategy.

Our team has operationally created and defined the term “qualified exercise professional” building upon the definition of Jamnik et al. (2007) regarding “qualified-university educated fitness professionals.” This term was chosen by our team to reflect the importance of advanced education, training, and certification (such as that provided by the

ACSM and other similar organizations) in the exercise sciences. The incorporation of qualified exercise professionals into this screening process was instrumental to the success of the PAR-Q+ in reducing barriers to physical activity participation. This supports directly the previous recommendations provided by Drs. Jamnik, Gledhill and Shephard regarding increasing the role of "qualified-university educated fitness professionals" in the risk stratification and pre-participation screening process (Jamnik et al., 2007). These findings also highlight further the importance of advanced education and certification in the exercise sciences and the integration of these professionals within allied health care team (Goodman et al., 2011; Jamnik et al., 2007; Warburton and Bredin, 2009; Warburton et al., 2011a; Warburton et al., 2011b; Warburton et al., 2011d; Warburton et al., 2010).

As a research team we are currently exploring various international validation processes of the PAR-Q+ and ePARmed-X+ risk stratification and exercise clearance strategy. This includes the systematic evaluation of these tools in different clinical populations, and individuals from across the lifespan. Those interested in participating in these international endeavours are welcome to contact our research team directly.

Conclusions

The PAR-Q has demonstrated a remarkable ability to safely and effectively clear millions of individuals for more than 35 years. However, the PAR-Q has been recently met with various criticisms, particularly related to its ability to screen individuals at the extremes of the age continuum and those with chronic disease. The recent creation of the new PAR-Q+ and ePARmed-X+ pre-participation screening and risk stratification strategy has led to even further reductions in the barriers to physical activity participation particularly for those that serve to benefit from becoming more physically active.

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As a research team, we are indebted to the important ongoing collaboration of colleagues from across the world (in particular Kim Buxton and Elaine McNish from the United Kingdom). We are also beholden to Dr. Roy Shephard, one of the original researchers responsible for the PAR-Q, who ensured that the new PAR-Q+ remained true to the intent of the original work conducted in the 1970s by Drs. David Chisholm, Shephard, and Don Bailey (and their collaborators).

Qualifications

The authors' qualifications are as follows: Darren Warburton Ph.D., CSEP-CEP, CSEP-CPT ME; Shannon S. D. Bredin Ph.D., CSEP-CEP, CSEP-CPT ME; Veronica Jamnik Ph.D., CSEP-CEP, CSEP-CPT ME; Norman Gledhill Ph.D., CSEP-CEP, FACSM.

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