Physical Activity Readiness Questionnaires for Post–COVID–19 Athletes: A Valid, Reliable, Low–Athlete Burden, Self–Assessment Screening Tool for Safe Return to Physical Activity and Exercise for Categories 1 and 2 COVID–19 Survivors

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Background: No disease-specific, reliable, and valid self-assessment tools exist for athletes with mild coronavirus disease (COVID–19) to self-return to sports. This study aimed to develop a self-assessment screening method for athletes with mild COVID–19.

Methods: Item generation, item reduction, and pretesting were used to develop a questionnaire that served as a screening tool to detect severe post-COVID-19 complications. The questionnaire was validated by both internal and external reviewers, and the final version consisted of 11 items. Face validity was assessed through direct interviews with 11 athletes. Severe COVID-19 complications were identified for criterion validity and correlation analysis. A total score of 11 indicates that there is no risk of severe COVID-19 complications and gradual return to play is recommended; results <11 indicate a need for further evaluation by trained medical personnel. For reliability test, 50 respondents were chosen and asked to answer the questionnaires 7 days after their first responses.

Results: Physical Activity Readiness Questionnaires for post–COVID–19 athletes (PAR-COVID-Q) demonstrated excellent internal consistency (r=1, P<0.05) and test-retest reliability (r=1, P<0.05). A total of 118 athletes scored 11, had normal health screening, normal electrocardiogram and chest X-ray, and successfully returned to sports without any reported complications (r=1, P<0.05). Two athletes scored <11 and underwent further medical evaluation.

Conclusion: The PAR-COVID-Q is a valid and reliable self-assessment tool with a low burden for athletes to return to sports following mild COVID–19.

Keywords: Exercise; COVID–19; Return to Sport; Return to Play; Post-COVID; Electrocardiography
INTRODUCTION

The coronavirus disease (COVID-19) pandemic, caused by a respiratory virus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), significantly affected the world in early 2020, and was described for the first time in Wuhan, China, in December 2019.1) Numerous studies have been extensively performed in a short period of time to understand the disease and its complications.2-6) Serious complications that can cause morbidity and mortality include COVID myocarditis, pulmonary embolism, and pulmonary fibrosis.7-9) High-risk factors for developing these complications are hospitalization, intensive care admission, and underlying medical illness.8,9) Sequelea of COVID-19 can be classified based on symptoms as severe or mild. Based on the data published by the Ministry of Health in Malaysia, most patients with post-acute COVID-19 have either mild or asymptomatic symptoms.3)

During the early pandemic, numerous international bodies recommended a proper screening before participation in sports, including echocardiography, electrocardiogram (ECG), cardiac marker, cardiac magnetic resonance, and a chest X-ray with or without D-Dimer screening.10-15) This type of screening is not economical and burdensome to the health care system. In April 2022, the British Journal of Sports Medicine updated a simpler guideline, the Graduated Return to Play (GRTP), for return to play for athletes with COVID-19.16) In the GRTP, all athletes are required to fulfill the following entry criteria: (1) complete all activities of daily living without excessive fatigue and/or breathlessness, and be able to walk on a flat surface without getting breathless; and (2) should not be hospitalized or require acute emergency care. Athletes must complete 5–10 days of gradual return to play, with monitoring of symptoms. However, the GRTP needs to be performed under supervision of a clinician. Lack of manpower in a healthcare system will overburden the service, leading to suboptimal care for patients. Additionally, the Institute of Sports Exercise and Health in the United Kingdom has developed a post-viral pre-participation health screening, which includes ECG and a chest X-ray prior to sports participation.

A self-assessment tool is an effective method for easing the financial and human resource burden on the healthcare system for athletes who have contracted categories 1 and 2 COVID-19, allowing them to return to play without the need for clearance from medical personnel. According to data from the Ministry of Health, Malaysia, categories 1 and 2 COVID-19 exhibit less severe complications.17) Complications, such as myocarditis, pulmonary fibrosis, pulmonary embolism, and severe fatigue, are commonly seen in patients with categories 3, 4, and 5 COVID-19, who require hospitalization and patients with underlying medical problems.17) These groups should undergo further assessments in healthcare facilities and close monitoring during gradual return to play. Therefore, this study aimed to develop self-assessment tools for athletes who contracted categories 1 and 2 COVID-19 infections for self-gradual return to play, and to validate and perform reliability testing. In these questionnaires, we expected athletes who answered “yes” to all the questions (11 questions) to successfully return to sports safely, with normal health screening, ECG, and chest X-ray.

METHODS

1. Item Generation

To create self-assessment tools for return to play in post-COVID-19 athletes, extensive literature regarding post-COVID-19 complications, safe return to physical activity, and exercise guidelines were reviewed to create the questionnaires. The literature was searched using PubMed and Scopus search engines. The terms used were ‘Covid-19’ OR ‘COVID’ OR ‘coronavirus’ OR ‘SARS-Cov-2’ AND ‘return to play’ OR ‘RTP’ OR ‘return to sport’ OR ‘RTS’ OR ‘athletes’ OR ‘Recommendation’ OR ‘Guidelines’ OR ‘consideration’ AND ‘post-infection’ OR ‘after infection’. The search was conducted between September 1, 2022 and December 1, 2022.

2. Item Reduction

Based on an extensive search, we divided the questionnaire domains into three categories: (1) to identify high-risk factors for developing severe post-COVID-19 complications, (2) to identify symptoms of severe post-COVID complications, and (3) to identify severe physical limitations. Each group comprised two sports physicians, one family medicine specialist with extensive experience in managing COVID-19 in the community, and one public health physician. Proposed questionnaires are provided in the supplementary files (Supplements 1, 2).

3. Sample Size

Our target sample included athletes who contracted COVID-19 and were followed-up for post-COVID-19 at the National Sports Institute between January 1, 2022 and May 10, 2023. An initial estimated sample size was 201, with a target sample size of 220 based on 11 items. A total of 312 athletes contracted COVID-19 and were followed-up at the National Sports Institute between January 1, 2022 and May 10, 2023. We used recall methods and asked the athletes to recall their post-COVID-19 symptoms from the latest COVID-19 infection between January 1, 2022 and May 10, 2023. This method was used because we predicted a low prevalence of COVID-19 in 2023. Therefore, a prospective study was not feasible. We chose January 1, 2022 because we would like to minimize the recall bias to one and a half years, and May 10, 2023 because that was the last date before our ethical approval.

4. Sample Recruitment

Of the 312 athletes, 33 had two episodes of COVID-19 infections during the study period. Therefore, we selected 279 athletes using WhatsApp. However, only 161 athletes (57.7% of 279) responded and agreed to participate in the study. Eighteen percent of the athletes (29 of 161) had difficulty understanding English language, and 12 were aged <16 years old; thus, they were excluded from the study. Therefore, only 120
athletes participated in the first round of answering the questionnaires (criterion validity) using Google Forms (Google LLC, Mountain View, CA, USA), which were then blasted using WhatsApp (WhatsApp Inc., Mountain View, CA, USA)—we are using the WhatsApp message to contact all athletes. Subsequently, the first 50 athletes were selected to answer a second round of questionnaire for reliability testing. Nonetheless, only 32 athletes responded, despite three reminders given through WhatsApp. Phone call was not made to respect the athletes’ privacy and their decision not to participate in the second questionnaire.

Files of 120 athletes were traced from the medical records of the National Sports Institute, and pre-participation health screening forms were extracted along with ECG, chest radiograph, and return-to-play duration. The following health screening forms were included: (1) demographic data: age, gender, and sports participation; (2) anthropometric data: height, weight, body mass index; (3) vital signs: blood pressure, resting heart rate, saturation of peripheral oxygen; (4) ECG report; and (5) chest X-ray report.

A pre-participation evaluation form, along with the ECG and chest X-ray reports, were available in electronic medical records and re-examined by a single examiner. The following categories were used to compare the findings with those of the Physical Activity Readiness Questionnaires for post-COVID-19 athletes (PAR-COVID-Q): all criteria should be fulfilled to classify patients as having no severe post-COVID-19 complications and safely return to sports category. (1) Athletes with absence of ongoing symptoms of cardiovascular disease, extreme fatigue or reduced performance, and no history of admission or referral post-COVID-19 were considered not having post-COVID-19 complications. (2) Athletes with normal ECG or ECG characteristics of athlete’s heart based on international criteria for ECG interpretations in athletes were considered not having post-COVID-19 complications. None of the athletes who completed the questionnaire had abnormal ECG findings. (3) Chest radiography without pulmonary fibrosis, collapse, or consolidation indicated no post-COVID-19 complications.

5. Content Validity
For content validation, internal reviewers reviewed the initial questionnaires consisting of four experts: (1) associate professor (Dr. Nur Amani) from primary care who was highly involved in the management of post-COVID in primary care settings; (2) associate professor (Dr. Nur Farizah) from the public health department and experts in COVID; (3) associate professor (Dr. Nahar) from sports medicine and researchers; and (4) Dr. Munawwar who was a sports physician working closely in the post-COVID clinic at the National Sports Institute, Malaysia. The initial questionnaires were revised, and preliminary questionnaires were developed, consisting of 11 items. Several suggestions and advice are provided regarding the wordings and terminologies used. A second version of the amended questionnaire was sent for

### Physical activity readiness for athletes with mild COVID-19 (PAR-COVID-Q)

Answer the following questions about your symptoms of COVID-19 and the risk of developing severe COVID-19. If you answer more or equal to 1 “no,” please visit your doctor for further evaluation before return back to sports.

1. I have never been hospitalised due to my current COVID-19
2. I do not have any of the following red flag symptoms:
   - Fever
   - Breathlessness at rest or minimal activity
   - Palpitation
   - Chest pain
   - Reduced performance
   - Severe calf pain
   - Lightheadness/blackout
3. I do not have problem that prevent me from exercising
4. I can walk for male >500 m without being breathless
   for female >580 m without being breathless
5. I have no underlying medical problems

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Figure 1. Final version of the Physical Activity Readiness Questionnaires for post-COVID-19 athletes (PAR-COVID-Q) with a total of 11 items.
content validation to external reviewers consisting of one consultant sports cardiologist, one consultant infectious disease physician, one exercise physiologist expert, one respiratory physician, one sports physician who was highly involved in post-COVID management in athletes, and one athlete who had a history of COVID-19 infection, using the Likert scale, as shown in Supplement 2. Eleven items remained, with changes in item 2(e) being replaced with chest tightness to reduce performance, and re-validated by the expert review. The final expert reviewer rated the amended questionnaire as adequately relevant, clear, simple, and without any doubt. The final set of questionnaires is shown in Figure 1. Overall validity indices are presented in Table 1.

6. Face Validity
For face validation, 11 athletes (1:10) had a direct interview session for 5–10 minutes regarding the PAR-COVID-Q. These athletes were national athletes who had been followed-up by the National Sports Institute for any reason and had contracted COVID-19. All the athletes agreed that the questionnaires were simple and easy to understand, less burdensome for follow-up, and easy to be self-administered. However, two athletes mentioned that some athletes in Malaysia might have problems with the Questionnaires in English language.

7. Criterion Validity
Absence of severe post-COVID-19 complications was characterized by a normal pre-participation evaluation form, normal ECG for athletes, and normal chest X-ray. The Spearman’s correlation coefficient ($\rho$) was calculated for the correlation between the total score of the questionnaire and presence of post-COVID complication, and $\rho=1$ suggested a significant correlation between both scales.

8. Reliability Test
The first 50 respondents were asked to answer the questionnaires 7 days after their first response. However, only 32 responded, despite being given a reminder 3 times.

<table>
<thead>
<tr>
<th>Question 1</th>
<th>Relevant</th>
<th>Sufficient</th>
<th>Simplicity</th>
<th>Clarity</th>
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<tr>
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<td>4.7</td>
<td>4.7</td>
<td>4.5</td>
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<tr>
<td>Question 2 (f)</td>
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<tr>
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<td>4.7</td>
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<td>Question 3</td>
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<td>Question 5</td>
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</table>


9. Data Analysis
Data are presented as frequencies (number), proportions (%), means, and standard deviations. Validity index (VI) was calculated after analyzing content validity. The VI was calculated as the number of experts providing a score <4 on the Likert scale (scores, 1–5) divided by the total number of experts.

To test the criterion validity, the Spearman’s Pearson correlation was used between the total score of all items and post-COVID-19 complications. We expect that a score of 11 (11 yeses) correlates with the absence of post-COVID complications, and a score <11 correlates with the need for further medical evaluation and/or the presence of post-COVID complications. Questionnaires were considered valid if the P-value was <0.05.

To test for reliability, internal consistency was estimated using the alpha coefficient. Cronbach’s $\alpha$ of at least 0.70 was suggested to indicate adequate internal consistency. Cut-off points for intraclass correlation coefficient (ICC) analysis were based on the guidelines which state that an ICC below 0.40 is a poor reliability; between 0.40–0.59 is fair; between 0.60–0.74 is good; and between 0.75–1.00 is excellent. For test-retest reliability, the Spearman’s correlation was used, and a P-value of <0.05 was considered significant. This study was approved by the National Sports Institute of Malaysia (RE/A/001/2023-002/2023). Informed consent was obtained from all individual participants included in the study.

RESULTS
In total, 120 athletes participated in the first round of the questionnaires. The mean age of the athletes was 23±5.14 years, ranging between 16–26 years. Approximately 35% (n=42) of the participants were female athletes, and 65% (n=78) were male athletes. Majority of the athletes (56.7%, n=68) were from the Malay race, 39.2% (n=47) were Chinese, 1.7% (n=2) were Indians, and 2.5% (n=3) were others. Sixty percent (n=72) of the athletes had category 2 COVID-19 infection, and 40% (n=48) had category 1. Demographic characteristics are outlined in Table 2.

All the athletes (98.3%, n=118) had a complete rest from the training for 1 week, followed by a gradual return to sports within 1–2 weeks after the COVID-19 infection. There were no documented complications post-COVID-19 in all the athletes who successfully returned to sports. Two athletes (1.7%) reported symptoms: chest pain (n=1) and reduced performance (n=1). These two athletes (1.7%) had a delay in returning to sports and received referral to a cardiologist for further cardiac evaluation. They were identified as C.S.Y. and M.T., respectively.

Twenty-one athletes (17.5%) had normal ECG, whereas 99 (82.5%) had ECG changes consistent with an athletes’ heart. No abnormal ECG findings were observed. The ECG characteristics are shown in Figure 2. All the athletes had normal chest radiographs. Two of the 120 athletes underwent echocardiography, and their results showed normal echo findings, with ejection fractions of 67% (C.S.Y.) and 68% (M.T.). Both athletes exhibited normal cardiac enzyme levels. Two of

https://doi.org/10.4082/kjfm.24.0036
the 120 athletes performed the stress test exercise; C.S.Y. was able to complete up to stage 5, and M.T. only was able to complete up to stage 2. The C.S.Y. was cleared and returned to play by a cardiologist. However, M.T. defaulted the cardiology follow-up.

For criterion validity, 118 athletes had a total score of 11 (11 yeses), with normal health screening, chest radiography, and ECG characteristics for athletes, and safely returned to sports (r=1, P<0.05). Two athletes with scores <11 were referred for further evaluation (r=1, P<0.05). The performance of each item is shown in Figure 3. When we compared the anthropometric characteristics and baseline vital signs between athletes with a score of 11 and those with a score <11, there were no statistical differences between the two groups (Table 3). For the reliability test, results showed an excellent internal consistency (r=1, P<0.05) and perfect test-retest reliability (κ=1, P<0.05) for all the items in 32 athletes.

### DISCUSSION

The current study is the first to examine test-retest reliability, internal consistency, and criterion validity of a newly developed screening questionnaires before returning to sports after contracting categories 1 and 2 COVID-19 infections. This questionnaire is simple and straightforward, with a low athlete burden.

#### 1. Development of Questionnaires

The questionnaire was used to screen for post-COVID-19 complications. In this questionnaire, there are three main domains covered to identify athletes at risk of severe complications and who should undergo medical screening by trained professionals: (1) a domain that identifies athletes with high-risk factors of developing severe complications covered by items one and five; (2) a domain that identifies symptoms at risk of developing severe COVID-19 complications covered by item 2 and its subdivision; and (3) a domain that identifies limitations of normal activity by items 3 and 4. These items were extensively reviewed by expert physicians with renowned experience in managing COVID-19 in Malaysia.

#### 2. Validity and Reliability

When testing for reliability, there was excellent internal consistency and perfect test-retest reliability in the 32 athletes. This demonstrated that our self-screening questionnaires were reproducible and highly reliable.
consistent. When we examined the validity of the criterion, athletes with a score of 11 (11 yeses) successfully returned to sports, with normal health screening, ECG characteristics, and chest radiographs. Two of the athletes underwent further evaluation for post-COVID-19 complications. One of the two athletes who had chest pain post-COVID had normal cardiac enzyme levels, a normal echocardiogram finding with an ejection fraction of 67%, normal hemodynamic response, and ECG changes during the stress test exercise up to stage 5, and was cleared for return to play. These results demonstrate that the PAR-COVID-19 is a valid questionnaire that can act as a self-screening tool for athletes prior to their return to play after mild COVID-19.

3. Clinical Implications
This is the first valid and reliable questionnaire as a self-screening tool for athletes returning to play after mild COVID-19. The application of these screening tools should help ease the healthcare burden and reduce costs. The PAR-COVID-Q is an excellent self-assessment tool. These questionnaires took <5 minutes to complete, were straightforward, and easy to understand. With efficient self-assessment tools, it creates less of a burden for athletes to visit hospitals.

We believe that the questionnaire has excellent reliability, reflecting the uncomplicated nature of the questions. The PAR-COVID-Q can be administered with minimal investigator assistance, thereby avoiding potential observer bias.

4. Limitations
However, we face many challenges and limitations when developing the PAR-COVID-Q. The prevalence of COVID-19 fluctuates worldwide. At the National Sports Institute in Malaysia, we observed a very low prevalence of COVID-19 among athletes, probably due to a lack of testing done these days. Thus, it is challenging to perform a prospective study because of the small sample size. Thus, this was a retrospective study. The main problem with retrospective studies is recall bias. To minimize bias, we limited the duration of our study to one and a half year starting from January 1, 2022. Nonetheless, when we compared athletes’ responses to their respective health screenings, the answers provided corresponded to the symptoms noted in the health screening. Even though the current prevalence of COVID-19 is low, we should expect an increase in the prevalence of COVID due to the swift evolution and mutation of the virus, which could lead to another pandemic. Other challenges included the struggle to obtain the target sample size. We targeted a 20:1 ratio as the optimal sample size for our study. However, we received a moderate response from the athletes (57.7%). This could be due to their busy schedules as national athletes, and many of the athletes trained outside the sports institute, making it difficult to reach them. As the questionnaires were delivered in English language, we observed that 18% of them had difficulty understanding English language, and most of them were from Malay ethnicity. Thus, we anticipate that there will be problems in delivering these self-assessment tools to non-English-fluent populations, and translation studies can be conducted to overcome such challenges. This study was not validated in children aged <16 years of age.

Nevertheless, the PAR-COVID Q is a valid, reliable, user-friendly, and low athlete burden screening tool for athletes aged >16 years to return to sports following mild COVID-19 infection. Athletes who an-

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Table 3. Difference in age, anthropometrics assessments, and vital sign of athletes with a score of 11 and those with scores <11

<table>
<thead>
<tr>
<th>Variable</th>
<th>Athletes with score of 11 (n=118)</th>
<th>Athletes with score &lt;11 (n=2)</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>Mean±SD 95% CI</td>
<td>Mean±SD 95% CI</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>63.5±12.5 [61.2 to 65.9]</td>
<td>74.5±21.9 [72.4 to 76.6]</td>
<td>0.304</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>168.1±9.7 [166.3 to 169.9]</td>
<td>162.5±7.7 [157.8 to 167.2]</td>
<td>0.477</td>
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<tr>
<td>Body mass index (kg/m²)</td>
<td>22.4±3.8 [21.7 to 23.1]</td>
<td>27.9±5.6 [27.3 to 28.5]</td>
<td>0.469</td>
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<tr>
<td>Oxygen saturation (%)</td>
<td>98.7±1.02 [98.5 to 98.9]</td>
<td>98.0±0.8 [96.8 to 99.2]</td>
<td>0.409</td>
</tr>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td>112.5±12.1 [110.3 to 114.7]</td>
<td>122.2±22.6 [118.5 to 125.9]</td>
<td>0.221</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm Hg)</td>
<td>72.1±8.3 [70.5 to 73.6]</td>
<td>82.5±10.6 [79.9 to 85.1]</td>
<td>0.783</td>
</tr>
<tr>
<td>Resting heart rate (beats/min)</td>
<td>66.1±10.6 [64.1 to 68.1]</td>
<td>58.1±16.9 [54.2 to 62.0]</td>
<td>0.438</td>
</tr>
</tbody>
</table>

Table 3 showed the difference in age, anthropometrics assessments, and vital sign of athletes with a score of 11 and with score less than 11. Student T test was used to compared within these two groups.

SD, standard deviation; CI, confidence interval.

*By t-test.

https://doi.org/10.4082/kjfm.24.0036
swer all yes (11 yeses) can gradually return to sports safely. In contrast, athletes who answered <11 yeses should undergo a thorough medical assessment to ensure that there are no severe complications of COVID-19.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGMENTS

We would like to thank all experts from various specialties involved in item development and expert reviewers who spent time providing valuable opinions during the content validity process.

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SUPPLEMENTARY MATERIALS

Supplementary materials can be found via https://doi.org/10.4082/kjfm.24.0036. Supplement 1. Initial proposal of PAR-COVID-Q. Supplement 2. First revision of PAR-COVID-Q.

REFERENCES