ARQUIVOS DE ASMA, ALERGIA E IMUNOLOGIA


*Original Article*

# Translation, Cultural Adaptation, and Validation of the Allergy Questionnaire for Athletes (AQUA) for Brazilian Portuguese

*Tradução, adaptação cultural e validação do Questionário de Alergia para Atletas (AQUA) para o português brasileiro*

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**ABSTRACT**

**Introduction:** Exercise-induced bronchospasm is characterized by temporary airway obstruction, causing breathlessness, dry cough, and wheezing during or after exercise. In athletes, exercise-induced bronchospasm may be linked to pre-existing allergies, affecting health, quality of life, and performance. **Methods:** This cross-sectional study included athletes who had been on university sports teams for ≥ 6 months and was conducted in 2 phases: (1) translation and cultural adaptation following international guidelines for semantic and conceptual equivalence; 2) validation and reproducibility by assessing inter- and intraobserver reliability. Exercise capacity and lung function were evaluated using incremental leg exercise testing and spirometry. Fifteen athletes (mean age 21.6 [SD, 2.3] years; 66.7% male) participated, whose most common sport was volleyball (33.3%). All participants had normal lung function. **Results:** Total scores were consistent between initial and repeated applications by the same examiner (6.6 [SD, 2.5] vs. 6.6 [SD, 2.6]; p = 1.0) and different examiners (6.6 [SD, 2.5] vs. 7 [SD, 3]; p = 0.4). The Cronbach's alpha of 0.94 (p < 0.001) indicated excellent reliability. Bland-Altman analysis confirmed good agreement between applications, supporting the instrument's reproducibility. **Conclusions:** The Brazilian version of the Allergy Questionnaire for Athletes is a reliable and reproducible instrument for assessing allergies in athletes. It also demonstrates validity in associating allergy status with exercise testing to detect exercise-induced bronchospasm.

**Keywords:** Bronchospasm, exercise, athletes, exercise-induced bronchospasm.

**RESUMO**

**Introdução:** O broncoespasmo induzido pelo exercício (BIE) é caracterizado por uma obstrução temporária das vias aéreas, causando falta de ar, tosse seca e chiado no peito durante ou após o exercício. Em atletas, o BIE pode estar relacionado a alergias pré-existentes, afetando a saúde, a qualidade de vida e o desempenho. **Método:** Foi realizado um estudo transversal com atletas que participavam de equipes esportivas há pelo menos seis meses. O estudo foi dividido em duas fases: (1) tradução e adaptação cultural seguindo diretrizes internacionais para equivalência semântica e conceitual; e (2) validação e reprodutibilidade, avaliando a confiabilidade interobservador e intraobservador. A capacidade de exercício e a função pulmonar foram avaliadas por meio de um teste incremental com os membros inferiores e espirometria. Participaram 15 atletas (média de idade 21,6±2,3 anos), sendo a maioria do sexo masculino (66,7%), com o vôlei como esporte mais comum (33,3%). Todos apresentaram função pulmonar normal. **Resultados:** Os escores totais do AQUA foram consistentes entre a aplicação inicial e a reaplicação pelo mesmo avaliador (6,6±2,5 vs. 6,6±2,6; p = 1,0) e entre avaliadores diferentes (6,6±2,5 vs. 7±3; p = 0,4). O alfa de Cronbach de 0,94 (p < 0,001) indicou excelente confiabilidade. A análise de Bland-Altman confirmou boa concordância entre as aplicações, apoiando a reprodutibilidade do instrumento. **Conclusão:** A versão brasileira do AQUA é confiável e reprodutível para avaliar alergias em atletas. Também demonstra validade ao associar o status alérgico com os testes de exercício para detectar broncoespasmo induzido pelo exercício.

**Descritores:** Broncoespasmo, exercício, atletas, broncoespasmo induzido pelo exercício.

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## Introduction

Exercise-induced bronchospasm (EIB) is a temporary airway obstruction caused by exercise that leads to dyspnea, dry cough, and wheezing.[1] It results from hyperventilation-induced dehydration of the lower airways, altering the osmotic gradient and triggering bronchospasm. Environmental factors, such as exercise intensity, air quality, temperature, and humidity, influence its onset.[2] EIB in athletes may also be linked to pre-existing allergic diseases, which involve abnormal immune responses. Thus, diagnosing allergies is crucial in the clinical assessment of athletes, given that allergic diseases can significantly affect health, quality of life, and performance.[3]

The Allergy Questionnaire for Athletes (AQUA) is a reliable allergy screening tool.[3,4] Despite its practicality and accessibility, no validation study has been conducted for the Portuguese language. Thus, we translated, validated, and culturally adapted the AQUA questionnaire into Brazilian Portuguese.

## Methods

This cross-sectional study was conducted at the University of Fortaleza's Human Movement Analysis Laboratory with athletes 18–30 years of age who had been on university sports teams for ≥ 6 months. The exclusion criteria included recent respiratory infections (≤ 6 weeks) and asthma requiring continuous medication.

The study was conducted in 2 phases: 1) translation and cultural adaptation of AQUA to Portuguese and 2) validation and reproducibility testing. The process followed best practices from the literature.[5] The ethical guidelines of National Health Council Resolution 466/12 were observed, including informed consent from all participants and approval from the University of Fortaleza Ethics Committee (decision 5,959,262).

AQUA consists of 25 questions on allergic symptoms, family history, suspected allergies, and medication use, which are scored based on a positive likelihood ratio. The total score determines the questionnaire's sensitivity, specificity, and predictive value. In this study, questions 4 to 16 were scored, classifying athletes as AQUA (+) (≥ 5) or AQUA (–) (< 5). The final Portuguese version is provided in the Supplementary Material. For validation and reproducibility, 15 athletes completed the questionnaire twice with different examiners (30 minutes apart) and once more with the initial examiner to assessment intraobserver agreement.

The exercise test assessed EIB and its correlation with AQUA. Participants avoided intense exercise, stimulants, and corticosteroids on test day. They wore light clothing and sneakers, with the lab temperature set at 24 °C–26 °C, as per guidelines.[6] Athletes performed an incremental leg test on a load-bearing ergometer, starting at 25 W for 3 minutes and increasing by 25 W per minute until exhaustion.

Pulmonary function was assessed using spirometry, measuring forced expiratory volume in the first second ($FEV_1$) and forced vital capacity. Four measurements were taken: before, immediately after, 5 minutes after, and 10 minutes after the incremental leg test. $FEV_1$ decreases > 10% were considered indicative of EIB. This criterion followed established recommendations from the Brazilian Thoracic Society and the American Thoracic Society.[6]

### *Statistical Analysis*

The data were analyzed using IBM SPSS Statistics 20.0 and GraphPad Prism 6.0. The Shapiro-Wilk test was used to assess data distribution, and descriptive analysis included mean (SD), frequencies, and delta variations. The instrument's reproducibility was assessed via the intraclass correlation coefficient, the Wilcoxon test, and Bland-Altman plots, while Cronbach's alpha was used to assess internal consistency. Spearman's correlation was used to validate AQUA against spirometry ($FEV_1$) and the incremental leg test (maximum load), with a significance level of 5%.

## Results

Fifteen athletes participated in the study, with a mean age of 21.6 [SD, 2.3] years and normal pulmonary function (Table 1). The reproducibility analysis showed no significant differences in AQUA scores between initial and repeated applications by the same examiner (6.6 [SD, 2.5] vs. 6.6 [SD, 2.6]; p = 1.0) or between applications by different examiners (6.6 [SD, 2.5] vs. 7 [SD, 3]; p = 0.4).

The intra-observer intraclass correlation coefficient was 0.93 (95% CI: 0.80–0.97), while the inter-observer intraclass correlation coefficient was 0.91 (95% CI: 0.75–0.97). Cronbach's alpha (0.94, p < 0.001) confirmed excellent reliability. Bland-Altman analysis

**Table 1**
Personal and clinical characteristics of the study participants

| | n = 15 |
|---|---|
| **Age (years)[a]** | 21.6±2.3 |
| **Sex[b]** | |
| Male | 10/66.6 |
| Female | 5/33.7 |
| **Weight (kg)[a]** | 77±19.6 |
| **Height (cm)[a]** | 1.79±0.1 |
| **BMI (kg.cm$^2$)[a]** | 23.8±4.9 |
| **Sport[b]** | |
| Volleyball | 5/33 |
| Athletics | 3/20 |
| Tennis | 3/20 |
| Basketball | 2/13.3 |
| Martial arts | 2/13.3 |
| **Pulmonary function[a]** | |
| $FEV_1$ (L) | 3.7±0.8 |
| $FEV_1$ (%) | 87.3±10.5 |
| FVC (L) | 4.4±0.9 |
| FVC (%) | 91.6±10.6 |

[a] Data expressed as mean ± standard deviation; [b] Data expressed as relative and absolute frequency; BMI = body mass index; cm = centimeters; $FEV_1$ = forced expiratory volume in 1 second; FVC = forced vital capacity; kg = kilograms; L = liters.

demonstrated strong intra- and interobserver agreement (Figure 1).

Regarding validity, AQUA scores showed moderate, significant correlations with $\Delta\%FEV_1$ immediately after vs. 5 minutes post-exercise (r = -0.6; p=0.04) and maximum load in the exercise test (r = -0.6; p = 0.04) (Table 2), supporting its reliability for identifying EIB in athletes.

## Discussion

The Portuguese version of AQUA demonstrated excellent reliability and reproducibility when administered by different observers and the same observer. This consistency suggests that the Portuguese version of AQUA reliably reproduces results when administered to athletes under similar conditions. These findings align with previous studies, reinforcing the instrument's reliability in assessing allergic predisposition in athletes.[3,7] Regarding sex and sports modality, the results were consistent with existing literature, showing a predominance of male athletes and a high proportion of AQUA (+) individuals.[8]

AQUA scores showed a moderate inverse correlation with pulmonary function ($\Delta\%FEV_1$) immediately after vs. 5 minutes post-exercise and maximum exercise load. While AQUA identifies allergy predisposition, its predictive capacity for EIB may be limited due to the small sample size and its design as a screening tool rather than a diagnostic test. This observation is consistent with a Swedish study that used a similar incremental test under more extreme temperatures (18 °C and -15 °C) and found no significant changes in $FEV_1$ or $FEV_1$/forced vital capacity post-exercise, suggesting that high-intensity exercise may not always induce EIB.[9] Similarly, a study in Lithuania with recreational runners using a stair test at approximately 20 °C found no significant differences in $FEV_1$ decrease at 1, 2, 5,

and 10 minutes post-exercise, with only 42.3% of the participants experiencing a decrease > 10%.[10]

One limitation of this study is its single-center design, as data were collected exclusively from athletes at one university, potentially limiting generalizability. Additionally, the small sample size may limit the external validity and generalizability of the findings, especially for broader populations of athletes. Moreover, as a cross-sectional study, it was not possible to evaluate the responsiveness of the Portuguese version of AQUA to interventions, such as bronchodilator therapy or behavioral and environmental changes.

As a reliable screening tool, AQUA enables early identification of allergic predisposition, which is crucial in sports, given that allergies impact performance, health, and well-being. Identifying at-risk athletes allows for preventive measures and early interventions, minimizing effects on performance while improving overall health and quality of life. AQUA also facilitates a multidisciplinary approach to athlete care, encouraging collaboration between sports medicine professionals, allergists, pulmonologists, and coaches. This integrated care model enhances decision-making and supports the development of comprehensive management plans that address each athlete's needs.

In conclusion, the Brazilian Portuguese version of AQUA is a reliable, reproducible, and valid tool for assessing allergic predisposition in athletes.

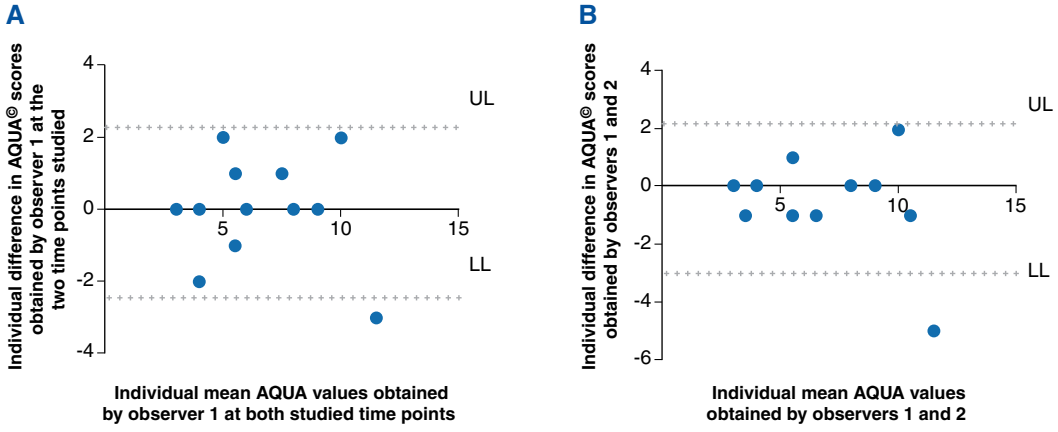


**Figure 1**
Bland-Altman graphs of intra- and interobserver analysis. In **A**, intraobserver analysis: mean = 0.1; upper limit (UL) = 2.56 and lower limit (LL) = –2.56. In **B**, interobserver analysis: mean = –0.33; UL = 2.69 and LL = –3.35

**Table 2**
Correlation between AQUA scores and spirometric data and incremental leg test results

| | AQUA (-) | | AQUA (+) | |
|---|---|---|---|---|
| | r | p | r | p |
| Δ%$FEV_1$ pre-test vs immediately post-test | 0.9 | 0.5 | 0.3 | 0.30 |
| Δ%$FEV_1$ pre-test vs 5 min post-test | -0.4 | 0.6 | -0.5 | 0.05 |
| Δ%$FEV_1$ immediately post-test vs 5 min post-test | -0.4 | 0.6 | -0.6 | 0.04* |
| Maximum workload in exercise test (watts) | -0.3 | 0.6 | -0.6 | 0.04* |

AQUA (+) = score ≥ 5; AQUA (–) = score < 5; $FEV_1$ = forced expiratory volume in one second; FVC = forced vital capacity.

**Supplement**

Brazilian version of the Allergy Questionnaire for Athletes (AQUA)

**Brazilian Version of the Allergy Questionnaire for Athletes (AQUA)**
**Versão Brasileira do Questionário de Alergia para Atletas**

Iniciais do nome_____
Local de Nascimento_____
Data de Nascimento _____
Cidade _____ Telefone (opcional)_____
Peso (kg) _____ Altura (m) _____
Modalidade Esportiva _____
Instituição de Ensino/Time _____
Matrícula _____

1) Quantas vezes na semana você treina?
( ) Até 3 vezes
( ) Mais de 3 vezes

2) Qual a duração média de cada treino?
( ) De 1–2 horas
( ) De 2–3 horas
( ) Mais de 3 horas

3) Você treina normalmente em:
( ) Locais abertos
( ) Locais fechados

4) Você já foi diagnosticado com alguma doença alérgica?
( ) Não
( ) Sim

Se sim, quais?
( ) Asma
( ) Rinite
( ) Conjuntivite
( ) Urticária
( ) Eczema
( ) Alergia a medicamentos
( ) Alergia a alimentos
( ) Alergia a picada de insetos (abelhas, mosquitos)
( ) Anafilaxia
Outras: _____

5) Você suspeita ter algum tipo de alergia mesmo sem nenhum diagnóstico médico?
( ) Não
( ) Sim

6) Você já usou medicamentos antialérgicos (“anti-histamínicos”, “esteroides tópicos”, “vacinas de alergias”)?
( ) Não
( ) Sim

7) Existe alguém alérgico na sua família?
( ) Não
( ) Sim, mãe e pai
( ) Sim, mãe ou pai
( ) Sim, outros parentes

**Supplement** *(continuation)*
Brazilian version of the Allergy Questionnaire for Athletes (AQUA)

8) Você fica frequentemente com os olhos vermelhos, lacrimejando e coçando?
( ) Não
( ) Sim

9) Você frequentemente espirra, tem coriza ou coceira no nariz (independente de estar resfriado)?
( ) Não
( ) Sim

10) Você já sentiu aperto no peito e/ou chiado?
( ) Não
( ) Sim

11) Você já teve coceira com erupções cutâneas?
( ) Não
( ) Sim

12) Você já teve alergias graves ou reações anafiláticas?
( ) Não
( ) Sim

13) Você já teve falta de ar, tosse e/ou coceira na garganta após um exercício?
( ) Não
( ) Sim

Se sim, teve mais dificuldades:
( ) No início do treino
( ) No final do treino
( ) Durante todo o treino

14) Se você sofreu alguns dos sintomas acima, eles ocorreram:
( ) Principalmente em ambientes abertos
( ) Principalmente em ambientes fechados
( ) Principalmente em dias quentes
( ) Principalmente em locais úmidos ou frios
( ) Independente de qualquer condição ambiental

15) Você já teve alguma reação alérgica a alimentos?
( ) Não
( ) Sim

Se sim, lembra qual alimento? _____

16) Você já teve alguma reação alérgica a medicamentos?
( ) Não
( ) Sim

Se sim, lembra qual medicamento? _____

17) Você sabia que alguns medicamentos para alergia e doenças respiratórias estão proibidos ou sob restrições da Agência Mundial Antidoping (WADA)?
( ) Não
( ) Sim

Se sim, marque quais substâncias você acha que estão incluídas nessa categoria:
( ) Anti-histamínicos
( ) Broncodilatadores
( ) Vasoconstritores

**Supplement** *(continuation)*
Brazilian version of the Allergy Questionnaire for Athletes (AQUA)

( ) Corticoides inalatórios (em doses ou em pó)
( ) Esteroides dermatológicos
( ) Esteroides injetáveis ou orais

18) Você tem receio que medicamentos respiratórios e/ou antialérgicos possam prejudicar sua performance ou infringir alguma regulamentação antidoping?
( ) Não
( ) Sim

19) Você usa algum suplemento alimentar (vitaminas, aminoácidos, creatina)?
( ) Não
( ) Ocasionalmente
( ) Regularmente

20) Você fuma?
( ) Não
( ) Sim

Se sim, quantos cigarros você fuma por dia?
( ) Menos que 5
( ) Entre 5–20
( ) Mais que 20

21) Com qual frequência você usou esses medicamentos no último ano?

| Medicamentos | Nunca | 1–3 vezes | 3–5 vezes | 5–10 vezes | Mais de 10 vezes |
|---|---|---|---|---|---|
| Antibióticos | | | | | |
| Anti-inflamatórios | | | | | |
| Analgésicos | | | | | |
| Antitérmicos | | | | | |
| Outros: | | | | | |

22) Você fez uso de algum medicamento na semana passada?
( ) Não
( ) Sim
Se sim, qual? _____

23) Você sofre frequentemente de alguma infecção respiratória (faringite, bronquite, resfriados) ou febre?
( ) Não
( ) Sim
Se sim, essas infecções são mais frequentes em períodos de treinamentos intensos?
( ) Não
( ) Sim

24) Você tem crises recorrentes de herpes labial?
( ) Nunca
( ) De 1-3 vezes por ano
( ) Mais de 3 vezes por ano

25) No último ano, quantas vezes você não pôde treinar devido a alguma infecção?
( ) Nenhuma
( ) De 1-3 vezes
( ) Mais de 3 vezes

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