The walking estimated limitation stated by history (WELSH): a visual tool to self-reported walking impairment in a predominantly illiterate population

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Abstract
Background: The prevalence of cardiovascular diseases is increasing in low-income countries. Various questionnaires to estimate walking capacity in patients are available in multiple languages but they are not suitable for illiterate patients.
Objectives: The walking estimated limitation stated by history (WELSH) tool aims at rating individual walking disability using only drawings and four items.
Methods: A six-month prospective study was performed on new patients referred to the Department of Cardiology at the Centre Hospitalier Universitaire Sourô Sanou in Bobo-Dioulasso, Burkina Faso. We administered the WELSH tool after a short oral presentation in the patient’s language or dialect. Thereafter, patients performed a six-minute walking test in the hospital corridor under the supervision of a nurse who was blinded to the results of the WELSH score. We performed a step-by-step multilinear regression analysis to determine the factors predicting maximal walking distance (MWD).
Results: There were 40 female and 10 male patients in this study. Their ages ranged from 54.8 ± 10.7 years. Only 32% of the patients had attended primary school. Most patients were classified as stage I to III of the New York Heart Association (NYHA) classification. The objective measurement of MWD during a six-minute walking test showed no association with the subjects’ educational level, body mass index, NYHA stage or gender, but a significant correlation with the WELSH scores. The Spearman $r$ value for the WELSH score-to-MWD relationship was 0.605 ($p < 0.001$).
Conclusions: The WELSH tool is feasible and correlated with measured MWD in a population of predominantly illiterate patients.

Keywords: questionnaire, illiteracy, exercise, walking impairment, quality of life

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The prevalence of diabetes, hypertension and their cardiovascular complications is increasing in Africa. Coronary artery disease is projected to be the leading cause of disability-adjusted life years lost in low-income countries by 2030. Estimation of walking disability in routine medical practice is of major interest, specifically in cardiovascular diseases. Among other available questionnaires, the walking estimated limitation calculated by history (WELSH) tool and the walking impairment questionnaire (WIQ) have been validated in different languages. The WELSH tool compares favourably with the WIQ in terms of ease of use and scoring. Unfortunately, all available questionnaires require the patient and/or healthcare provider to be able to read. Therefore they are unsatisfactory in countries with a high prevalence of illiterate people.

To the best of our knowledge, to date no standard questionnaire to estimate walking impairment has ever been developed that could be used by healthcare providers (nurses or technicians) and/or proposed for patients (children or adults) who are uncomfortable with reading or unable to read. Since
illiteracy is still high in Burkina Faso, as in many sub-Saharan African countries,13 we aimed to test an empirical new tool: the walking estimated limitation stated by history (WELSH). The WELSH tool is derived from the WELCH but is based on drawing (text-free). Furthermore, we wanted the WELSH score to be simple and calculable without the need for a computer.

The aim of this study was to estimate the applicability of the WELSH tool in a population of predominantly illiterate or low-literacy patients in Burkina Faso. The WELSH tool aims at evaluating walking impairment quickly by history. Although walking tests remain of interest, they are time consuming and do not necessarily reflect self-perceived impairment. Correlation of the New York Heart Association (NYHA) classification with walking capacity is very poor.14 The WELSH tool would not replace the NYHA classification but, once validated as an applicable tool, it could be proposed as an easy method to analyse outcome under treatment in future studies.

Methods
A six-month prospective study was performed on new patients referred to the Department of Cardiology in the Centre Hospitalier Universitaire Sourou Sanou in Bobo-Dioulasso, Burkina Faso. The patients were referred for follow up of a confirmed cardiovascular disease.

Eligibility was age over 18 years, ability to read time on a clock/watch dial, ability to walk without physical assistance, and ability to understand the study goal and potential instructions. We did not include patients classified as NYHA stage IV14 who had a recent history of unstable coronary syndrome or recent myocardial infarction.

In the context of the Burkina Faso healthcare system and due to the very low accessibility of investigative tools, most diagnoses remain unconfirmed. For this study we retrieved the diagnosis at referral and provided results for the few available functional investigations.

All investigators participating in the study were trained by the principal investigator on how to perform the investigations, complete the files and score the questionnaires. The questionnaire was first explained to the two technicians, who filled a minimum of 10 files and calculated the score with the principal investigator, before doing the tests alone.

For each included patient, we recorded general social and anthropometric characteristics. We used the NYHA classification as a descriptive tool of self-reported limitation.15 This tool is commonly used as a method for functional classification in patients with heart disease.15

We used the concept of the WELCH questionnaire to build a new form based on only simple drawings. The original WELCH included four items. The first three items proposed various

Fig. 1. The WELSH tool. On the first page the patient is asked to draw a line on the number of minutes corresponding to the duration sustainable without stopping for different tasks (see text for explanation). The second page requires the patient to estimate his/her usual walking pace.
durations that patients felt they were able to perform at different walking speeds without stopping, and the fourth item questioned the usual walking speed. We designed the WELSH tool on the same concept.

The WELSH tool requires the patients to estimate their walking time on an empty watch dial from zero to 59 minutes for three different walking speeds: slow (illustrated by the turtle), normal (illustrated by a human) and fast (illustrated by a rabbit). If unable to do the task (e.g. walk fast), they were instructed to put a cross on the watch screen. A fourth and last item requires the patient to estimate his/her usual pace: very slow (illustrated by a snail), slow (illustrated by a turtle), normal (illustrated by a human) or fast (illustrated by a rabbit). Illustrations of the WELSH tool are presented in Fig. 1.

Patients were provided a blue or black pen and reading glasses if needed, and received oral explanation of the protocol and on how to fill in the WELSH questionnaire in their native language or dialect. Patients were asked to self-complete each of the three watch dials and define whether they felt they walked at their usual pace. The two series of drawings (first three items about maximal duration at different paces and fourth item on usual pace) were printed on each side of the same sheet and were thereby submitted in a random order.

Once self-completed, the technician, nurse or physician checked the questionnaire and completed any incomplete questionnaires. For the WELSH tool, an error was defined as a missing answer, multiple answers to the same item or a reported increase in the duration of a task that was more difficult than the task of lower intensity (e.g. reported higher ability to walk fast than to walk at a normal speed). Errors were discussed with the patient and corrections or additions were made and written in red.

We empirically defined a method for scoring of the questionnaire that could easily be memorised and done by mental calculation and would result in a maximal score of 100. The number of points attributed to the possible durations ranged from zero points if the task was impossible, to eight points for 51 to 60 minutes. The number of points increased by one point for each interval of five minutes up to 20 minutes, and for each interval of 10 minutes from 20 minutes to one hour. Estimated usual walking speeds were attributed coefficients ranging from one for ‘much slower – snail’ to four for ‘faster – rabbit’. The final score was the sum of the number of points obtained at each pace plus one, multiplied by the coefficient resulting from the estimation of walking speed. Therefore the minimum possible WELSH score is 1 = [(0 + 0 + 0) +1] × 1, and the maximal score is 100 = [(8 + 8 + 8) +1] × 4.

All patients had a six-minute walking test to objectively quantify their walking ability. This test was performed by a different physician, technician or nurse from the one who supervised the WELSH completion and blinded to the results of the WELSH score. The test was performed between two plastic cones positioned 30 m from each other in a corridor. Oral instruction in the patient’s language or dialect was to: (1) walk (never run) back and forth as many times as possible, turning around the plastic cones; (2) cover as much distance as possible over six minutes; (3) slow down or stop if needed, and restart walking when possible. For all tests, we recorded the maximal walking distance performed at minute six (MWD).

The study was approved by the Institutional Review Board of the Ministry of Health of Burkina Faso in August 2017, and registered on ClinicalTrials.gov Identifier: NCT03482869. It was performed according to the international ethics standards and conforms to the Helsinki Declaration. A signature confirming informed consent to participate in the study was obtained from all patients after oral (and written when possible) explanation of the study.

Statistical analyses

We analysed the number of incomplete questionnaires to estimate the questionnaire feasibility. The correlations of the WELSH scores with MWD were performed with step-by-step linear regression analysis to determine the factors associated with MWD. Then the Pearson r-coefficient of correlation between the WELSH score and MWD was calculated. Results are presented as mean ± standard deviation or number and percentages.

From previous studies, we estimated the r-coefficients of correlation between the objective measure of walking distance and the questionnaire to range from 0.35 to 0.66.6,16-18 Assuming a coefficient of correlation between WELSH and MWD of at least 0.40, the minimum number of subjects to reach a power of 80% for two-tailed alpha equal to 0.05 was 47 subjects.

For organisational reasons, the protocol was scheduled over a series of periods starting in March 2018, in order to recruit 50 patients. Correlation from 0.40 to 0.59 was considered fair, from 0.60 to 0.75 was considered good, and above 0.75 was considered very good. Statistical analyses were performed with SPSS V15.0. For all tests, a two-tailed p < 0.05 was used to indicate statistical significance.

Results

Of the 50 patients, 29 (58.0%) were referred for the follow up of treatment for chronic hypertension, 10 (20.0%) were referred for apparent non-ischaemic cardiomyopathy, three (6.0%) had

<table>
<thead>
<tr>
<th>Table 1. Characteristics of study patients</th>
<th>Number (%)</th>
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<tbody>
<tr>
<td>Characteristics</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>54.8 ± 10.7</td>
</tr>
<tr>
<td>Females</td>
<td>40 (80.0)</td>
</tr>
<tr>
<td>Residential area</td>
<td></td>
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<tr>
<td>Urban</td>
<td>47 (94)</td>
</tr>
<tr>
<td>Suburban</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Rural</td>
<td>2 (4)</td>
</tr>
<tr>
<td>School level</td>
<td></td>
</tr>
<tr>
<td>Never been to school</td>
<td>19 (38.0)</td>
</tr>
<tr>
<td>Elementary</td>
<td>15 (30.0)</td>
</tr>
<tr>
<td>Primary</td>
<td>13 (26.0)</td>
</tr>
<tr>
<td>Secondary</td>
<td>3 (6.0)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>74.9 ± 15.2</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163 ± 10</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>28.6 ± 9.2</td>
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<tr>
<td>Waist circumference (cm)</td>
<td>92.5 ± 11.8</td>
</tr>
<tr>
<td>Self-reported walking limitation</td>
<td>33 (66.0%)</td>
</tr>
<tr>
<td>Heart failure</td>
<td>34 (68.0%)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>New York Heart Association classification</th>
</tr>
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<tbody>
<tr>
<td>No dyspnœa</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>II</td>
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<tr>
<td>III</td>
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a clinical history of infarction and four patients (8.0%) were assumed to suffer from chronic valvular disease. Among all these patients, only four had an echocardiography and two had chest X-ray imaging to estimate the cardiothoracic index.

The characteristics of the 50 included patients are presented in Table 1. Notably, two-thirds of the patients stopped their education at elementary school. Among the 50 patients, one was unable to complete the WELSH questionnaire even under supervision. Among the other 49 patients, 33 patients completed the WELSH tool without errors and the other 16 patients (32.6%) made errors on one or more of the four items, with a median number of errors of two items, mainly in the first three items dealing with the duration of each task. Most of these errors related to a paradoxical increase in the duration that could be sustained for a walking speed with an increase in task difficulty, and were corrected after discussion with the patients.

The WELSH scores were calculated for all patients and the mean was $35 \pm 17$. An example of scoring is presented in Fig. 2. In this example, the subject reported he/she was able to walk for a maximum of approximately 23 minutes at a ‘slow’ speed (five points), approximately 17 minutes at a ‘normal’ speed (four points) and approximately three minutes at a ‘fast’ speed (one point) and reported he/she walked slower (turtle) than other people (coefficient = 2). The final score was $22 = [(5 + 4 + 1) + 1] \times 2$ (Fig. 2).

No adverse event occurred during the six-minute walk test. The mean maximal walking distance was $292 \pm 57$ m.

The step-by-step multilinear regression analysis stopped at step one with the WELSH score being the sole predictor of MWD ($r = 0.68$, $p < 0.001$) and the model being $MWD = 1.99 \times \text{score} + 224$ m. None of the other variables introduced in the model (gender, age, school level, body mass index, waist circumference, NYHA class) reached statistical significance for the association with MWD, as shown in Fig. 3.

**Discussion**

This is the first ever reported standard tool developed to facilitate and standardise the estimation of walking disability in illiterate patients. The feasibility of the WELSH tool is relatively high, keeping in mind that half of the self-completed walking impairment questionnaires (the most widely used tool to estimate walking impairment) need correction.$^{19}$ The WELSH tool is easily scored and its correlation with objectively measured maximal symptom-limited walking distance and the six-minute maximal walking distance was good.

Beyond the obvious interest in a tool for non-literate children or illiterate adults, developing a tool to score walking disability based on only drawing could also be valuable to eliminate language differences in questionnaire translations. What is of particular interest is that the proportion of our patients attending primary and secondary school was in the range of literacy estimated for the Burkinabé population.$^{20}$ Indeed, using a questionnaire in a language that is different from the language in which it was initially developed is a complex process, requiring cross translation and validation in the new language.$^{9,20,21-23}$ Whether or not the WELSH tool can be used in a context other than the African population remains to be studied.

We underscore here that the drawings were chosen on purpose with animals that are present worldwide. Specifically, when developing the WELSH tool, the fast speed was initially suggested to be an antelope but these animals are not present in all countries (e.g. America or Australia).

Another issue to be solved was the representation and estimation of time. With digital watches, classic watch screens may gradually disappear, and the selection of patients able to read a classic clock/watch screen may have biased our results.$^{24}$ In fact very few patients, except those with cognitive disorders, were excluded because of their inability to read a watch. This might partly be due to the use of watches and clocks for religious purposes because of a high proportion of Islamic
patients in Burkina Faso. A second question was whether or not numbers should be added on the clock. Adding Western type (Arabic) numbers may have facilitated the completion of the questionnaire, and these can easily be converted to other types (e.g. Roman or Chinese) with no ambiguity.

The WELSH tool can provide additional information to the six-minute walking test about the self-reported impairment in the community, keeping in mind that the six-minute test is performed at a forced pace, and not at the usual pace of the patient. Furthermore, the WELSH tool should not replace the NYHA scoring by the physician but provide information on self-perceived impairment, which the NYHA does not do. Walking disability is observed in a wide variety of diseases. The WELSH tool (from which the WELSH was inspired) was validated in only patients with suspected peripheral artery disease (PAD). The WELSH tool was tested on a population of patients referred to the cardiology department for various conditions that unfortunately could not be confirmed.

In Burkina Faso, the prevalence of hypertension is estimated at 46%, with 27.4% of patients having a medical history of dilated cardiomyopathy. From a thesis completed in 2014 in Bobo Dioulasso on 127 diabetic patients, the most represented cardiovascular pathologies were hypertension (60.3%), ischaemic heart disease (26.6%) and cardiomyopathy (3%). It can be assumed that our population was similar. Testing the WELSH tool in more selected patients is necessary but we assume that the WELSH tool is not PAD-specific.

Limitations

There are limitations to this study and to the use of the WELSH tool. First, it is important to note that in the context of Burkina Faso medicine, information on and confirmation of the cardiovascular disease underlying the patient’s symptoms is rarely possible. The university hospital in Bobo Dioulasso has only occasional access to ultrasound and radiology and diagnoses are based on clinical evidence in most cases. Besides, as no centralised data files and archives are available, patients are responsible for their own files and rarely bring them for repeat visits. This could appear to be a major limitation but the WELSH tool is not disease-specific and the fact that the population is likely to be heterogeneous and poorly defined on the basis of para-clinical confirmation is not, in our opinion, a major limitation.

Second, the WELSH tool cannot be considered a tool that can be self-completed because initial explanations are needed to understand how the drawings must be completed. However it allows for both a standardisation of the estimation of walking impairment and a simple scoring system.

Third, no validation against treadmill testing could be performed because no treadmill was available for routine use in the hospital of Bobo Dioulasso. The six-minute walking test is probably not the ideal reference tool because no treadmill was available for routine use in the hospital. Other methods of validation not requiring a treadmill could be used, such as the global positioning system (GPS).

Fourth, we arbitrarily predefined the WELSH scoring, which is possibly not optimal. It may be changed to improve the correlation between the WELSH score and objective measurement of walking impairment, such as the MWD, but the correlation was already quite high. Future studies are needed to confirm these results.

Conclusion

The WELSH tool is feasible for use in predominantly illiterate or low-literacy cardiac patients in Burkina Faso. There was a good correlation between the WELSH score and the six-minute walking test. Its applicability in other populations of patients remains to be tested. Test–retest reproducibility as well as its sensitivity to therapeutic interventions remain to be assessed in futures studies.

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