

BMJ Open Internal structure validity and internal consistency reliability of the Minnesota Living with Heart Failure Questionnaire: a systematic review protocol

Ambreen Amir Ali Gowani ^{1,2}, Gail Low,³ Colleen Norris,⁴ Matthias Hoben⁵

To cite: Gowani AAA, Low G, Norris C, *et al.* Internal structure validity and internal consistency reliability of the Minnesota Living with Heart Failure Questionnaire: a systematic review protocol. *BMJ Open* 2023;**13**:e076780. doi:10.1136/bmjopen-2023-076780

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2023-076780>).

Received 16 June 2023

Accepted 09 October 2023



© Author(s) (or their employer(s)) 2023. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Ambreen Amir Ali Gowani;
gowani@ualberta.ca

ABSTRACT

Introduction The Minnesota Living with Heart Failure Questionnaire (MLHFQ) is one of the most used tools to measure health-related quality of life in heart failure. Despite extensive use in research, evidence on the MLHFQ's internal structure validity remains heterogeneous and inconclusive. There are no known reviews that systematically summarise the evidence related to the MLHFQ's factor structure (internal structure validity). This gap highlights a need to critically appraise, summarise and compare the available evidence on the internal structure and internal consistency reliability (ICR) of the MLHFQ.

Methods and analysis The review will adhere to the reporting guidelines of the Cochrane Handbook for Systematic Reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis. We will systematically search eleven electronic databases/search engines (Medline, EMBASE, Cumulative Index for Nursing and Allied Health Literature, PsycINFO, Global Health, Health and Psychosocial Instruments, Scopus, Journals, Web of Science, Google Scholar, and Dissertation and Theses Global) for quantitative studies assessing the MLHFQ's factor structure and ICR. Two reviewers will then independently screen studies for eligibility and assess the quality of included studies using the COnsensus-based Standards for the selection of health status Measurement Instruments checklist. Throughout the review, discrepancies will be resolved through consensus or by the involvement of the third reviewer. We will analyse and present results using descriptive statistics (frequencies, proportions and ranges) and narrative synthesis. We will include all the relevant studies published within the timeframe covered by the database. We carried out the preliminary search in November 2022 except for Dissertation and Theses Global which was searched in September 2023; however, we will update the entire search right before the review completion in January 2024.

Ethics and dissemination Ethical approval is not required as no primary data is being collected from individuals. We intend to share the findings of the review at international conferences and publish manuscripts in peer-reviewed journals.

PROSPERO registration number CRD42023346919.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the first review to systematically synthesise the evidence on the structural validity and internal consistency reliability of the Minnesota Living with Heart Failure Questionnaire (MLHFQ), which has an extensive history of use in cardiovascular research.
- ⇒ A strong and consistent internal structure is pivotal to the interpretation of a tool's score. This review synthesises and critically appraises the extensive evidence on the structural validity and internal consistency reliability of the MLHFQ, thereby informing clinicians and researchers about the inadequacies of the tool and ambiguity in the interpretation of its scores.
- ⇒ The review will follow the Cochrane Handbook of Systematic Reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.
- ⇒ We do not plan to conduct meta-analyses of quantitative findings because our research question is descriptive; however, depending on the data, we may perform subgroup analysis by participants' geography.

INTRODUCTION

Heart failure (HF) is a global health problem affecting more than 64 million people.¹ Its global prevalence has increased by 36% since 1900² and is projected to increase by another 46% by 2030³ owing to longevity and advancement in the diagnosis and treatment of this disease.^{1 4 5} It is the most frequent cause of rehospitalisation (80%) and mortality (90%) among people aged 65 years and older.² HF-related rehospitalisations impose an enormous global economic burden on health-care systems, amounting to approximately 108 billion USD per annum.³ Since HF is a chronic and progressively worsening clinical syndrome, alleviating the symptoms is the priority treatment goal.⁶

Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

BMJ Open: first published as 10.1136/bmjopen-2023-076780 on 8 November 2023. Downloaded from <http://bmjopen.bmj.com/> on October 22, 2025 at Grant MacEwan Comm College City Centre Campus

The clinical endpoints most highly prioritised in HF are symptoms, such as shortness of breath, oedema, generalised fatigue, weight gain and persistent cough. The impact of these symptoms on a person's life is most commonly measured with the New York Heart Association functional class assessment^{7 8} and/or biological markers (left ventricular ejection fraction and B-type natriuretic peptide). Although these assessment tools inform the physician about a person's health status,^{7–10} they are poor proxies of a patient's perceived impact of HF on their life (ie, person's health-related quality of life (HRQOL)).^{11–13}

Incongruities may emerge when some patients with severe limitations in their Activities of Daily Living may rate their HRQOL as relatively high, while others with mild limitations in their physical functions may perceive their HRQOL as poor.¹⁴ Instruments measuring HF-related HRQOL aim to assess how a patient perceives, faces and copes with HF and its treatment. They allow patients to reflect on their day-to-day experiences of illness and make their own treatment-related goals rather than accepting physicians' opinions and decisions about their health status.¹⁵

The goals of HF treatment have evolved over the last few years. Now improving patients' well-being and reducing hospital readmissions are as important as reducing mortality.¹⁶ Guidelines of HF treatment and care in North America, Europe and the UK consistently advocate for maximising the HRQOL of HF patients.^{17–19} To meet this priority, HRQOL should be assessed regularly using reliable and valid instruments encompassing physical, psychological and social HRQOL dimensions.²⁰ Despite strong evidence and wide acknowledgement supporting the importance of HRQOL for HF, its adoption into clinical practice is lacking.^{21–24}

Various generic and disease-specific instruments measure the HRQOL of people with HF.^{12 24 25} While generic instruments are comprehensive and assess the overall well-being of people by exploring general concepts, such as pain and discomfort, they are less sensitive to disease-specific changes in HRQOL.²⁰ Disease-specific instruments focus and reflect on specific impacts of HF on a person's life^{20 25 26} and are therefore preferred in measuring HRQOL in HF.¹² Table 1 lists the disease-specific and generic HRQOL tools identified by a comprehensive review done in 2016.¹⁵

Among the instruments listed in table 1, the Minnesota Living with Heart Failure Questionnaire (MLHFQ) is the tool most widely used and recognised to assess HRQOL in adults with HF.²⁵ Developed in 1987 by Thomas Rector,²⁶ the MLHFQ has been translated into more than 30 languages and cited in over 100 publications.²⁷ Focusing on the underlying relationship between pathophysiology, symptoms, functional limitations and psychological distress, it measures the impacts of symptoms and treatment on different dimensions of HRQOL in HF patients.²⁸

The MLHFQ is a 21-item questionnaire that assesses the HRQOL of HF patients, using a Likert scale of 0 (no

Table 1 Generic and disease-specific instruments for HRQOL in HF

Generic HRQOL tools	
Acronym	Full name
SF-36	Medical Outcomes Study 36-Item Short-Form Health Survey
NHP	Nottingham Health Profile
WHOQOL-BREF	World Health Organization's Quality of Life Instrument-Short Version
SIP	Sickness Impact Profile
Disease-specific HRQOL tools	
EQ-5D-3L	Euro Heart Failure Quality of Life Questionnaire
QLQ-SHF	Quality of Life in Severe Heart Failure Questionnaire
KCCQ	Kansas City Cardiomyopathy Questionnaire
MLHFQ	Minnesota Living Heart Failure Questionnaire
CHQ	Chronic Heart Failure Questionnaire
LVDQ-LVD-36	Left Ventricular Dysfunction Questionnaire
CHP-CHF	Cardiac Health Profile Congestive Heart Failure
CHAT	Chronic Heart Failure Assessment Tool
MacNew (ex-QLMI)	Quality of Life after Myocardial Infarction
SDHFQ	San Diego Heart Failure Questionnaire
HeartQOL	Heart Quality of Life
CaReQoLCHF	Care-Related Quality of Life Survey for Chronic Heart Failure (CHF)
HF, heart failure; HRQOL, health-related quality of life.	

limitations) to 5 (very much) to rate how strongly each item impacts a person's life.^{26 28} The items of the MLHFQ were developed following a robust process including the review of literature that explored the adverse impact of HF on patients' lives, the opinions of the clinical experts and the contents of the tool identified by HF patients, suggesting an acceptable content validity. Also, previously published reviews comparing the psychometric properties of the different HRQOL instruments for HF conclude that the MLHFQ has an acceptable convergent and divergent validity as it has consistently demonstrated satisfactory correlations with the standard clinical measures and other HRQOL measuring instruments.^{29 30} However, the review did not discuss the internal structure of the tool which reportedly has marked variability.

Studies have evaluated the MLHFQ's internal structure using highly heterogeneous approaches under Classical Test Theory (CTT) and Item Response Theory (IRT).^{31 32} According to the initial factor analytic study conducted by the tool's developers,^{27 28 33 34} the MLHFQ comprises two

subscales: physical limitations (eight items) and emotional impacts (five items). Although reflecting different aspects of work, sexual and social life, the remaining eight items neither factored into the two identified subscales (physical and emotional impacts) nor did they form one or more additional factor(s). Downplaying the statistical evidence that the MLHFQ was not a unidimensional tool and some items did not contribute to any latent factors, the developers retained all the items and recommended that the tool be scored by summing all of these items (possible range between 0 and 105), with higher scores indicating worse HF-related HRQOL.^{26 28}

Within the realm of CTT, exploratory factor analysis (EFA) takes an unrestricted approach to extract factor models while confirmatory factor analysis (CFA) confirms the a priori hypothesised factor models.³⁵ Similarly, IRT-based models examine the dimensionality of the tool, taking into account the relationship between a tool's items and a respondent's performance.³⁶ Internal consistency (interconnectedness among the items of the scale/subscales of a tool) is also assessed using various approaches including Cronbach's Alpha, McDonald's Omega³⁷ and greatest lower bound (glb).³⁸ Underlying assumptions for coefficient alpha include unidimensionality, equal τ coefficients and no correlation among the error, whereas Coefficient Omega and glb can be used when the assumptions of unidimensionality and equal τ coefficients are unmet.³⁷

Correspondingly, results related to the MLHFQ's internal structure have been highly heterogeneous.²⁷ Some studies confirmed the original two-factor structure of the tool,²⁷ while others reported a three-factor structure with the subscales of physical, emotional and social impacts of HF on a patient's life.²⁷ Since the internal structure of a tool is prerequisite for its internal consistency, these heterogeneous methods and conclusions eventually make it challenging to interpret the reliability and validity of the MLHFQ's scores. Hence, the call for a systematic inquiry on the nature, quality and results of evaluations of the MLHFQ's internal structure is posited.

Non-systematic reviews are available on instruments measuring the HRQOL in HF (including the MLHFQ)¹² and the measurement of HF-related QOL from a nursing perspective.³⁹ Systematic reviews about HF-related QOL synthesise the factors influencing the HRQOL of HF patients⁴⁰ and compare the content of different HF-related HRQOL measures.⁴¹ These reviews highlight the measurement issues of various tools overall, which makes it impossible to understand and discuss the measurement issues of a specific tool (MLHFQ) in one specific area (structural validity) in detail.

Creating a composite score for a tool that empirically fails to hold the assumption of unidimensionality affects the accuracy of the interpretation of the scores (ie, the ability to distinguish between good and poor HRQOL).⁴² It also impacts the tool's construct validity (ie, are the test scores associated with other constructs as hypothesised?) and internal consistency reliability (the level

of interconnectedness among the scale's items).⁴³ The proposed study, therefore, aims to identify, critically appraise, summarise and compare the available research evidence on the internal structure validity and internal consistency reliability of the MLHFQ. The review will also highlight critical research gaps and issues with current practices of creating and using scores based on the MLHFQ items.

MATERIALS AND METHODS

Review design

The systematic review will be conducted in accordance with the Cochrane Handbook⁴⁴ and Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.⁴⁵ This protocol is registered with an international database of prospectively registered systematic reviews in health and social care (PROSPERO) (CRD42023346919).⁴⁶

Search strategy

Supported by an experienced research science librarian at the University of Alberta who is an expert in systematic review methodology and advanced searches of health sciences databases, we have developed a search strategy (online supplemental file 1). We have identified relevant search terms for key concepts, such as MLHFQ, psychometric properties, factor analysis, validity, reliability and HRQOL, to search the following databases/search engines:

- ▶ Medline via OVID.
- ▶ EMBASE via OVID.
- ▶ Cumulative Index for Nursing and Allied Health Literature (CINAHL) via EBSCOhost.
- ▶ PsycINFO via OVID.
- ▶ Global Health via OVID.
- ▶ Health and Psychosocial Instruments via OVID.
- ▶ Scopus via Elsevier.
- ▶ Journals via OVID.
- ▶ Web of Science.
- ▶ Google Scholar.
- ▶ Dissertation and Theses Global via Proquest.

We will include all the relevant studies published within the timeframe covered by the database. We carried out the initial search in September 2022 and September 2023 (Dissertation and Theses Global) and will update it before publishing the review. The review is expected to be completed by January 2024.

Inclusion and exclusion criteria

Inclusion and exclusion criteria are detailed in [table 2](#). As our multidisciplinary research team members speak English, German, Nepalese and Persian fluently, we will not exclude studies based on the language of publication. For studies written in any other language, colleagues in our comprehensive academic networks will help us determine the eligibility of those studies.

Study screening

After removing duplicate studies and exporting the references into the Covidence software, two reviewers

Table 2 Study inclusion and exclusion criteria

	Inclusion criteria	Exclusion criteria
Study purpose	▶ Studies reporting on the internal structure and/or ICR of the MLHFQ	▶ Studies reporting the validity evidence of sources other than the tool's internal structure ▶ Studies reporting on the development of the MLHFQ without validating the tool ▶ Studies reporting reliability measures other than ICR
Study design	Original research studies applying one of the following quantitative designs: ▶ Randomised controlled trials or regression discontinuity ▶ Non-randomised controlled trials ▶ One group pre-post ▶ Interrupted time series or other time series ▶ Cross-sectional ▶ Case-control ▶ Cohort ▶ Mixed methods	▶ Non-empirical publications (editorials, commentary papers, opinion texts) ▶ Original research studies applying qualitative research designs ▶ Literature reviews *may use to identify/harvest potential eligible research studies
Study outcomes	▶ Validity evidence related to the internal structure of the MLHFQ, including results of exploratory or confirmatory factor analyses and item response theory models. Those results may include: – Model fit indices, such as chi-square, Akaike information criterion (AIC), standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), normed fit index (NFI), mean square information weighted statistics (Infit), outlier sensitive statistics (Outfit), separation indices for item and person – Model parameter estimates (factor loadings, factor variances and covariances, item residual variances, etc.) – Number of factors identified – Authors' scoring recommendations and whether they are in line with the identified factor structure ▶ ICR of the MLHFQ, such as Cronbach's α, Revelle's β, McDonald's ω, greatest lower bound for reliability and others	▶ Studies using the MLHFQ for research and only reporting any of the outcomes mentioned in the inclusion criteria assessed by other studies.
Study population	▶ Adult participants aged 18 years and above with CHF	▶ Participants younger than 18 years

ICR, internal consistency reliability; MLHFQ, Minnesota Living with Heart Failure Questionnaire.

will independently screen the titles and abstracts of the retrieved studies and reconcile discrepancies through consensus or by the involvement of a member of the research team. Using the same process, they will also screen the full texts of studies that were not excluded during the title/abstract screening.

Quality appraisal

To evaluate the quality of evidence, we will use a three-step process. First, we will evaluate the methodological quality of each study using a COConsensus-based Standards for the selection of health status Measurement Instruments (COSMIN) risk of bias checklist.⁴⁷ It consists of nine indicators representing each measurement property: patient reported outcome measurement development, content validity, criterion validity, structural validity, internal consistency, cross-cultural validity/measurement

invariance, reliability, measurement error and responsiveness. Two independent reviewers will assess each study for the risk of bias related to the structural validity and internal consistency reliability⁴⁷ using a 4-point Likert scale (4 = 'very good', 3 = 'adequate', 2 = 'doubtful' or 1 = 'inadequate'). Following the risk of bias assessment, both reviewers will independently rate the result (ie, structural validity and internal consistency reliability) of each study against the updated criteria for good measurement properties.⁴⁸ They will rate each result as sufficient (above the quality criteria threshold: +), insufficient (below the quality criteria threshold: -) or indeterminate (less robust data that do not meet the quality criteria: ?). Lastly, we will summarise the evidence and two reviewers will grade the quality of evidence as high, moderate, low or very low using the modified Grading of Recommendations,

Assessment, Development and Evaluations approach.^{47 48} Throughout the process of quality appraisal, discrepancies will be resolved through mutual consensus or by the involvement of one of the coauthors. Finally, a summary table will present the COSMIN score of the methodological quality of each study, rating of the measurement property and overall quality of the summarised evidence of the structural validity and internal consistency reliability of the MLHFQ.

Data extraction

The data extraction form for this review will encompass all study information relevant to this review: first author, year of publication, title, language of publication, study design, name of the journal, country of the study, language of the MLHFQ, study purpose/study questions, study design, study setting, sample size, sampling characteristics, sampling strategy, type of the statistical analysis and results of the factor analysis of the tool.

Two reviewers will extract the data on the key variables described above, check each other's data extraction and resolve discrepancies through group consensus (reviewers and thesis supervisor). If any study does not provide adequate information required for the review, we will contact the original authors for clarification and send reminders accordingly.

Data analysis

A descriptive table will present the number and proportion of studies, applying different study designs and methods of analysis (EFA, CFA, IRT). Also, it will provide ranges of the model fit indices highlighted in table 2. Using figures and tables, we will also present different factor structures reported by different studies.

For internal consistency reliability, we will provide the ranges of different coefficients listed in table 2. A narrative summary detailing tabular findings will also be included in the review. We do not plan to conduct meta-analyses of quantitative findings because our research question is descriptive; however, depending on the data, we may perform subgroup analysis stratified by countries/cultures.

DISCUSSION

To the researcher's best knowledge, this systematic review will be the first to assess the measurement properties (internal structure and internal consistency reliability) of the MLHFQ. This review protocol describes a step-by-step approach to synthesise the evidence on the selected measurement properties of the MLHFQ and critically appraise the methods used to evaluate the internal structure of the MLHFQ. It will also inform researchers about the strengths and limitations of the MLHFQ to correctly interpret the scores of the MLHFQ.

Patient and public involvement

We do not plan to involve patients or public in the study.

Ethics and dissemination

Ethical approval is not required as no primary data is being collected from individuals. We intend to share the findings of the review at international conferences and publish manuscripts in peer-reviewed journals.

Author affiliations

¹Faculty of nursing, University of Alberta College of Health Sciences, Edmonton, Alberta, Canada

²School of nursing and midwifery pakistan, The Aga Khan University, Karachi, Sindh, Pakistan

³Faculty of nursing, College of Health Sciences University of Alberta, Edmonton, Alberta, Canada

⁴Faculty of Nursing, University of Alberta, Edmonton, Alberta, Canada

⁵Graduate program in Nursing, York University, Toronto, Ontario, Canada

Acknowledgements We thank the librarian at the University of Alberta for helping us design the search strategy for this review and Stephen Kuntz for aiding in the writing revision process.

Contributors Conceptualisation: AAAG, MH, GL. Methodology: AAAG, MH, GL. Supervision: MH, CN. Writing original draft: AAAG. Writing-review and editing: AAAG, MH, GL, CN.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Ambreen Amir Ali Gowani <http://orcid.org/0000-0002-1046-033X>

REFERENCES

- 1 Groenewegen A, Rutten FH, Mosterd A, *et al*. Epidemiology of heart failure. *European J of Heart Fail* 2020;22:1342–56. 10.1002/ehf.1858 Available: <https://onlinelibrary.wiley.com/toc/18790844/22/8>
- 2 Lippi G, Sanchis-Gomar F. Global epidemiology and future trends of heart failure. *AME Med J* 2020;5:15.
- 3 Cook C, Cole G, Asaria P, *et al*. The annual global economic burden of heart failure. *Int J Cardiol* 2014;171:368–76.
- 4 Benjamin EJ, Muntner P, Alonso A, *et al*. Heart disease and stroke Statistics—2019 update: a report from the American heart Association. *Circulation* 2019;139:e56–528.
- 5 Mamataz T, Uddin J, Ibn Alam S, *et al*. Effects of cardiac rehabilitation in low-and middle-income countries: A systematic review and meta-analysis of randomised controlled trials. *Prog Cardiovasc Dis* 2022;70:119–74.
- 6 Heidenreich PA, Bozkurt B, Aguilar D, *et al*. 2022 AHA/ACC/HFSA guideline for the management of heart failure: executive summary: A report of the American college of cardiology/American heart

- Association joint committee on clinical practice guidelines. *J Am Coll Cardiol* 2022;79:1757–80.
- 7 Butler J, Hamo CE, Udelson JE, *et al.* Exploring new endpoints for patients with heart failure with preserved ejection fraction. *Circ Heart Fail* 2016;9:e003358.
 - 8 Williams BA, Doddamani S, Troup MA, *et al.* Agreement between heart failure patients and providers in assessing New York heart Association functional class. *Heart & Lung* 2017;46:293–9.
 - 9 Caraballo C, Desai NR, Mulder H, *et al.* Clinical implications of the New York heart Association classification. *J Am Heart Assoc* 2019;8:e014240.
 - 10 Meijers WC, Hoekstra T, Jaarsma T, *et al.* Patients with heart failure with preserved ejection fraction and low levels of natriuretic peptides. *Neth Heart J* 2016;24:287–95.
 - 11 Arnold E, Hites L, Milntner R, *et al.* Transitional care home visits: outcomes among Underserved patients in a heart failure clinic. *Heart & Lung* 2020;49:221–2.
 - 12 Louredo AB de, Leite ALC, Salerno GRF, *et al.* Instruments to assess quality of life in patients with heart failure. *Fisioter Mov* 2015;28:851–8.
 - 13 Romero M, Vivas-Consuelo D, Alvis-Guzman N. Is health related quality of life (Hrql) a valid indicator for health systems evaluation *Springerplus* 2013;2:664.
 - 14 Moser DK, Heo S, Lee KS, *et al.* It could be worse... let's Worse! Why health-related quality of life is better in older compared with younger individuals with heart failure. *Age Ageing* 2013;42:626–32.
 - 15 Thompson DR, Ski CF, Garside J, *et al.* A review of health-related quality of life patient-reported outcome measures in cardiovascular nursing. *Eur J Cardiovasc Nurs* 2016;15:114–25.
 - 16 Baert A, De Smedt D, De Sutter J, *et al.* Factors associated with health-related quality of life in stable ambulatory congestive heart failure patients: systematic review. *Eur J Prev Cardiol* 2018;25:472–81.
 - 17 Al-Mohammad A, Watt V, O'Toole L, *et al.* Insights into the epidemiology of incident heart failure (HF): outcomes of rapid HF access clinic applying the NICE guidelines. *European Heart Journal* 2013;34:P4225.
 - 18 Bozkurt B, Fonarow GC, Goldberg LR, *et al.* Cardiac rehabilitation for patients with heart failure: JACC expert panel. *J Am Coll Cardiol* 2021;77:1454–69.
 - 19 von Haehling S, Arzt M, Doehner W, *et al.* Improving exercise capacity and quality of life using Non-Invasive heart failure treatments: evidence from clinical trials. *European J of Heart Fail* 2021;23:92–113. 10.1002/ehhf.1838 Available: <https://onlinelibrary.wiley.com/toc/18790844/23/1>
 - 20 Adebayo SO, Olunuga TO, Durodola A, *et al.* Quality of life in heart failure: A review. *Nig J Cardiol* 2017;14:1.
 - 21 Gallagher AM, Lucas R, Cowie MR. Assessing Health-Related quality of life in heart failure patients attending an outpatient clinic: a pragmatic approach. *ESC Heart Fail* 2019;6:3–9.
 - 22 Mark DB. Assessing quality-of-life outcomes in cardiovascular clinical research. *Nat Rev Cardiol* 2016;13:286–308.
 - 23 Moradi M, Daneshi F, Behzadmehr R, *et al.* Quality of life of chronic heart failure patients: a systematic review and meta-analysis. *Heart Fail Rev* 2020;25:993–1006.
 - 24 Real J, Cowles E, Wierzbicki AS, *et al.* Chronic heart failure in adults: summary of updated NICE guidance. *BMJ* 2018;362:k3646.
 - 25 Zuluaga MC, Guallar-Castillón P, López-García E, *et al.* Generic and Disease-Specific quality of life as a Predictor of Long-Term mortality in heart failure. *Eur J Heart Fail* 2010;12:1372–8.
 - 26 Rector T. Patient's self-assessment of their congestive heart failure: II. content, Reliability and validity of a new measure-the Minnesota living with heart failure questionnaire. *Heart Fail* 1987;3:198.
 - 27 Garin O, Ferrer M, Pont À, *et al.* Evidence on the global measurement model of the Minnesota living with heart failure questionnaire. *Qual Life Res* 2013;22:2675–84.
 - 28 Rector TS. A conceptual model of quality of life in relation to heart failure. *J Card Fail* 2005;11:173–6.
 - 29 Garin O, Herdman M, Vilagut G, *et al.* Assessing health-related quality of life in patients with heart failure: a systematic, standardized comparison of available measures. *Heart Fail Rev* 2014;19:359–67.
 - 30 Garin O, Ferrer M, Pont A, *et al.* Disease-specific health-related quality of life questionnaires for heart failure: a systematic review with meta-analyses. *Qual Life Res* 2009;18:71–85.
 - 31 Alagumalai S, Curtis DD. Classical test theory. In: *Applied Rasch measurement: A book of exemplars*. Springer, 2005: 1–14.
 - 32 Hambleton RK, Jones RW. Comparison of classical test theory and item response theory and their applications to test development. *Educational Measurement: Issues and Practice* 1993;12:38–47.
 - 33 Bilbao A, Escobar A, García-Perez L, *et al.* The Minnesota living with heart failure questionnaire: comparison of different factor structures. *Health Qual Life Outcomes* 2016;14:23.
 - 34 Brokalaki H, Patelarou E, Giakoumidakis K, *et al.* "Translation and validation of the Greek "Minnesota living with heart failure" questionnaire". *Hellenic J Cardiol* 2015;56:10–9.
 - 35 Brown TA, Moore MT. Confirmatory factor analysis. *Handbook of Structural Equation Modeling* 2012;361:379.
 - 36 Wu M, Adams R. Applying the Rasch model to psycho-social measurement: A practical approach. *Educational Measurement Solutions Melbourne* 2007.
 - 37 McNeish D. Thanks coefficient alpha, we'll take it from here. *Psychol Methods* 2018;23:412–33.
 - 38 Chakraborty AsstProfR. Estimation of greatest lower bound reliability of academic delay of gratification scale. *IOSRJRM* 2017;07:75–9. 10.9790/7388-0702017579 Available: <http://www.iosrjournals.org/iosr-jrme/pages/vol7-issue2.ver.1.html>
 - 39 Johansson P, Agnebrink M, Dahlström U, *et al.* Measurement of health-related quality of life in chronic heart failure, from a nursing perspective—a review of the literature. *Eur J Cardiovasc Nurs* 2004;3:7–20.
 - 40 Levelink M, Brütt AL. Factors influencing health-related quality of life of patients with a left ventricular assist device: a systematic review and thematic synthesis. *Eur J Cardiovasc Nurs* 2021;20:803–15.
 - 41 Moshki M, Khajavi A, Vakilian F, *et al.* The content comparison of health-related quality of life measures in heart failure based on the International classification of functioning, disability, and health: a systematic review. *J Cardiovasc Thorac Res* 2019;11:167–75.
 - 42 A. E. R. Association, A. P. Association, and N. C. o. M. i. *Education, Standards for educational and psychological testing*. American Educational Research Association, 1999.
 - 43 Tavakol M, Dennick R. Making sense of Cronbach's alpha. *Int J Med Educ* 2011;2:53–5.
 - 44 Bunn F, Trivedi D, Alderson P, *et al.* The impact of Cochrane systematic reviews: a mixed method evaluation of outputs from Cochrane review groups supported by the UK National Institute for health research. *Syst Rev* 2014;3:125.
 - 45 Moher D, Shamseer L, Clarke M, *et al.* Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015;4:1.
 - 46 Schiavo JH. PROSPERO: an international register of systematic review protocols. *Med Ref Serv Q* 2019;38:171–80.
 - 47 Mokkink LB. *COSMIN checklist manual*. Amsterdam: University Medical Center, 2012.
 - 48 Prinsen CAC, Mokkink LB, Bouter LM, *et al.* COSMIN guideline for systematic reviews of patient-reported outcome measures. *Qual Life Res* 2018;27:1147–57.