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# *Checklist for Theoretical Report in Epidemiological Studies (CRT-EE): explanation and elaboration*

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**Abstract:** **Introduction:** The theory is considered essential to research, however, its value is often underestimated in development and/or reporting in epidemiological studies. **Objective:** To present a document for the elaboration and explanation of an instrument for theoretical reporting in epidemiological studies.

**Methods:** A theoretical model was developed, based on the theory of Meaningful Learning and literature review, to list dimensions and variables related to the quality of theoretical reporting. The review was carried out between July 2018 and August 2019, in the databases: Medline, SciELO, LILACS, SCOPUS and Web of Science. There were no restrictions related to the period of publications. The languages used were: Portuguese, English and Spanish.

**Results:** A checklist of 15 points was developed, related to the title (1), abstract (1), introduction (4), methods (4), results (2), discussion (2) and conclusion (1) of the articles; and presents a column for marking the information requested in the article for each point. Explanations about each point of the instrument are presented, including examples, references to studies and justifications.

**Conclusion:** This document provides guidance for improving theoretical reporting in epidemiological research and facilitates theoretical evaluation and interpretation of studies by reviewers, editors and readers.

► **Keywords:** models; theoretical; checklist; epidemiologic studies.

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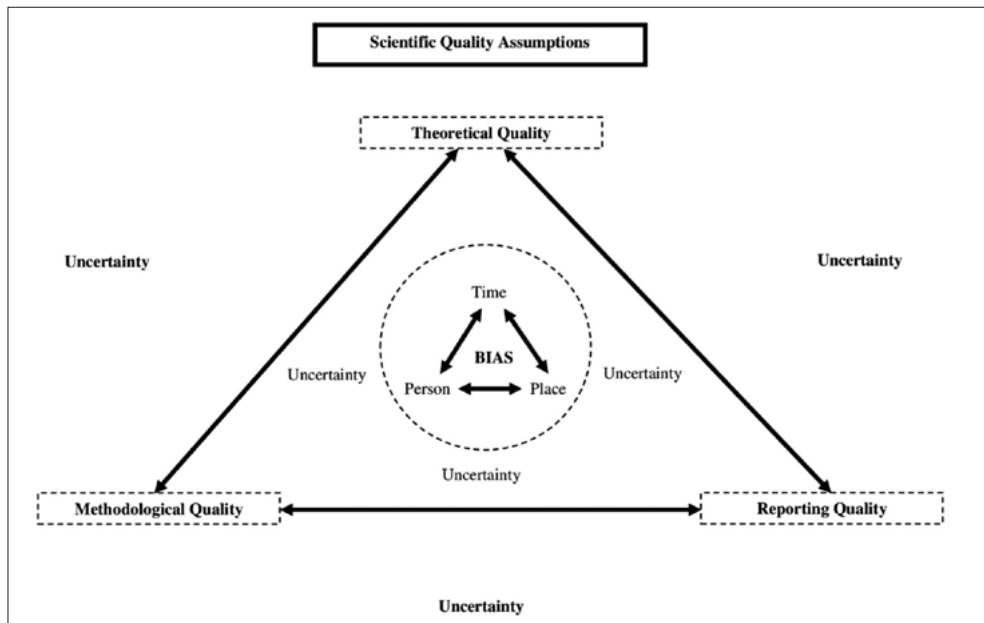
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## Introduction

Scientific practice can be characterized as the interpretation of knowledge regarding a time, person, or place acquired through the combination of theory, methodology, and reporting (SOUZA FILHO; STRUCHINER, 2021). Thus, we developed a theoretical model of scientific quality assumptions for epidemiological studies (figure 1), which reveals that epidemiological studies of high scientific quality are only possible when these pillars of knowledge (theory, methodology, and reporting) are of high quality, and there is no hierarchical relationship among them or prioritization of one pillar over the others.

**Figure 1.** Theoretical model of scientific quality assumptions for epidemiological studies



Source: the authors (2019).

Although a theoretical framework is an essential aspect of the research process (ADOM; HUSSEIN; AGYEM, 2018; CONCARI, 2001), it is often misunderstood or underestimated by researchers, with only a few in-depth reports on theory or theoretical models to support and guide scientific research (CABRERA ARANA, 2007; CABRERA ARANA; MOLINA MARÍN; RODRÍGUEZ TEJADA, 2005).

The development of a theoretical framework is often the result of the researcher's ontological (nature of being) and epistemological (knowledge theory) perspectives (HEALE; NOBLE, 2019). Under-reporting and lack of explanation of theories or theoretical models in epidemiological studies can limit the understanding and critical assessment of readers regarding both the theoretical model used as well as the broader study. Thus, the theoretical framework must be clearly identified and made explicit in any research or scientific publication, to guide the research team as well as the reader (COUGHLAN; CRONIN; RYAN, 2007). All studies, irrespective of whether they use qualitative, quantitative, or mixed methods, must be linked to a theory and/or theoretical model and a theoretical and conceptual framework that guides all stages of the study (ROCCO; PLAKHOTNIK, 2009).

However, theory is not always valued as many authors consider it secondary to empirical results and scientific evidence (BELLER; BENDER, 2017). Social constructionists, for example, advocate against using theories a priori, preferring that theorization arise from data analysis. They claim that, given the nature of social phenomena, no previously selected theory could account for actual observations and that the adoption of a theoretical framework before the data collection phase can obscure the researcher's view. Nevertheless, they advocate the use of theory in the final project as researchers are expected to theorize based on the data (ALVES-MAZZOTTI, 2001).

Post-positivists as well as many theorists and theoretical critics recommend the use of theory in formulating hypotheses and identifying categories of analysis. They claim that it is difficult for a researcher to start collecting data without a theoretical framework, and emphasize that absence of criteria for data collection can result in loss of time, collection of excess data, and difficulty in interpretation (ALVES-MAZZOTTI, 2001).

Theory-oriented thinking and action is particularly important when selecting a topic, developing research questions, conceptualizing the literature review, defining the methodological approach, and performing data analysis (DAVIES; WALKER; GRIMSHAW, 2010). Moreover, a good structure and theoretical framework facilitates result interpretation, discussion, and reflection, in addition to the identification of limitations, which contributes to cohesive and coherent conclusions (ADOM; HUSSEIN; AGYEM, 2018; GRANT; OSANLOO, 2014).

Thus, the framework must be reported in depth at all stages of the article (HEALE; NOBLE, 2019; CABRERA ARANA, 2007).

The lack of theoretical reports in epidemiological studies may be related to the scarcity of instruments to guide researchers on how to report the theoretical bases with quality and completeness. The main instruments with reporting guidelines (MOHER et al., 2010; LIBERATI et al., 2009; VANDENBROUCKE et al., 2007) are mainly focused on methodological issues associated with specific study designs, and thus, neither deepen theoretical issues nor relate them to research.

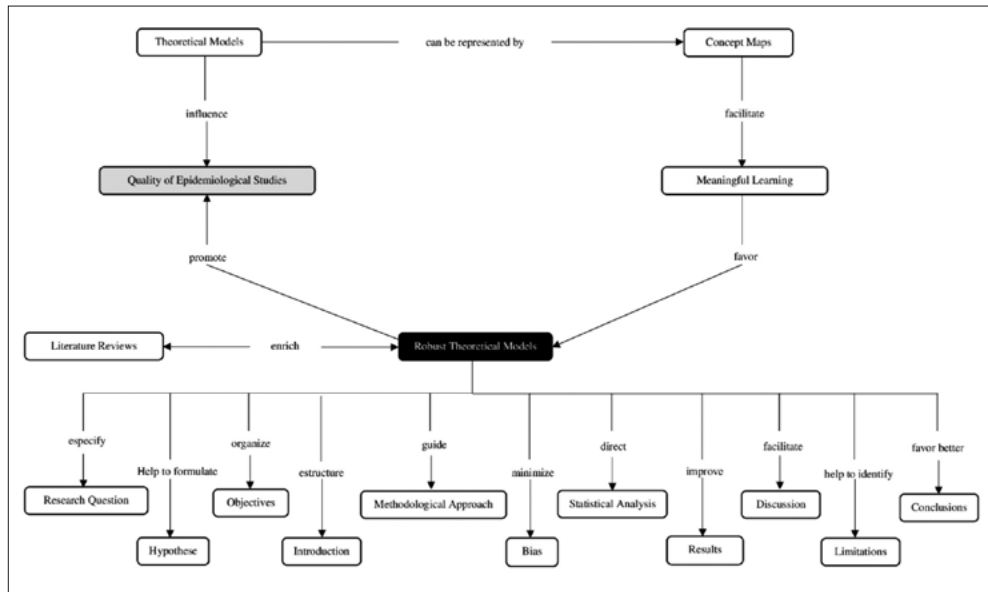
Based on the theoretical model of assumptions for scientific quality, this study aims to present a document of the elaboration and explanation of a checklist to improve the report quality of the theory or theoretical models used in epidemiological studies. It also provides a methodological background, examples of published articles, and consistent reports for each item of the instrument. We believe that this instrument can help researchers better report the theory or theoretical model guiding their study.

## Developing of the Checklist for Theoretical Reporting in Epidemiological Studies (CRT-EE)

The checklist for reporting of theory/theoretical model in epidemiological studies was developed for helping researchers better report the theory guiding their study, and for making author suggestions that can facilitate the development of more transparent and complete theoretical reports. This tool was not designed to assess the quality of the studies, nor does it refer directly, or in detail, to the methodological and practical aspects of research, for which other guides are available (STERNE et al., 2019; STERNE et al., 2016; HIGGINS; GREEN, 2011).

A theoretical model was developed before developing the checklist (figure 2), which comprises important dimensions and variables related to the quality of theoretical reporting in epidemiological studies, identified through literature reviews and previous knowledge.

**Figure 2.** Theoretical model developed using the theory of meaningful learning and literature review



Source: the authors (2019).

A narrative literature review was conducted from July 2018 to August 2019 using the main databases: MEDLINE (Medical Literature Analysis and Retrieval System Online) at the PubMed; SciELO (Scientific Electronic Library Online) and LILACS (*Literatura Latino-Americana e do Caribe de Informação em Ciências da Saúde, in Portuguese*) at the BVS (*Biblioteca Virtual de Saúde*); SCOPUS and Web of Science via the portal of CAPES journals. There were no restrictions on the publication date. The articles were written in Portuguese, English, and Spanish. The DeCS/MeSH keywords and descriptors used in the search strategy were: *Teoria/Theory*; *Modelos Teóricos/Models*, *Theoretical*; *Quadro Teórico/Theoretical Framework*; *Lista de Checagem/Checklist*; *Guia/Guideline*; *Relatório de Pesquisa/Research Report*; *Avaliação da Qualidade/Quality Evaluation*; and *Estudos Epidemiológicos/ Epidemiologic Studies*. The Boolean operator AND was used to ensure greater specificity of the findings and the Boolean operator OR was used to combine the terms.

A narrative review consists of a qualitative synthesis study in which the authors are free to interpret and critically analyze literature findings (ROTHER, 2007).

Moreover, it is an appropriate method to describe and broadly discuss the state-of-the-art of specific subjects from a theoretical point of view. Such a review has an important role in continuing education, as it allows researchers to quickly determine the state-of-the-art for a given subject (ROTHER, 2007). However, narrative reviews may have significant limitations as they are not imperative for methodological rigor, which may make it impossible for other researchers to reproduce them (COOK, 1997; CORDEIRO et al., 2007; ROTHER, 2007). Despite these limitations, this method, which was used for developing a conceptual theoretical model that guided the development of the checklist, contributes significantly to scientific literature and researchers through debate, reflection, and promotion of this topic in the context of epidemiological research (SOUZA FILHO; STRUCHINER, 2021).

Data were selected and extracted by the first author. The articles were read in full, and then categorized and analyzed to support and strengthen the authors' line of reasoning and the scientific validity of the findings. A qualitative synthesis of the topics related to the development of theoretical models was performed. Thus, the quality of the studies included in this review was not evaluated. We prepared a table with the main studies to use as a basis for the development of the checklist (available in the supplementary file). The studies are not directly related to each other, with the relationships being identified during a critical analysis of the content. Furthermore, meetings were held so that the specialists could decide together on the items that would make up the final version of the checklist.

We do not seek to resolve the debate on the topic, but to present a line of reasoning that shows the importance of this debate for a general audience and our view on this matter.

## How to use the Checklist for Theoretical Reporting in Epidemiological Studies (CRT-EE)

The Checklist for Theoretical Reporting in Epidemiological Studies (table 1), was prepared and was based on other reporting guidelines (MOHER et al., 2010; LIBERATI et al., 2009; VANDENBROUCKE et al., 2007), to standardize and make this article relatable and facilitate the involvement and understanding of readers. The purpose of this checklist is to help researchers, reviewers, and editors in the preparation of more transparent and complete theoretical reports. In this article,

we explain each item in the checklist; the supplementary file lists exemplary articles that can be considered as good reports, corresponding to each item of the instrument.

We consider that all items on the checklist are important when reporting the theory/theoretical model in scientific studies. However, we recognize that authors may need to modify or incorporate additional items for their research. It is not our intention to make scientific practice rigid, and we emphasize that the pointers we advance are only suggestions to the authors based on the reviewed literature; this is not an instrument developed to assess the quality of studies or to present methodological guidelines.

Thus, the checklist for reporting a theory/theoretical model in epidemiological studies presents a list of 15 items to be considered when reporting theoretical frameworks in studies and indicates where additional information can improve the transparency of this process. We present the items numerically according to the sections: title, abstract, introduction, methodology, results, discussion, and conclusion. Moreover, we have included a column for indicating, in a dichotomous manner (yes or no), whether the requested information for each item was included.

Unlike other reporting guidelines (MOHER et al., 2010; LIBERATI et al., 2009; VANDENBROUCKE et al., 2007), which suggest that authors do not need to address the items in a specific order, we emphasize that information for each item of our instrument should be included in the indicated sections, as these are the most suitable places for theoretical reporting according to the reviewed literature (ADOM; HUSSEIN; AGYEM, 2018; GRANT; OSANLOO, 2014; KITCHEL; BALL, 2014; IMENDA, 2014).

To emphasize to authors, and others, the importance of transparent and in-depth theoretical reporting, we encourage journals that support our Checklist to endorse it and include their email address ([www.crt-statement.org](http://www.crt-statement.org)) in their instructions to authors and thus encourage authors to adhere to its principles. In addition, this Checklist is registered with the EQUATOR Network, the main international initiative for the dissemination and recommendation of reporting guidelines.



**Table 1.** Checklist items to be included in the theoretical report in epidemiological studies

Session/topic	Item	Checklist for Theoretical Reporting in Epidemiological Studies (CRT-EE)	Answer
<b>TITLE</b>			
Title	1	Did the article title mention the theory/theoretical model and the related main variables that underlie the research?	<input type="checkbox"/> YES <input type="checkbox"/> NO
<b>ABSTRACT</b>			
Reasoned Abstract	2	Did the article present, in the abstract, the theory/theoretical model and its main related variables that underlie the research and explain how they were evaluated and what the main findings, potential limitations, and conclusions are, in relation to the theory/theoretical model used?	<input type="checkbox"/> YES <input type="checkbox"/> NO
<b>INTRODUCTION</b>			
Mention and Refer	3	Did the article explicitly mention and referenced to one or more theories/theoretical models on which the study is based? (In cases where the study is based on a theoretical model specifically developed for the research, the authors must explicitly mention it and, whenever possible, provide a reference.)	<input type="checkbox"/> YES <input type="checkbox"/> NO
Describe the Variables	4	Did the article describe the variables of the theory/theoretical model and their interrelations with the research cohesively and coherently?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Review Literature	5	Did the article report the existence/absence of other theories/theoretical models related to the analyzed phenomenon and explain the choice with scientific coherence?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Innovation/Theoretical Gap	6	Did the article report the contribution of the chosen theory/theoretical model to the phenomenon studied?	<input type="checkbox"/> YES <input type="checkbox"/> NO
<b>METHODOLOGY</b>			
Explanatory Topic	7	Did the article dedicate a topic (preferably at the beginning of the Methods session) to describe in depth how the theory/theoretical model guided the methodological paths developed in the research?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Graphic Representation	8	Did the article represented the theory/theoretical model using a graph? (e.g., figure in the form of a concept map, causal diagram, among other forms). When it is not available in the article, did the article inform where and how it can be accessed (e.g., email address, appendix, supplementary file)?	<input type="checkbox"/> YES <input type="checkbox"/> NO

to be continued...

Session/topic	Item	Checklist for Theoretical Reporting in Epidemiological Studies (CRT-EE)	Answer
Conceptualize and Categorize	9	Did the article conceptualize, categorize, and inform how interrelated research variables in the theory/theoretical model will be recorded and/or classified?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Theoretical Analysis	10	Does the data analysis plan include all the variables of the theory/theoretical model related to research? If any variables have been excluded or included in the analysis, please justify.	<input type="checkbox"/> YES <input type="checkbox"/> NO
<b>RESULTS</b>			
Results of the Variables	11	Did the article present the results of all the variables of the analyzed theory/theoretical model? If any variable has been occulted, please justify.	<input type="checkbox"/> YES <input type="checkbox"/> NO
Theoretical Impact	12	Did the article report how the study's findings impact the theory/theoretical model and explanation the final Theory/Theoretical Model? In the same way as in item 8: (for instance, figure in the form of concept map, causal diagram, among other forms) and when necessary (e.g., email address, appendix, supplement file).	<input type="checkbox"/> YES <input type="checkbox"/> NO
<b>DISCUSSION</b>			
Discussion and Reflection	13	Did the article discuss the study's findings cohesively and coherently based on the interrelations expected and those found using the theory/theoretical model adopted and other existing ones?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Limitations	14	Did the article describe the limitations of the theory/theoretical model (e.g., theory/theoretical model simplified or incomplete and possible exclusions of variables in the analysis)?	<input type="checkbox"/> YES <input type="checkbox"/> NO
<b>CONCLUSION</b>			
Conclusions	15	Did the article present a general interpretation of the theory/theoretical model used in the study considering other theories/theoretical models regarding potentialities, gaps, and implications for future studies on this theory/theoretical model?	<input type="checkbox"/> YES <input type="checkbox"/> NO

Source: the authors (2019).

# Explanation of the items of the Checklist for Theoretical Reporting in Epidemiological Studies (CRT-EE)

## TITLE

### *Item 1: Title*

Did the article title mention the theory/theoretical model and the related main variables that underlie the research?

### *Explanation*

Authors should objectively identify the theory/theoretical model and the main variables related to the study in the title. A title containing this information can increase the interest of readers; facilitate their understanding; and stimulate new studies, reviews, and systematic reviews on the theoretical perspective, as the first stage of the search and selection of documents commonly involves reading the titles of works (BOOTH; CARROLL, 2015).

Authors often choose titles for their articles that incorporate the main exposure and outcome variables used in the study, which can make it difficult to identify and understand the variables related to the Theory/Theoretical Model. The variables related to the objective of the study are encompassed within the theoretical body, which can contain different constructs for the same relationship. Thus, readers need to read other sections of the article to find theoretical information, and thus, judge the relevance of the article to their work, as shown in the example: *“Fear of falling and risk of falling: A systematic review and meta-analysis”* (PENA et al., 2019).

This title does not mention the theory/theoretical model used in the article. The main variables (exposure and outcome) of the study (“fear of falling” and “risk of falling”) and the study design are described. Thus, it is necessary to read other sections to understand the theoretical basis of the study. In the Introduction section, this article presents several theoretical models for the “fear of falling” concept and its interrelation with the “risk of falling” and states that the variations are due to multifactorial phenomena and cognitive, physiological, and behavioral elements (PENA et al., 2019).

These theoretical differences may impact the choice of variables in the theoretical model and, consequently, modify the interpretation of the findings and its replicability

and reproducibility. A reader interested in a particular theoretical approach would have to read the entire article to obtain this fundamental information.

Thus, identifying and mentioning the theory/theoretical model and its main related variables could facilitate the acquisition of information about the article, increasing the interest of readers and the likelihood of reading.

## ABSTRACT

### *Item 2: Reasoned Abstract*

Did the article present, in the abstract, the theory/theoretical model and its main related variables that underlie the research and explain how they were evaluated and what the main findings, potential limitations, and conclusions are, in relation to the theory/theoretical model used?

### *Explanation:*

The Abstract section provides important information that allows readers to quickly understand how the research was developed from conception to completion, presenting the objectives, methodological procedures, expected and obtained results, potential limitations, and related conclusions. Complete descriptions can increase the reader's interest and the likelihood of reading the entire article. We suggest the inclusion of the theoretical report in the Abstract section as it could facilitate readers' understanding and critical analysis. The preparation of structured abstracts is desirable as they provide readers with more complete and easily located information.

The scientific literature shows that a structured abstract can include: Introduction (or Context), Objective (or Purpose), Methods (or Methodological Procedures), Results, Limitations (when applicable), and Conclusions (or implications) (LIBERATI et al., 2009). Thus, we suggest the inclusion of a synthetic reporting of the theoretical and conceptual framework, how it guided the study, and how the research results may impact the theoretical framework, as reported in the body of the article.

We suggest that authors mention not only the main exposure and outcome variables in the Objective, but also the theory/theoretical model used in the study. In the Methods section, we suggest describing the main variables directly or indirectly related to the theoretical basis and providing a brief explanation of the method used for collecting the variables and their inclusion in the analysis, justifying, when necessary, the exclusion or inclusion of variables related to the theoretical model

used in the study. In the Results section, we suggest reporting the main findings obtained from the included and excluded variables (if applicable) of the Theory/Theoretical Model. Finally, in the Limitations and Conclusion sections, we suggest reporting the main limitations and conclusions of the Theory/Theoretical Model, positive and negative aspects compared to other theories, gaps, and implications for future research related to the theory/theoretical model chosen.

We understand that many journals impose stringent limits on the number of characters and/or words for the Abstract section, which can make it difficult to present an in-depth theoretical framework. However, the synthetic description of the article in the Abstract section will be the result of an understanding of the relationship between the theoretical and conceptual framework of the research and its methods of preparation, results, and developments, which can be a challenging but instinctive task for researchers. Journals' editors should consider making more space available for allowing a complete and robust presentation of pertinent information in scientific articles.

## INTRODUCTION

The introduction, a section in which authors commonly find more freedom to contextualize the study, provides a better understanding of the theoretical bases that guide the research. The theory or model can be presented more broadly and descriptively, sharing information on the references, its scientific validity, the existence of other similar theories or gaps in the literature, and the reasons that guided the choice of the theory/theoretical model based on hypotheses on how it could contribute to the phenomenon in the article.

Thus, we suggest reporting the theoretical and conceptual framework transparently and completely in the Introduction section, describing the related variables and presenting other Theories/Theoretical Models, and justifying the choice and presenting its limitations and potentialities.

Thus, we developed the following items:

### *Item 3: Mention and Refer*

Did the article explicitly mention and referenced to one or more Theories/Theoretical Models on which the study is based? (In cases the study is based on a

theoretical model specifically developed for the research, the authors must explicitly mention it and, whenever possible, provide a reference.)

***Explanation:***

Authors should mention and referenced the theory/theoretical model that guided the research, as there may be theories or models with the same name, but with different conceptual and structural aspects for the same research relationship. Thus, the accurate reporting of this information facilitates the reader's identification of the study's theoretical orientation and an analysis of the potentialities and limitations arising from the researcher's theoretical choice.

Moreover, in this case, as the study is based on an original theoretical model that was specifically developed for the study, it is important to explicitly mention it and provide a reference, allowing readers to access the model and analyze the validity of the theoretical and conceptual framework developed and presented by the authors.

Thus, we suggest that these explanations should be included in the opening paragraphs (example 1 in the supplementary file) and reinforced in the last paragraph of the Introduction section, which is commonly used to describe the objective of the study (example 2 in the supplement).

***Item 4: Describe the Variables***

Did the article describe the variables of the theory/theoretical model and their interrelations with the research cohesively and coherently?

***Explanation:***

Once the theory or theoretical model that guides the study is mentioned, we suggest including the description of the variables related to the study and those corresponding to the possible dimensions included in the theoretical and conceptual structure of the research. The objective of a robust presentation of the conceptual framework is to categorize and describe concepts relevant to the study and map the relationships between them (HEALE; NOBLE, 2019; IMENDA, 2014).

Thus, we suggest that the authors provide detailed information about the variables and their interrelationships according to the theoretical and conceptual frameworks presented in the study. Omitting or not justifying the inclusion or exclusion of variables related to the theory or model can make it difficult for

readers to understand, generate doubts regarding the potential of the theoretical choice for the study, impact the analysis plan and statistical findings and their interpretation (GRANT; OSANLOO, 2014).

### ***Item 5: Review Literature***

Did the article report the existence/absence of other Theories/Theoretical Models related to the analyzed phenomenon and explain the choice with scientific coherence?

#### ***Explanation:***

This item suggests the integrated review, criticism, and synthesis of the representative literature on the topic with the theory or theoretical model that guides the research so that new frameworks, insights, and perspectives are generated. Thus, we suggest that the authors present initial holistic conceptualizations about the phenomenon and theory and information about other theories or models related to the studied phenomenon that can provide a new understanding and theoretical concepts.

Moreover, reporting this information facilitates the reader's reflection on the authors' justification of the theoretical choice to support and guide their research. Moreover, a good structure and theoretical framework favor the interpretation of results, discussions, and critical reflections, and the identification of limitations, which contributes to reaching cohesive and coherent conclusions based on the theory or theoretical model used in the research (ADOM; HUSSEIN; AGYEM, 2018; GRANT; OSANLOO, 2014).

### ***Item 6: Innovation/Theoretical Gap***

Did the article report the contribution of the chosen theory/theoretical model to the phenomenon studied?

#### ***Explanation:***

It is desirable to present possible gaps or innovations in the developed, adapted, or chosen theory and their relationship with identifying possible research hypotheses, the potentialities of the theory/theoretical model used to answer these hypotheses, and the possible implications of the research results for the theoretical framework.

It is important that the author not only describes and presents the theory based on its relevance but also recognizes the possible gaps and insights that were not foreseen by the theory and expands the knowledge on the topic. This practice can improve the readers' understanding of the author's hypotheses and intentions regarding the study object.

Thus, we suggest that such information should be described in the last paragraphs of the Introduction section being reinforced in the paragraph that contains the objectives of the study in the same section of the article.

## METHODOLOGY

This session presents to the reader the detailed theoretical basis used in the research and the Theory and/or Theoretical Model that guided the methodological path used for searching, analyzing, and interpreting the findings.

Thus, we suggest the inclusion of a detailed topic on how the theory or theoretical model was used and operationalized for choosing the methodology; the included and excluded variables with their respective justification and how the conceptual theoretical framework conducted the analysis. The graphical presentation of the theoretical model is an attempt to provide greater clarity about the variables involved and their relationships to the reader and the researchers involved in the research to: facilitate the identification of the variables of interest and their interrelationships; promote greater meaningful learning of the phenomenon studied; enable the continuous improvement of the model by including or excluding variables and identifying new relationships not initially considered; minimize bias and improve the methodology; among other aspects.

### *Item 7: Explanatory Topic*

Did the article dedicate a topic (preferably at the beginning of the Methods session) to describe in depth how the theory/theoretical model guided the methodological paths developed in the research?

### *Explanation:*

The literature highlights the important role of mechanisms, which are essential in the evaluation of the methodological process (MOORE et al., 2019). Describing



the theory model transparently provides greater clarity and consistency in choosing the methodological path.

For example, the descriptions of complex interventions often lack details necessary to facilitate their replication and reproducibility by other researchers. Hence, we emphasize the importance of implementing reporting guidelines for transparent articles, which also includes the theoretical aspects that underlie the studies, given their importance in the study design, discussion, and comparison of the results and their potential to aggregate innovations or modify established scientific knowledge.

Thus, we suggest that journals recommend authors to include a topic that addresses the contextual and structural aspects related to the theories and/or theoretical models used in their studies. It is important to include detailed descriptions of the main aspects of the model, including the hypotheses about the relationships, the role of the variables, and the meaning of the symbols in the graphic model and/or unconventional terms used by the authors, facilitating the readers' understanding.

Nonetheless, it may not be possible to present the complete information due to the restricted space commonly imposed by journals. We suggest that, along with the topic summarized in the body of the article, authors can present detailed information on other platforms such as other published articles, appendices, supplement files, web pages, among others.

### ***Item 8: Graphic Representation***

Did the article represented the theory/theoretical model using a graph? (e.g., figure in the form of a concept map, causal diagram, among other forms). When it is not available in the article, did the article inform where and how it can be accessed (e.g., email address, appendix, supplementary file)?

### ***Explanation:***

A graphical representation can be more effective than a text for the communication of complex contents (VEKIRI, 2002). This is because the mental processing of images causes less cognitive overload than the verbal processing of a text.

Allan Paivio (1991) presents the Dual Coding Theory, which indicates the existence of two interrelated cognitive subsystems: the imagetic, concerning non-verbal objects and elements; and the verbal, combined with language. The relationship between the two cognitive systems causes information to be coded in a

dual way, which facilitates the understanding of the relationships and connections established in the cognitive structure.

Thus, we consider graphic representation to be a component that can improve and facilitate the mechanisms of decoding and recoding of language by readers and researchers. Thus, we consider the graphic explanation, by the authors, of the Theory and/or Theoretical Model on which the study is based to be important, whether through conceptual maps, causal diagrams, or others.

This practice can facilitate readers' understanding and interpretation of the research and, consequently, its replicability and scientific reproducibility. It could also help identify possible mistakes or the need to improve the theoretical model used or to include or exclude variables (PEARL; MACKENZIE, 2018).

Thus, we suggest graphical representation should be included in the Methodology section, and whenever possible, accompanied by a brief text that addresses the pertinent relationships in the figure, which may appear together with the explanatory topic described in the previous item. If necessary, the authors can, in addition to explaining the illustration in the body of the article, provide supplement files that explain the graphic or other illustrations that are necessary in greater depth.

### ***Item 9: Conceptualize and Categorize***

Did the article conceptualize, categorize, and inform how interrelated research variables in the theory/theoretical model will be recorded and/or classified?

#### ***Explanation:***

There may be different ways conceptualize, categorize, and record the same variable within the same theoretical framework or model (HEALE; NOBLE, 2019; ADOM; HUSSEIN; AGYEM, 2018). Thus, we suggest that the authors describe these in detail in the study according to the theoretical framework to allow the reader to understand how the variables of the theoretical model were operationalized.

Such information about the operationalization process of the variables allows readers to make reflective criticisms about the theoretical conceptual structure and methods of collecting and recording the data used in the research. It also facilitates the repeatability and reproducibility of the studies as it favors understanding the rationale used by the author in the interaction and transposition of concepts/constructs and variables between the theoretical and empirical levels.

For cases in which the theory or theoretical model of the study has a high number of variables that require many words for their detailed description in the article, the authors may make this information available as a supplement file or link to provide access to the readers as shown in the following example: *“A questionnaire was developed according to the guidelines for Theory of Planned Behavior surveys. It contained 23 question items (Additional file 1: Table S1), measuring attitudes, subjective norms, perceived behavioral control and behavioral intentions of the prescribers”* (LIU et al., 2019).

### ***Item 10: Theoretical Analysis***

Does the data analysis plan include all the variables of the theory/theoretical model related to research? If any variables have been excluded or included in the analysis, please justify.

#### ***Explanation:***

The detailed explanation of the analysis method used for the variables related to the theory and/or model and the explanation and justification of the variables included and excluded for analysis is part of the transparency of the scientific report, indicating that the authors are coherent with the conceptual theoretical framework and consider the most recent scientific evidence on the subject.

Thus, it is desirable that the authors, along with explaining all the variables related to the theoretical and conceptual structure of the research in the previous items, describe how the theoretical model influenced the choice of methods for analyzing the variables, thus, presenting explaining their inclusion and exclusion according to the hypotheses and the role of the variables in the theoretical model. We suggest that the authors should identify and classify the variables (as confounding or mediating, for example) and justify when necessary. If the theoretical model used for the analysis is different from the initially developed conceptual theoretical model, a new graphical representation of the theoretical model of analysis can be presented by the authors along with the textual explanation.

Many studies briefly report the methods of analysis and the criteria used to include or exclude variables for analysis. Simplifying variables in the theoretical framework for analysis can lead to simplified research results subject to bias and different from analyses based on more robust and complete theoretical models (JAHN-EIMERMACHER et al., 2017).

## RESULTS

### *Item 11: Result of the Variables*

Did the article present the results of all the variables of the analyzed Theory/Theoretical Model? If any variable has been occulted, please justify.

#### *Explanation:*

In the Results section, the authors should report the findings referring to all analyzed variables, which were chosen based on the theory and/or theoretical model, and present justifications related to possible exclusions or inclusions of variables from the initial theoretical model.

Changes in the initial conceptual variables can generate changes in the results of the study, over-or under-estimating values and relationships according to the theoretical structure (JAHN-EIMERMACHER et al., 2017). Moreover, it may be difficult to determine causal mechanisms, rely on generalization to other populations, or establish the clinical significance of the effects of the intervention in a study that does not define a theoretical framework in the context of mixed methods to capture the complexity of the examined relationships (EVANS; COON; UME, 2011). Hence, it is important to present the results for each variable related to the theoretical structure, including those in which had no relation or statistical significance and may have been excluded from the initial theoretical model.

In all causal modeling, the interpretations should raise questions about the ethics and feasibility of the interventions implicit in the effect definitions (WESTREICH; GREENLAND, 2013). Thus, the presentation of estimates for all variables included in the model can generate misinterpretations related to possible direct or indirect effects which will require attention in the reporting and interpretation of the results. Thus, we recommend presenting the effect estimates, when necessary, according to the type of estimated effect related to the theoretical model.

### *Item 12: Theoretical Impact*

Did the article report how the study's findings impact the theory/theoretical model and show it in the final theory/theoretical model (in the same way as in item 8; for instance, figure in the form of concept map, causal diagram, among other forms)?

***Explanation:***

We suggest the description and explanation, in the Results section, of the possible impacts of the findings on the theory and/or model used in the research. Moreover, it would be interesting to present the graphical representation of the new theoretical model, which was adjusted based on the possible impacts of the results, when applicable, to allow comparison with the initial theoretical model.

The results of theories or models in epidemiological studies can vary for several reasons, whether they are related to time, person, and/or place. Such changes need to be reported in the article so that readers identify the scope of the theoretical model and its impacts on the theory under analysis. In this way, readers will be able to determine how the theoretical and conceptual framework used in the research varies according to a certain temporality, individuality, and/or environment, improving scientific reproducibility, bringing greater reliability to the findings, and showing its potential limitations.

**DISCUSSION*****Item 13: Discussion and Reflection***

Did the article discuss the study's findings cohesively and coherently based on the interrelations expected and those found using the Theory/Theoretical Model?

***Explanation:***

We emphasize the importance of describing and discussing the study's findings with the theoretical basis for the research, considering the expected results, the inclusion and exclusion criteria of variables in the analysis model and the limitations related to the theoretical model. Moreover, we suggest the incorporation of other theories or theoretical models in the discussion, contrasting the results of the study with other theoretical references.

Different contexts can influence the results and their interpretations, requiring that the authors not be guided only by the empirical findings but also consider the theoretical and conceptual framework used for the research (JAHN-EIMERMACHER et al., 2017; ADOM; HUSSEIN; AGYEM, 2018; GRANT; OSANLOO, 2014). Thus, it is important to consider that findings with statistical significance do not always suggest clinical, political, or other relevance. Similarly, a non-significant result does not necessarily determine the permanence or exclusion of a particular variable in the

theoretical model. For this, it is necessary to analyze a complex causal chain and the results of several studies on the topic, considering uncertainty.

Hence, we believe that along with comparisons and discussions about empirical data (often presented as the main factor in a study), the theoretical report should be discussed, compared, criticized, and a matter of reflection for the researchers. Moreover, a discussion section should be well guided by the theoretical framework to enable richer discussions and allow critical reading by readers (GRANT; OSANLOO, 2014).

#### ***Item 14: Limitations***

Did the article describe the limitations of the theory/theoretical model (e.g., theory/theoretical model simplified or incomplete and possible exclusions of variables in the analysis)?

#### ***Explanation:***

We suggest reporting, in a transparent manner, the possible limitations of the theory or model and its possible impacts on the results. These limitations should be completely described so that readers will be able to analyze in detail the potentialities and weaknesses of the theory and reflect on the quality of research, allowing the development of improved studies in the future.

## **CONCLUSION**

#### ***Item 15: Conclusions***

Did the article present a general interpretation of the theory/theoretical model used in the study considering other Theories/Theoretical Models regarding potentialities, gaps, and implications for future studies on this Theory/Theoretical Model?

#### ***Explanation:***

We suggest that the authors present, in their final considerations, a general interpretation of the theory/theoretical model used in the study and its relationship with other Theories/Theoretical Models, as reported in the other sections of the article. The objective is to briefly defend their positions and points of view regarding the findings, potentialities, gaps, and implications of their article for future studies.

## Final considerations

We wrote this explanatory article to discuss the importance of reports transparent and complete regarding the theoretical aspects that fundamentals and guide research. Throughout the text, we explain why the items were included in the checklist, with examples of published articles that we consider to be good reports (in the supplementary file). We hope that the presented material helps authors and editors use the checklist.

The Checklist for Theoretical Reporting in Epidemiological Studies provides recommendations for researchers to report, in a transparent way, aspects related to the theory/theoretical model they used in their epidemiological studies. A proper report reveals the strengths and weaknesses of a study and facilitates the interpretation and application of the research results (ADOM; HUSSEIN; AGYEM, 2018; VANDENBROUCKE et al., 2007).

Moreover, this Checklist can help in the planning of epidemiological studies associated with other methodological and reporting guidelines specifically developed for study design and methodological issues (STERNE, J. A. C. et al., 2019; SHEA et al., 2017; STERNE, J. A. et al., 2016; HIGGINS; GREEN, 2011; MOHER et al., 2010; LIBERATI et al., 2009; VANDENBROUCKE et al., 2007), which can positively impact the quality of the research. Furthermore, our instrument can guide editors and peer reviewers in evaluating and identifying the use and depth of the theories and theoretical models in manuscripts.

We emphasize that, similar to other recommendations and reporting guidelines (LIBERATI et al., 2009; MOHER et al., 2010; SHEA et al., 2017; STERNE, J. A. C. et al., 2019), the Checklist for Theoretical Reporting in Epidemiological Studies and the Theory of Scientific Quality Assumptions that underlies it, are under development, which can be considered a limitation of this study. We emphasize the importance of continuous evaluation, refinement, and, if necessary, alteration. Thus, the principles and items presented in this article and the checklist are open to change based on new evidence and critical comments.

Therefore, we invite all readers and future supporters of our instrument to share critiques and suggestions relating to our checklist, so that we can improve the theoretical report in epidemiological studies.<sup>1</sup>

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## Note

<sup>1</sup> B. A. B. de Souza Filho, E. F. Tritany and C. J. Struchiner were equally responsible for the conception; methodological choice; data analysis and interpretation; writing of the article and final review. This work is the result of the doctoral dissertation of the first author. There was no conflict of interest.

# Resumo

## Checklist *para Relato Teórico em Estudos Epidemiológicos (CRT-EE): explicação e elaboração*

**Introdução:** A teoria é considerada imprescindível à pesquisa, mas muitas vezes tem seu valor subestimado no desenvolvimento e/ou relato em estudos epidemiológicos. **Objetivo:** Apresentar documento de elaboração e explicação de um instrumento para relato teórico em estudos epidemiológicos. **Métodos:** Foi desenvolvido um modelo teórico, baseado na teoria da Aprendizagem Significativa e revisão de literatura, para elencar dimensões e variáveis relacionadas à qualidade de relato teórico. A revisão foi realizada entre julho de 2018 a agosto de 2019, nas bases de dados Medline, SciELO, LILACS, SCOPUS e *Web of Science*. Não houve restrições relacionadas ao período das publicações. Os idiomas utilizados foram: português, inglês e espanhol. **Resultados:** Foi desenvolvida uma lista de verificação de 15 itens, relacionados ao título (1 item), resumo (1 item), introdução (4 itens), métodos (4 itens), resultados (2 itens), discussão (2 itens) e conclusão (1 item) dos artigos; e apresentada uma coluna para marcação das informações solicitadas no artigo para cada item. Explicações sobre cada item do instrumento são apresentadas, incluindo exemplos, referências a estudos e justificativas. **Conclusão:** Este documento fornece orientações para aprimorar o relato teórico em pesquisas epidemiológicas e facilita a avaliação teórica e interpretação dos estudos por revisores, editores e leitores.

► **Palavras-chave:** modelos teóricos; lista de checagem; estudos epidemiológicos.

