Influencing variables of health: dimensions and their determinants – A systematic review

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Abstract

Background: The aim of this systematic review is to identify all determinants and influencing factors to quantify health as holistically as possible using a multilevel model. The model is derived from determinants, influencing factors and variables of found health measurement constructs. Thus, the quantifiability of health in the model can be ensured.

Methods: The present systematic review is based on the items of the PRISMA guidelines and thus corresponds to the valid guidelines of a systematic review. Literature searches were conducted in English (PubMed, Scopus, Web of Sciences) and German databases (BISp-Surf). All instruments that measured health within one of the five identified dimensions of health (mental, physical, social, existential, environmental) were included. The scores were rated with a quality appraisal tool. All scores were incorporated into a newly created multilevel health model to show health as holistically as possible with all important determinants, influencing factors and variables.

Results: In total, 47 instruments distributed over five dimensions of health were found through the systematic literature search. Of these, 19 instruments were rated as "weak", 19 as "medium" and six as "strong". The review offers good comparability because most instruments were questionnaires.

Conclusion: A multilevel health model based on health measurement instruments was created. This model offers a simple and clear holistic representation of relevant determinants and influencing factors of health. In the future, the model can be used as a basis for the creation of a multidimensional health score that can evaluate people's individual health.

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Background

Problem Statement and General Formulation of the Research Question

Health is "a resource for everyday life, not the objective of living" (WHO, 1986). To address this resource in a sustainable way, it is important to limit it as precisely as possible and to identify important aspects that influence it. This is precisely why it is important to use a specific definition or model of health to narrow the concept. The individual health of a person is complex and divided into many aspects, and it depends on different determinants and influencing factors (Bircher & Kuruvilla, 2014). Thus, there are different ways and possibilities to measure health. To make health measurable, it is important to have a quantifiable definition of health. This could be a model of health that can be broken down into specific characteristics and made quantitatively measurable. A possible classification of the construct of health may involve examining its determinants, influencing factors and variables to identify what it depends on. The state of scientific research gives an orientation towards relevant dimensions of health, but there is no clear compilation of the relevant determinants and influencing factors that depend on these dimensions. Individual works show the determinants of a dimension (Dhar,

Chaturvedi, & Nandan, 2011; O'Brien, 2019; Pineo et al., 2018). Risk and protective factors are important characteristics of health since they are relevant influencing factors in most existing health concepts. The work of Kaiser, Schuhmacher, Schmidtke, and Bös (2021) shows multidimensional health scores and their coverage of holistic health. This research concentrated on multidimensional scores, leading to the need to expand research to unidimensional scores. Intention is the derivation of dimensions corresponding to determinants, the way they are measured and their potential to be combined into a model of health. The aim of this systematic review is to define and map health against a holistic multilevel model based on determinants, influencing factors, variables representing health measurements, and the ability to quantify health.

Theoretical Foundation

Health Dimensions

Health is a complex construct that depends on the so-called health dimension factors. These dimensions are mapped below (see Figure 1) based on the work of Kaiser et al. (2021), and their relevance is explained in more detail with the help of health models and definitions of health.

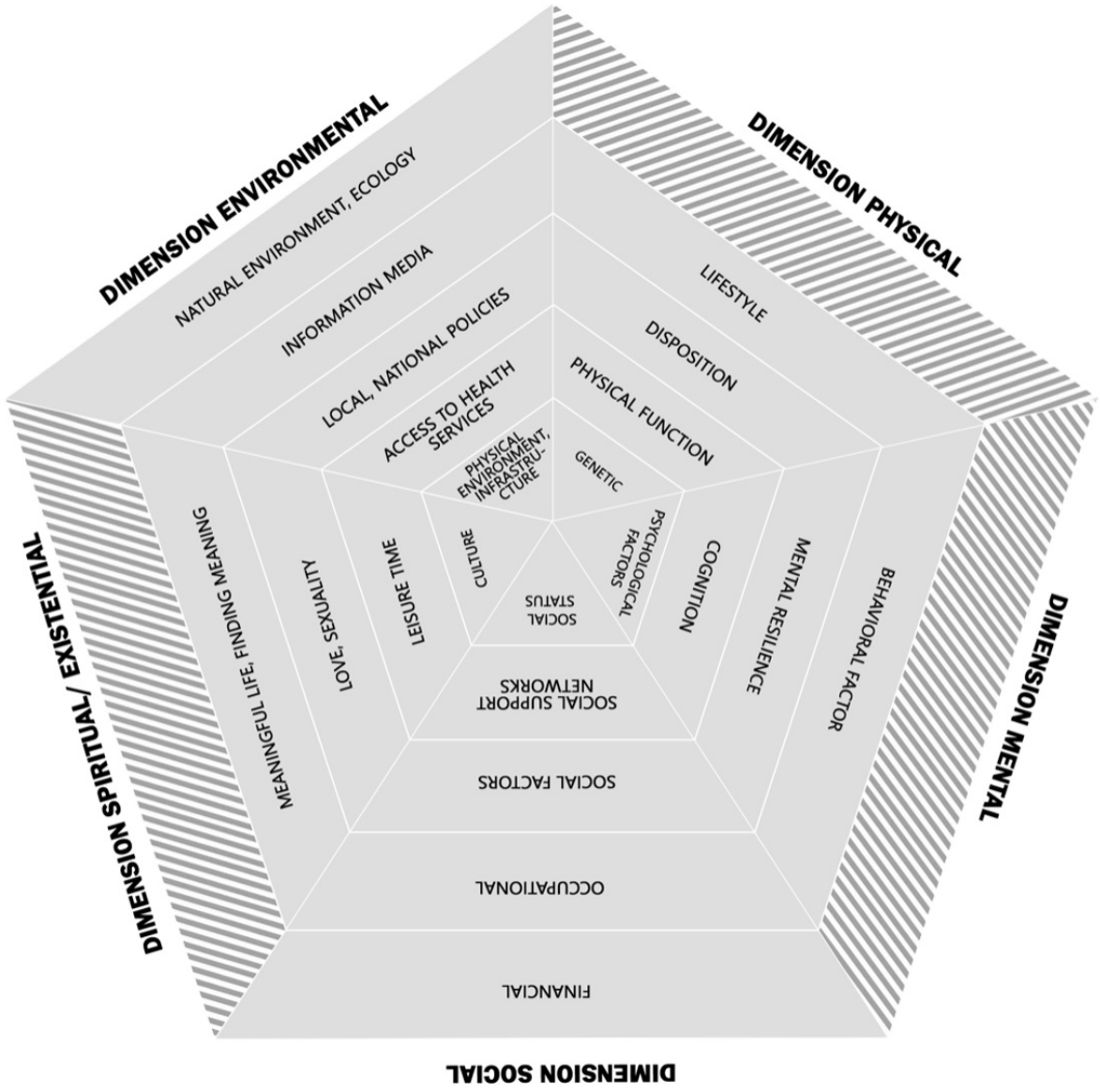

Figure 1. Health dimensions based on the work of Kaiser et al. (2021)

The globally recognized definition of health by the WHO (1948) describes health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". Based on Antonovsky's salutogenic model, Kruse (2004) defined the **physical dimension** of health as the physical and physiological functions of the body.

The **mental or psychological dimension** of health gained relevance in clinical medicine due to Engel (1977), who added two dimensions to the biomedical model to develop the biopsychosocial model. Mental health is defined as “a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community”. It manifests through the ability to think, interact, feel and enjoy life (WHO, 2018). In Engel's (1977) biopsychosocial model as well as in the WHO’s definition of health (1948), the **social dimension** of health plays an important role. Social health can be described as “the extent to which an individual lives up to the standards of his particular society”. A socially healthy person is a functioning member of a

community depending on the cultural and normative standards of the community (Renne, 1974). The **existential dimension** of health is one of the newer dimensions. The existential approach to health was first mentioned in the salutogenic approach of Antonovsky. Kruse (2004) notes that the existential dimension is about finding meaning for a meaningful life. The **environmental dimension** of health is becoming more relevant due to the increasingly important public health approach. The National Environmental Health Association states that environmental health is about preventing human injuries and illness by promoting well-being. The main tasks are identifying and evaluating environmental sources and hazardous agents as well as "limiting exposures to hazardous physical, chemical, and biological agents in air, water, soil, food, and other environmental media or settings that may adversely affect human health (National Environmental Health Association, o. J.)".

Interactions Between Dimensions of Health

To look at health holistically, it is necessary to consider the dimensions of health. These individual dimensions interact with and influence each other, so it is difficult to consider just one dimension in isolation. For example, the mental health dimension is influenced by social, psychological, and biological factors (WHO, 2018). The results of a study by Assing Hvidt et al. (2016) show that the understanding of the existential dimension is inseparable from other dimensions, such as the physical or mental dimension. Environmental health considers the health of societies and measures the social and socioeconomic components, which are also a part of the social dimension of health (Payne-Sturges & Gee, 2006). The social and mental dimensions of health are strongly intertwined. In the early understanding of health, the social dimension was part of the mental dimension (Ryff, 1989). The WHO (2018) claims that an individual's mental health is determined through social, psychological and biological factors. This means that the mental dimension is closely related to the physical or biological and social dimensions. Using multivariable models such as the ALI – Allostatic Load Index is one possible way to address different dimensions of health (Mauss et al., 2015).

Determinants of Health

Determinants of health are factors that have both positive and negative influences on health. In the following, various determinants of health from the literature are briefly presented. The work of Kaiser et al. (2021) shows a detailed compilation of various determinants of health based on five identified health dimensions, which were identified by nonsystematic literature research. Table 3 (additional file 1) reflects the identified determinants and corresponding sources. The findings are represented in a determinant matrix structured according to dimensions in determinant levels 1 and 2. In the physical dimension, genetic determinants, including personal factors and family biography, are referenced most often, followed by lifestyle factors associated with physical activity, nutrition, stress, alcohol and tobacco consumption. Further determinants are dispositions in the meaning of diseases, physical functions such as vitality and power or determinants representing a physical status, such as blood pressure and overweight. Kaiser et al. (2021) noted that the identified determinants do not reflect their positive or negative health effects. Determinants that both improve health and worsen health are equated and not distinguished.

Synthesis and Consequences for this Work

Multilevel Model of Determinants of Health

For this work, a multilevel model of health is created based on aspects of the salutogenic approach in combination with the pathogenetic approach to classify relevant determinants of health. The determinants are derived from the measurement instruments used to survey each dimension. The end of the paper will present the extent to which the newly constructed multilevel model with the results of in this work fits the determinants from the unsystematic literature review (see “determinants of health”). The construction of the framework of the multilevel health model (see Figure 2) consists of a combination of pathogenic models and a salutogenic model. The model consists of protective factors, risk factors, and undirected factors that can shift health along a continuum. The protective factors describe the salutogenic approach (Why do people stay healthy? (homeostasis)). The risk factors describe the pathogenic approach (Why do people get sick? (heterostasis)). The undirected factors cannot be clearly assigned because they can work in both positive and negative directions. At the first level of the model are the dimensions of health that are described above (see “health dimensions”). At the second level are determinants that define and delimit the dimensions through influences. These determinants at the second level have no positive or negative properties. At level three, the level-two determinants are made measurable by undirected factors and positive (protective) or negative (risk) influencing factors. At the last level are possible influencing variables that influence the factors at the third level.

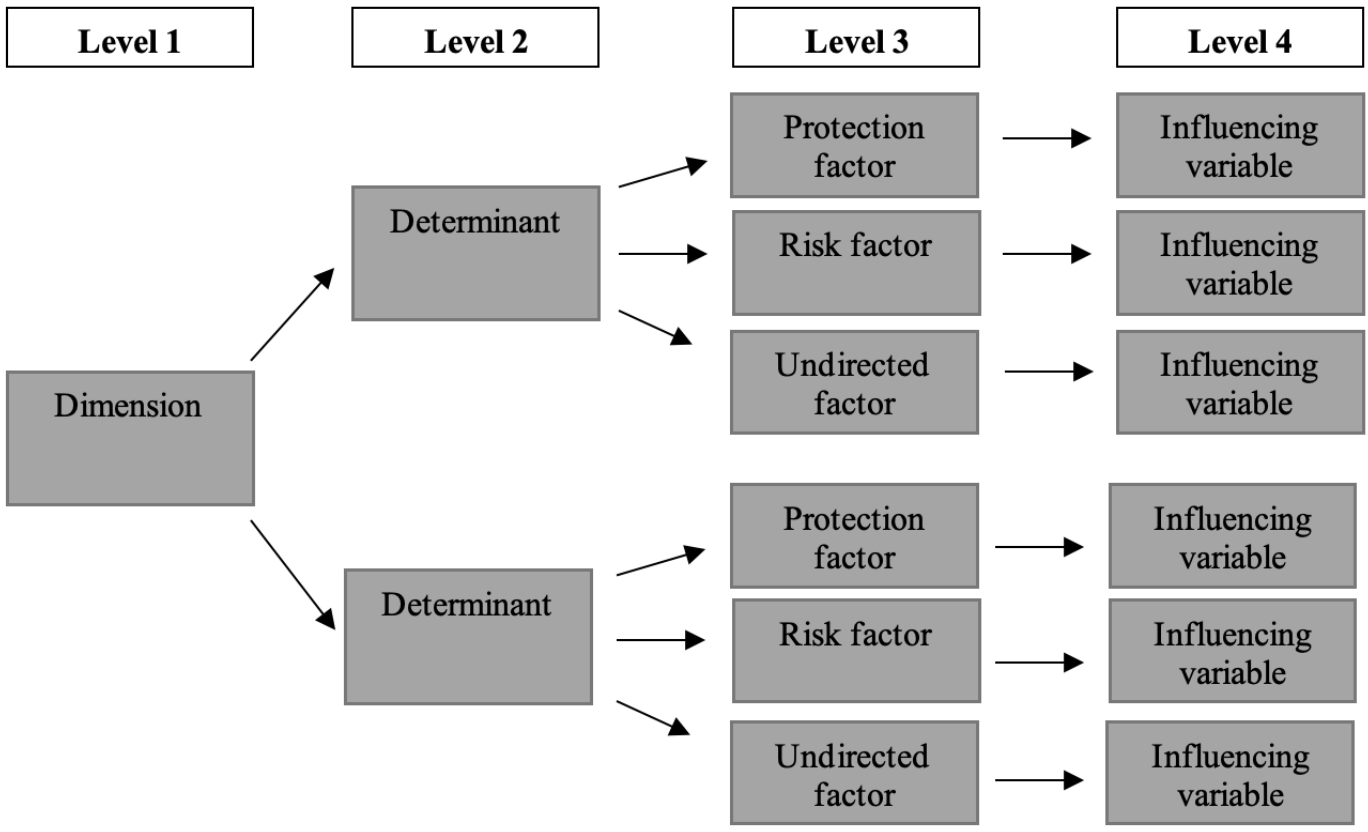

Figure 2. Framework of the multilevel health model

Risk factors can be described as factors that move health status towards the negative pole on the health continuum. They are characterized by an increased likelihood of contracting diseases, suffering health problems, developing a developmental disorder, decreasing quality of life, or dying prematurely (Sperlich & Franzkowiak, 2022). In contrast, protective factors move health status towards the positive pole on the health continuum. They provide resilience and moderate the impact of stress and transient symptoms on health, reducing the likelihood of disorders and diseases (Rönnau-Böse et al., 2022).

There are four relationships within the model that can be described:

1. Health is delimited and defined by dependency with different dimensions (level 1)
2. The health dimensions are delimited and defined by influences of the determinants (level 2)
3. The determinants of the health dimensions are made measurable by positive, negative and undirected influencing factors (level 3)
4. Protective factors, risk factors and undirected factors can have influencing variables that affect them (level 4).

Prefilled Health Model with Multidimensional Health Scores

The framework of the multilevel health model described above was first tested and verified using the multidimensional measurement instruments from Kaiser et al. (2021). Appendix I shows the measurement instruments that have been integrated into the prefilled health model. In the results section of the work, the newly found unidimensional measurement instruments from the systematic review will be incorporated into the multilevel health model to provide a greater density of measurement instruments and thus a more accurate depiction of health. At the end of the work, a holistic model can be created from the collected determinants and influencing factors of the measurement instruments. This multilevel model will be compared in the discussion section with the general determinants of health from the literature, and adaptation proposals will be made.

Explicit Formulation of the Research Objectives

The research aim of this work is to evaluate the dimensions of health and the dependent determinants that influence them. The influencing determinants are captured with the help of a systematic review of the literature. Thus, unidimensional measurement instruments for individual health based on Western living conditions are systematically searched. Through the measurement instruments found, the determinants of health can be filtered out and integrated into the multilevel model created above. A systematic review is used to reflect the complete state of research in the best case. The determinants, influencing variables and their dependencies are presented within a multilevel model. The results of the work form the basis for creating a health model that can capture individual health in a multidimensional and holistic way.

Methods

The present systematic review is based on the items of the PRISMA guidelines (Liberati et al., 2009) and thus

corresponds to the valid guidelines of a systematic review.

Eligibility Criteria

This review is based on Western living conditions, and five health dimensions (mental, physical, social, existential, and environmental, as described in the theoretical background section) are used. The instruments must provide a quantified statement of health or subareas of health. All subjects, regardless of their gender, sociodemographic status, or health status, were considered. All qualitative, quantitative and mixed-method studies were included in the search.

Search

PubMed, Web of Science and Scopus were used for the English literature search, and BISp-Surf databases were used for the German-language search. The last search was performed on October 30, 2021. Each language received an individual search term due to linguistic differences. Both the English and German search strategies consisted of three main search domains. The first area was the health dimension, the second was the context, that is, health or well-being, and the third was the instrument or measurement method. For more details, see the additional file 1 (Table 1-2 & chapter “detailed search terms”).

Study Selection

The study selection process was performed by an independent reviewer. The results were narrowed down step by step using the Endnote program to identify and exclude unsuitable studies. In the first step, duplicates were removed from all studies found due to the different databases.

Then, a title screening was performed using different exclusion criteria (for example, tools developed for specific disease or illness, specific settings and specific target groups were excluded). See the additional file 1 (“exclusion criteria”) for all exclusion criteria. In the next step of the study selection, an abstract screening was performed, and in the final step, a full text screening was performed. The same exclusion criteria were used. Furthermore, all nondevelopmental studies were excluded. In the snowball search, all developmental studies that were not found by the search term were included.

Data Collection

A data extraction sheet based on the criteria grid for motor tests according to Bös (2001) and the work of Freire & Lopez (2017) and Hesselink, Kuis, Pijnenburg, & Wollersheim (2013) was created, tested and improved accordingly. Based on the sheet, the following data were extracted from the studies: (1) instrument and source: name of the instrument and source of the developing study; (2) the specific purpose of the instrument and why it was developed; (3) the measurement method and the administration of the instrument; (4) the subscales of health that the instrument measures; (5) the item count and how the instrument is scored; (6) the further processing of the measured values/data; (7) the item generation or content and subjective area; (8) description of the specific measurement items; and (9) different versions of the instrument

and reference standards. After the review process started, no variables were added.

Synthesis of Results

In the first part of the synthesis, relevant instruments that measured health in one of its five dimensions were identified. The instruments found were used to develop a model of health by extracting the items and subscales of the instruments (Table 4 – see additional file 1) and integrating them into a new multilevel health model. This new model defined health and its underlying determinants. In the second part of the synthesis, the quality of the instruments found was assessed to better classify the quality of the model created.

Multilevel Health Model

The basic framework of the multilevel health model to be used for the synthesis is described in detail in the theoretical background (see “Multilevel Model of Determinants of Health”). In the first step, the multidimensional health scores from the work of Kaiser et al. (2021) were integrated into the prefilled health model. In the results section, the health model is extended with the new instruments found in the systematic review.

Quality Appraisal

To rate the quality and to prevent the risk of bias in the instruments, a quality appraisal tool based on Bös (2001), Freire & Lopez (2017) and Hesselink et al. (2013) was created.

The quality appraisal tool rated the instrument on a score from 3 to 10 points. A lower score indicated worse quality, and a higher score indicated better quality. The criteria on which the tool rated the quality were the literature usage, validity, reliability and feasibility. Literature usage was rated as follows: “the instrument has thus far only been published by the author”, “there are a few publications of other specialist scientists” or “there are many publications of other specialist scientist”. Validity and reliability scoring were based on the literature on the specific instrument. A low score indicated that there was only one developmental study that evaluated validity and reliability, a medium score indicated that there were more validity and reliability studies and only the developmental study existed, and a high score was given if an overview or review of the validity and reliability of the instrument existed. Feasibility was rated on a dichotomous scale of “information given” and “no information given”. A weak rating was given for instruments that scored 3 to 5 points, a medium rating from 6 to 8 points and a strong rating from 9 to 10 points.

Results

Across all English and German databases, a total of 7378 studies were found. After all duplicates were removed, 3882 studies remained for the screening process. In the mental dimension (see Figure 3), 112 full texts remained for the analysis because studies were excluded due to the title (n=1725) and abstract screening (n=239). For the qualitative synthesis, 19 articles remained, nine due to full text assessment and ten due to a snowball search. For other dimensions,

see the additional file 1 (Figure 6-9).

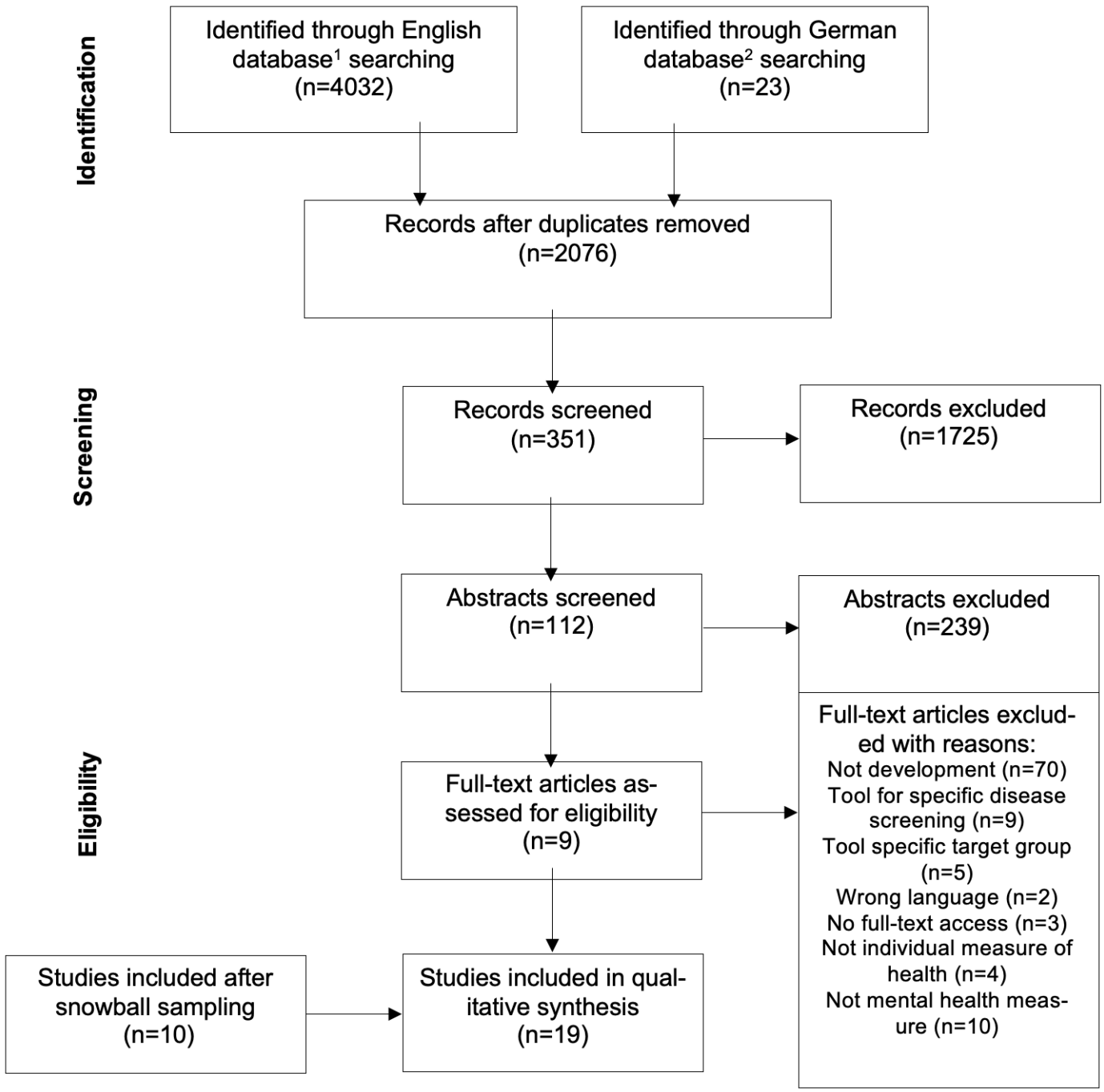

Figure 3. Flow diagram of mental dimension study selection

[1]PubMed, Scopus, Web of Science

[2]BISp-Surf

Study Characteristics

The measurement instruments found in the studies were 44 different questionnaires, two physical or physiological measurements, two related databases and one computer program. There were different administrations for the use of the instruments: 40 instruments were self-rating tools, one involved physician rating, five were administered by interviews and

two were administered through examinations. All instruments had different items that attempted to evaluate health or subareas of health. The number of these items varied between the instruments; the smallest number of items of an instrument was four, and the largest was 50 items. Another important characteristic was the outcome of the evaluated items. Thirty-one instruments processed the results into a total score to represent health. Twenty-seven instruments created subscale scores that were intended to represent a specific domain of health. Many instruments collected both a total score and subscale scores. An important characterization was the origin of the items of the individual instruments. Nine instruments derived their items from a theory or model. Items derived from the literature could be found in 22 instruments. Seventeen instruments generated their items empirically. Table 5 “characteristics of instruments” (see additional file 1) describes further characteristics and all instrument-specific characteristics of the included studies.

Risk of Bias Within Studies

In Table 6 “Quality appraisal of the instruments“ (see additional file 1), the ratings of the identified instruments are presented and described in detail. Forty-seven instruments were examined and evaluated using the newly created quality appraisal tool. A total of 19 instruments were rated as "weak", 19 as "medium" and six as "strong". Three instruments could not be evaluated with the tool because their characteristics did not match the tool criteria.

Synthesis of Results

The multilevel health model is divided into the mental health model, the physical health model, the social health model, the existential health model and the environmental health model based on the five dimensions of health. Each dimension has its own specific determinants and their dependent influencing factors and variables. For the incorporation of the newly found instruments into the health model, the tested prefilled health model with the previously inserted determinants from the work of Kaiser et al. (2021) was used. Thus, the model was improved, enlarged and condensed by the newfound determinants, factors and variables. The differences between the prefilled health model and the main model are revisited in the discussion section.

A total of 838 items were screened from the various instruments found for the construction of the multilevel health model, and all items were categorized (Table 4 – see additional file 1) and then integrated into the new multilevel health model. Items that could not be categorized are called "unclassified" items. These could not be categorized because they did not belong to one of the health dimensions. Another reason for an "unclassified" item was when several dimensions were combined in the item itself.

In the following, each dimension of health within the model is (descriptively) presented. All five dimensions together make up the final model of health.

Mental Health Model

The mental health model is shown in Figure 4. All identified determinants and factors are linked to the instrument from which they were extracted. The model has four main determinants at level 2. The level 2 determinant "emotion" is

influenced by two protective factors, four risk factors and one undirected factor. No level 4 influence variables are found to influence level 3. "Cognition" is influenced by two protective factors and four undirected factors, and no risk factors are found. Protective factors are influenced by one level 4 influencing variable, and no other level 4 variables are found. The level 2 determinant "mental role" is among the most influencing factors. Four factors are protective factors, three are risk factors, and two are undirected factors. At level 4, there are three influencing variables, one for protective factors, one for risk factors, and one for undirected factors. The last level 2 determinant, "mental state," has one protective, two risk, and one undirected factor at level 3. The risk factor is influenced by three level 4 variables, and the undirected factor is influenced by two level 4 variables. Overall, four level 2 determinants, 27 level 3 factors, and nine level 4 variables are identified. Looking at the measurement instruments, the determinant most frequently queried is "mental role" with 27 different instruments, and the determinant least frequently covered is "cognition" with 15 instruments. In total, the mental health model is represented by 40 different instruments.

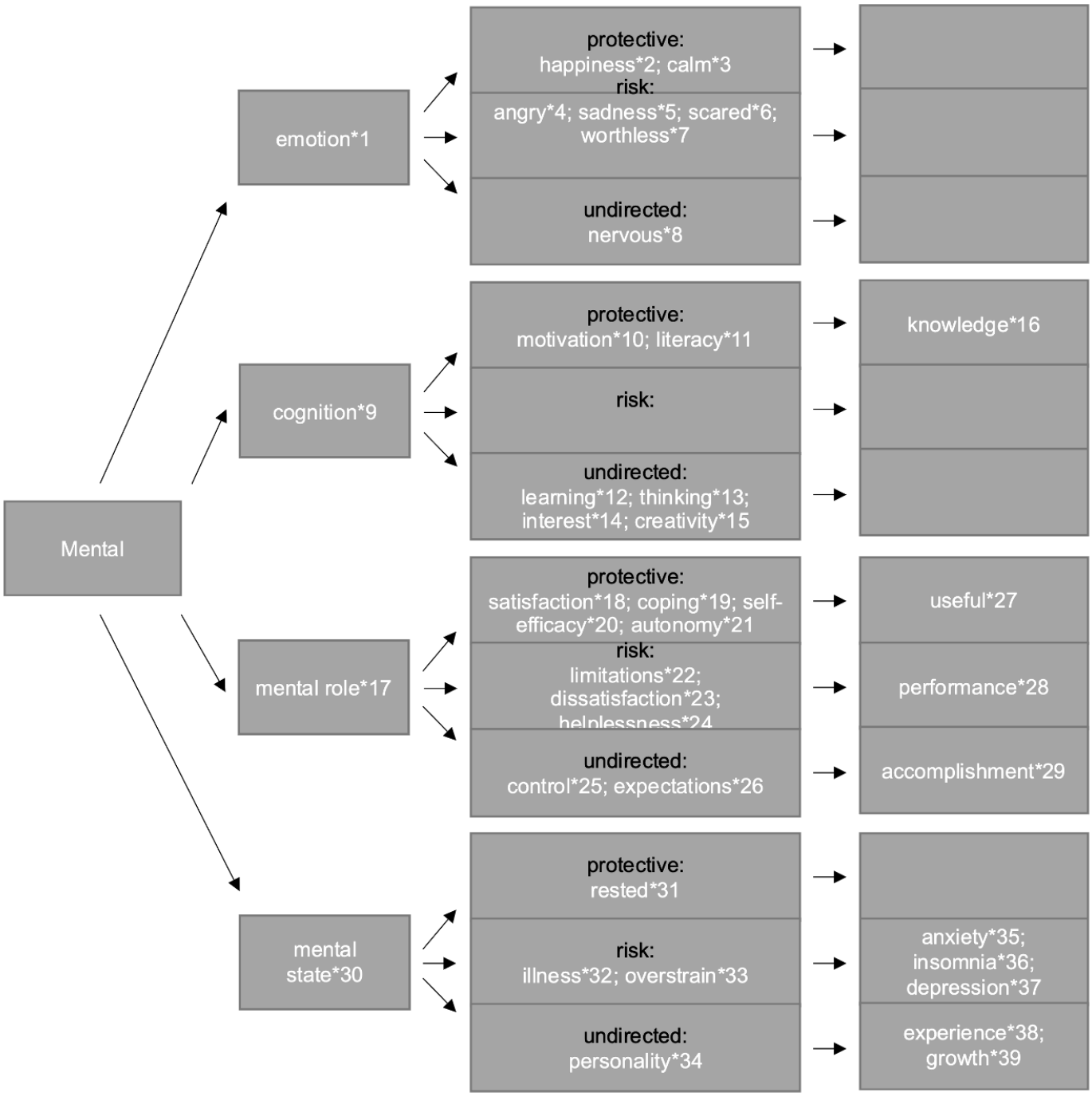

Figure 4. Mental health model

Physical Health Model

In Figure 5, the physical health model and its associated instruments are shown. Five main determinants represent level 2 of the model. The first determinant, “physical function”, has one protective, one risk and two undirected factors at level 3. Level 4 has one variable that influences risk factors and three variables that influence undirected factors. The level 2 determinant “body state” depends on one protective, three risk and two indirect factors. Five level 4 influence variables are associated with the risk factors at level 3. “Behaviour” has six level 3 influence factors, one protective, three risk and two undirected factors. One influencing variable at level 4 is presented for the protective factor.

The level 2 determinant “vitality” has two protective factors, one risk factor and no undirected factor. One level 4 variable influences the protective factors, and no other level 4 variables are found. The last level 2 determinant, “physical role”, has the fewest influencing factors. It has one protective and one risk factor and no undirected factor or level 4 influence variable. Overall, five level 2 determinants, 21 level 3 factors and 11 level 4 variables represent the physical model.

Looking at the physical model at the level of the instruments, the “behaviour” determinant is recorded most frequently by the measurement instruments, with 15 instruments. In comparison, the “physical role” is only measured by six instruments. A total of 31 instruments define the determinants, influencing factors or variables of the physical health model.

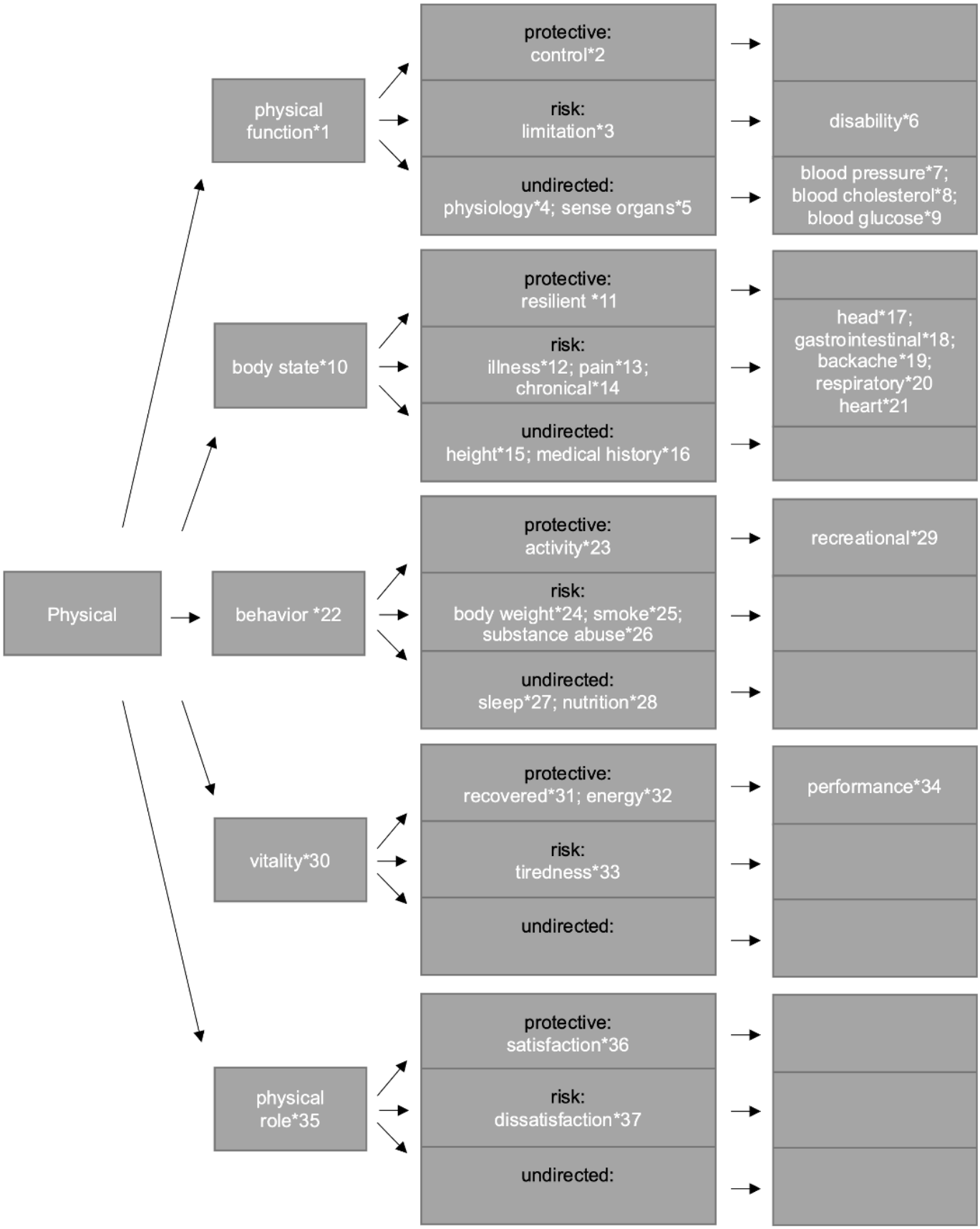

Figure 5. Physical health model

Social Health Model

The social health model is shown in Figure 6. It has four main determinants at level 2. “Social function” is influenced by two protective, one risk and four undirected factors at level 3. The undirected factors are affected by three variables at level 4, and no influence variables for protective or risk factors are found. The level 2 determinant “social factors” has the most level 3 influence factors, of which four are protective, three are risk and one is an undirected factor. The protective factors have two influence variables, and no other variables are represented. “Occupational” is determined by two protective, two undirected and no risk factors. No level 4 variables are found. The last level 2 determinant, “financial”, is affected by one protective, one risk and two undirected factors. No level 4 variable is represented.

The social model of health has four level 2 determinants, 23 level 3 influencing factors and five level 4 variables. The determinant most frequently recorded is “social function”, with 30 instruments. The least covered determinant is “financial” with nine instruments. Overall, 35 different instruments are the basis for the creation of the social health model.

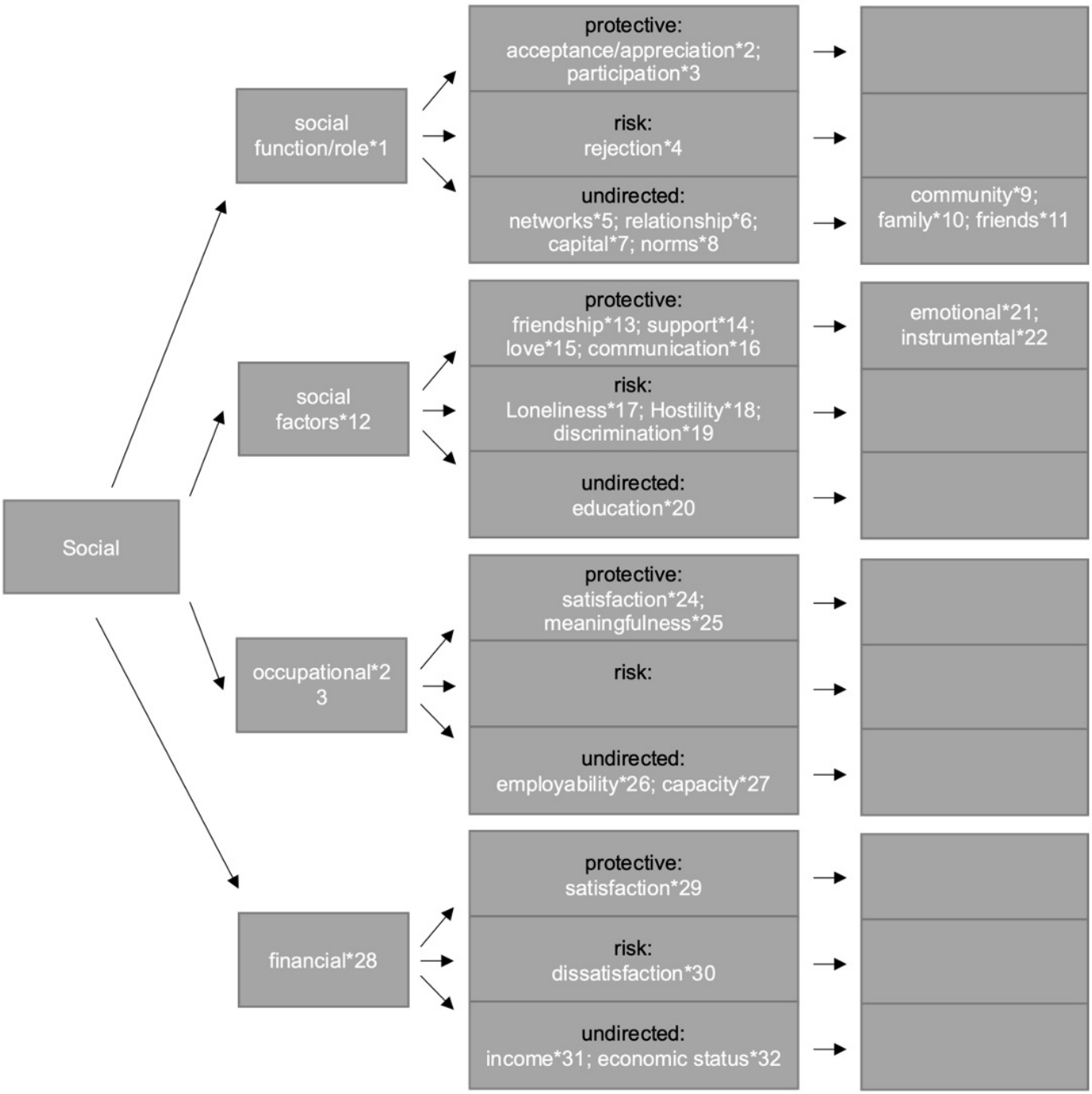

Figure 6. Social health model

Existential Health Model

The existential health model is shown in Figure 7. It has two main level 2 determinants. The determinant “culture” is affected by four undirected factors, and no risk or protective factors are found. One level 4 variable influences the undirected factor. The second determinant, level 2 “life behaviour”, has two protective, one risk and four undirected factors at level 3. No level 4 variables are represented. In total, the existential health model has two level 2 determinants, 11 level 3 influencing factors and one level 4 variable. “Life behaviour” is represented by the most instruments, with 20 different instruments measuring this determinant. In comparison, the determinant “culture” is measured by only eight instruments.

A total of 23 instruments are responsible for the creation of the existential health model.

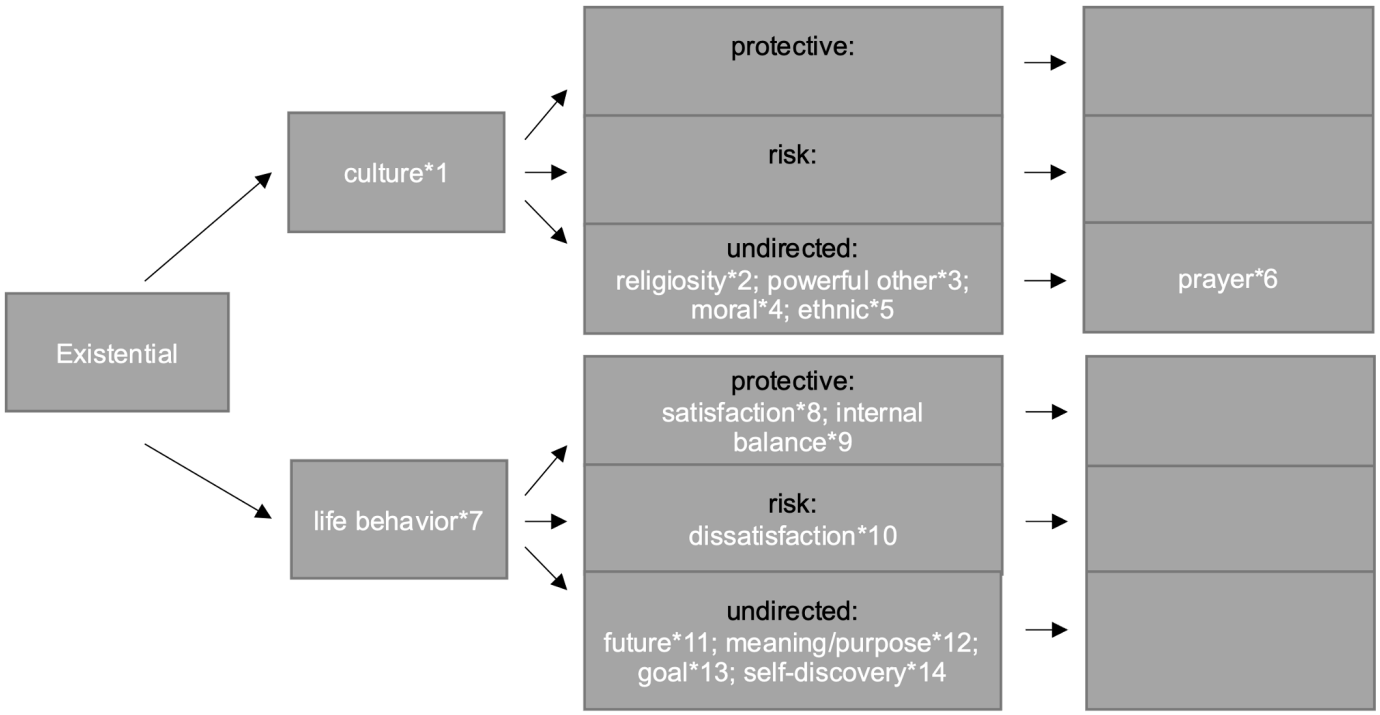

Figure 7. Existential health model

Environmental Health Model

The environmental health model is shown in Figure 8. It has five main determinants at level 2. The first determinant is “security”, which has one protective, three risk and no undirected factor. Two level 4 variables influence the risk factors, and no variables that affect protective factors are found. “Health utilization” has one protective and one indirect factor. No risk factor or level 4 variable is represented. The third determinant, level 2, is the physical environment, which has four undirected factors and no risk or protective factor. At level 4, there exist nine influencing variables. “Policies” has one undirected factor and no level 4 variables. For the last determinant, level 2 “media” is not a level 3 influence factor or level 4 variable.

Overall, five level 2 determinants, 11 level 3 influencing factors and 11 level 4 variables are extracted. With ten instruments, the determinant most covered by instruments at level 2 is the "physical environment". The least covered are “policies” and “media” with just one instrument. In total, 16 instruments define the environmental health model.

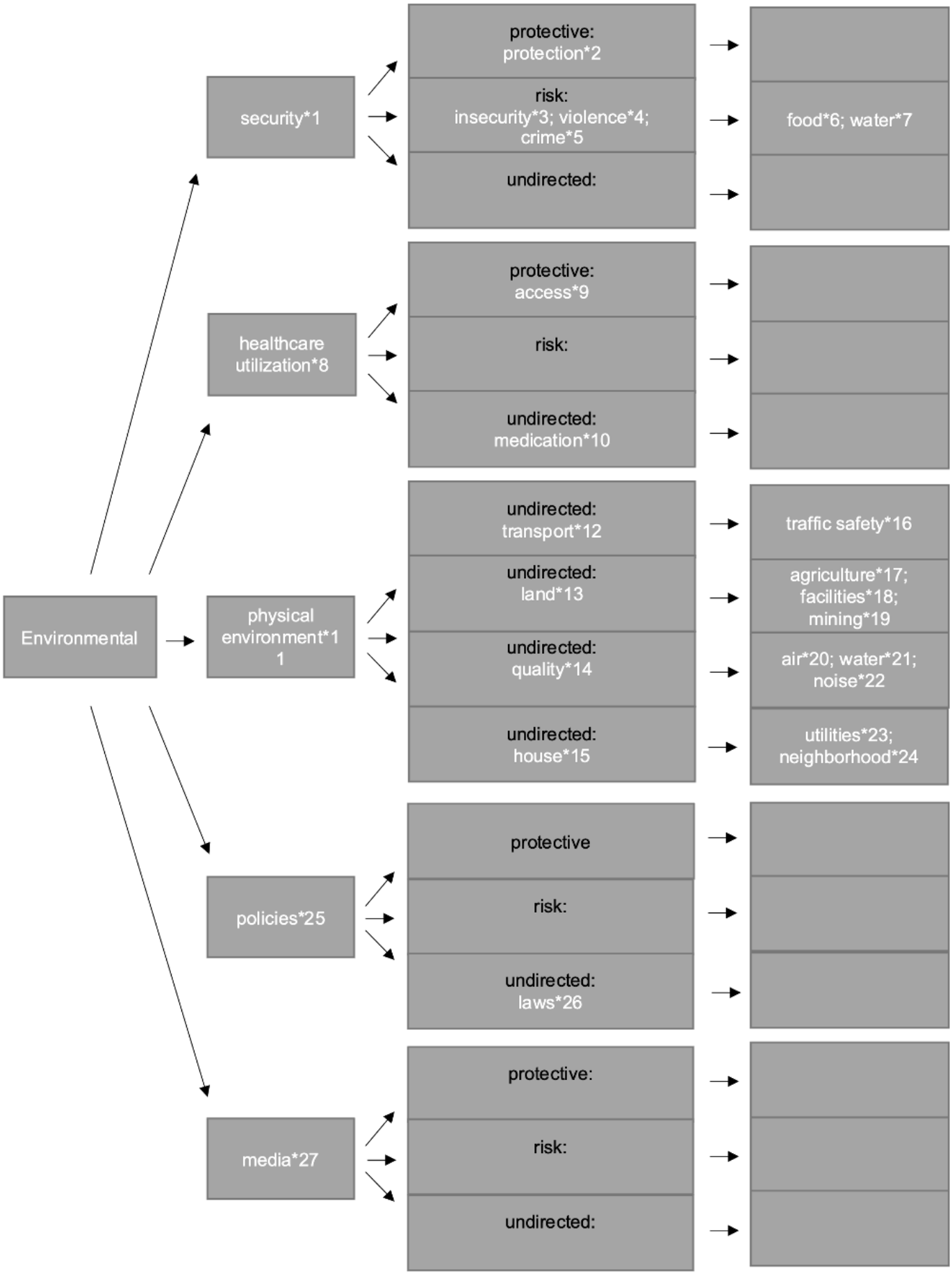

Figure 8. Environmental health model

Discussion

Summary of Evidence

With the help of the systematic review, relevant determinants of health were identified within all five dimensions of health. On the basis of these determinants, a multilevel model of health was established, which should represent health in all its facets and make it measurable by means of instruments. The instruments found in this work were integrated with the measurement instruments from the work of Kaiser et al. (2021) into a model previously derived from the literature. Furthermore, the instruments were evaluated with the help of a quality appraisal to draw conclusions about the relevance of the instruments. This will be relevant in future steps beyond the scope of this paper to develop a multidimensional health score. In total, 47 instruments distributed over five dimensions of health were found through the systematic literature search. The review offers good comparability because most instruments are questionnaires. The results indicate that the literature review was successful because there are many overlaps with the instruments of the prefilled health model (see additional file 1, figure 1-5). However, it also shows that if only the prefilled model is considered based on the multidimensional scores, there are still many gaps that could be closed by this work. The mental health model was extended by eight determinants compared to the prefilled model. The physical health model was extended by five determinants, and the social health model was extended by nine determinants. The existential model was increased by four determinants and the environmental model was increased by 20 determinants. Thus, the step to extend the search to the unidimensional level was correct. Many new determinants could be identified at all levels of the model, and the model could be improved. Furthermore, the number of instruments that collect a determinant increased. In the prefilled model, determinants were often represented that were collected by only one instrument. In the multilevel model, most determinants were asked by more than one instrument. An exception is the environmental health model since the number of instruments was very low compared to the other dimensions. Overall, however, the determinants used in the model were relevant to define and survey health.

Taking a closer look at the results section, there are still gaps in the model. Overall, it is clear that the mental dimension is very well covered at level 2 and level 3. There is only one gap because no risk factors are found in the “cognitive” level; otherwise, protective, risk and undirected factors are found for each level 2 determinant. In the physical dimension, there are gaps within level 3 in the undirected influence factors of “vitality” and “physical role”. The social dimension has a gap within the “occupational” determinant in the risk factors. One reason is that the “occupational determinant” in particular is setting-specific and large. The work of Magnavita and Chirico (2020) addresses this problem. The risk factors mentioned by the authors can be physical and biological hazards, chemical risks and psychosocial factors. The two least covered health dimensions are the existential and the environmental dimensions. For the existential health model, only two determinants at level 2 were identified, and for the determinant “culture”, no protective or risk factors were found. In the environmental health model, many level 2 determinants were found, but level 3 of the model was incomplete. One reason for this could be that both dimensions are new dimensions of health that are not mentioned in the WHO definition of health. Nevertheless, they have a strong and relevant impact on health (see theory section) and should not be neglected. Especially at the environmental level, fewer studies investigate the impact on individual health, but more studies

investigate population-related factors and thus fall out of the grid due to the search criteria of the review. In the existential dimension, most instruments specifically ask only about spirituality in the context of health. It should be considered whether the existential dimension should be renamed the spiritual dimension.

If the density is considered with regard to the number of influencing variables at level 4 in connection with the number of factors at level 3, the number within level 4 is low. The main reason lies in the methodology or the search terms of this work. To cover level 4 more precisely, a further search would be necessary that does not look specifically for the level 1 dimension but looks specifically for level 2 and 3 determinants. This search would go beyond the time frame of this work and was therefore not accomplished. Another important point in the creation of the model is the arrangement of the determinants in the specific dimensions. Many determinants, influencing factors and variables have an impact on health across multiple dimensions and thus could be classified into other dimensions. An example of this is the financial determinant, which could be classified into both the existential and social dimensions. Another is the determinant of health literacy, which is presented in the work of O'Brien (2019) as a social determinant. In this work, it is included in the mental health model under the determinant "cognition" as it is also used in the literature (see additional file 1, figure 1-5). The determinant "house" or "housing" is often used in the context of the social dimension. In this work, it has been deliberately included in the environmental health model. This determinant has an influence on both dimensions, but due to the literature (see additional file 1, figure 1-5), it was included in this way. Alternatively, the determinants and influencing factors that have an influence on more than one dimension could have been named in the respective dimension; thus, they would be named several times in the entire multilevel health model. However, for the sake of simplicity, they have been placed under only one health dimension in the multilevel model.

Comparing this model with the determinants of health described in the literature (see additional file 1, figure 1-5), there are many overlaps, which speaks in favour of this model. The Institute of Medicine (1997) names the social determinants family, education, networks, occupation, social class and property. The environmental determinants of safety, housing and infrastructure are also physical determinants. These determinants were also found in this multilevel health model. O'Brien (2019) mentions the social determinants of poverty, employment, food insecurity, housing, transportation, health literacy, trauma exposure/history and social support. This is also represented in this work’s multilevel health model. At the environmental level of health, Pineo et al. (2018) notes the relevant determinants of transportation, housing, air and water quality, land use, services and utilities, food environment, natural environment and noise. These are included in the environmental health model. There are also determinants mentioned in the literature that could not be extracted from the measurement tools, such as genetic endowment (Institute of Medicine, 1997), urban design, public open space, pollutants, and waste management (Pineo et al., 2018). These could be subsequently integrated into the model. Overall, the constructed multilevel health model has very strong overlaps with the literature.

Limitations

A limitation of the systematic review is that the structured search may not have found all relevant instruments to assess health in all five dimensions, so the results should not be considered inclusive.

Many instruments were found that claimed to measure only one or two dimensions, but a closer look at the items shows that there are often items that measure other dimensions according to this work's definition of health. Many instruments have different versions with different numbers of items (see Table 5 "characteristics of instruments", additional file 1). The version used for this review was always the one found through the systematic search. Other versions were linked to ensure integrity.

Another important point is that full access to all measurement instruments was not available, especially with regard to the items. Thus, the determinants could sometimes be derived only from the subscales and not from the direct items.

If the limitations are considered within the individual dimensional models, it becomes apparent that in the existential dimension, many spiritually related questionnaires were found, and very few went beyond spirituality to existential issues. Within the social health model, as described above, the occupational determinant is specific and large. This cannot be captured holistically by the search term used; a separate search would have to be conducted for this determinant. The literature found on the environmental dimension is much more recent in terms of publication years, with the oldest publication dating from 2011 and two out of five dating from 2021. This shows that the environmental level of health is still in its infancy compared to the other dimensions. There were also items from instruments that could not be classified in the multilevel health model, such as the "quality of life" item. If quality of life instruments such as the WHOQOL or the AQoL 8D are compared with the instruments found, the determinants of the instruments are very similar. This is because the quality of life construct is very similar to the health construct.

Looking at the procedure of the quality appraisal, it becomes apparent that a relevant limitation is the collection of scores for validity and reliability. Validity and reliability are estimated on the basis of the number of studies that have examined them. This estimation involves the error that low validity and reliability values of the instruments can seep through since the exact values in the studies are not interpreted. However, this is deliberate since the specific collection of all validity and reliability values exceeds the scope of the work. Thus, these quality appraisal values can only show a tendency. Another limitation of the quality appraisal tool is that instruments within the environmental health model that are based on databases cannot be evaluated by the tool.

Conclusion

Due to the large body of literature, the multilevel health model was created using only measurement instruments to measure health. One reason for this is that the health model is used to create a multidimensional holistic health score. Health scores are instruments that measure health and represent it quantitatively.

Because of the framework condition, the validity and reliability of the instruments were evaluated only superficially. In a future work, it is necessary to consider the exact validity and reliability values and to evaluate the instruments found on the basis of these values.

To solidify the model and to close gaps within it, further investigations must be conducted. A further step would be to

evaluate the influence on mortality and morbidity of the individual dimensions and determinants. Thus, a weighting of the strength of influence on health of the individual determinants, factors and variables described in the model could be presented. To create a health score, it is also important that the instruments used are standardized to a single score, i.e., the result of the instruments shows numerical data within the health continuum. An example would be from 0 (death) to 1 (perfect health). This is influenced by protective factors and risk factors. The weighting of protective and risk factors with regard to their influence on health has been previously performed. A further and important step is the empirical validation of the multilevel health model. This could be done by creating a derived instrument from the model, for example, a questionnaire. This instrument would then be tested on a random sample for its psychometric properties.

Declarations

- Ethics approval and consent to participate
  - Not applicable
- Consent for publication
  - Not applicable
- Availability of data and material
  - All data generated or analysed during this study are included in this published article [and its supplementary information files]
- Competing interests
  - Not applicable
- Funding
  - Not applicable
- Authors' contributions
  - DK did the initial research to identify the research gap and to formulate the research question. KB contributed in that early stage with his expert knowledge in that area of science. AS and DK set-up the manuscript concept and design in alignment with KB. AS performed the systematic review – DK and KB reviewed and acted as input providers. DK supported with research in parallel. Analysis and interpretation of results has been done by AS and DK. All authors read and approved the final manuscript.
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Additional files

- Additional file 1
- File format: .pdf
- Title of data: Supplementary information
- Description of data:
  - Table 1: English search strategy
  - Table 2: German search strategy
  - Detailed Search Terms: English search term 3
  - Detailed Search Terms: German search term 4
  - Extended information: Exclusion criteria
  - Figure 1: Prefilled Mental Health Model
  - Figure 2: Prefilled Physical Health Model
  - Figure 3: Prefilled Social Health Model
  - Figure 4: Prefilled Existential Health Model
  - Figure 5: Prefilled Environmental Health Model
  - Figure 6: Flow diagram of physical dimension study selection
  - Figure 7: Flow diagram of social dimension study selection
  - Figure 8: Flow diagram of existential dimension study selection
  - Figure 9: Flow diagram of environmental dimension study selection
  - Table 3: Dimension and Determinant of Health Scores (Kaiser et al., 2023)
  - Table 4: Item Categorization
  - Table 5: Characteristics of Instruments
  - Table 6: Quality appraisal of the instruments
  - References

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