The structure of the Risk Culture Framework: Evidence from a health context

Moritz Bielefeld$^1$, Bernhard Streicher$^2$, and Can Gürer$^1$

$^1$Affiliation not available
$^2$UMIT-Tirol University

March 21, 2023

Abstract

Risk assessment and behavior of social entities, such as societies, organizations or groups, are shaped by shared values and beliefs. Such shared convictions on how risk is perceived and handled are widely labeled as risk culture. While risk culture is a promising approach for comprehensively considering risk aspects in social dynamics, its structure still lacks conceptual clarity. In this regard, the recently introduced Risk Culture Framework (RCF) was aimed at providing an operationalization foundation for risk culture research through a 3x3 grid representing different cultural levels and influencing domains. However, until now, the RCF has neither been empirically applied nor tested. In the current study, the structural fit of the model is evaluated using empirical data pertaining to health risks gathered by an exploratory questionnaire ($N = 500$). For the sake of methodological consistency, the cultural level of implicit factors was not considered due to its methodological specificity. Confirmatory factor analyses were used to analyze the fit of the assumed model structure as well as that of other applicable models. Model indices for the RCF-oriented risk culture model structure were acceptable and better than those for the other models tested. Overall, results support the theoretical-based structure of the RCF, and provide a foundation for further research on risk culture. Future approaches and applications of the RCF to more specific risk subjects are discussed.
The Structure of the Risk Culture Framework: Evidence from a Health Context

Moritz Bielefeld
UMIT-Tirol Hall i.T.

Bernhard Streicher
Ludwig-Maximilian-University, Munich

Can Gürer
UMIT-Tirol, Hall i.T.

Corresponding Author: Bernhard Streicher, streicher@bernhardstreicher.de

Risk assessment and behavior of social entities, such as societies, organizations or groups, are shaped by shared values and beliefs. Such shared convictions on how risk is perceived and handled are widely labeled as risk culture. While risk culture is a promising approach for comprehensively considering risk aspects in social dynamics, its structure still lacks conceptual clarity. In this regard, the recently introduced Risk Culture Framework (RCF) was aimed at providing an operationalization foundation for risk culture research through a 3x3 grid representing different cultural levels and influencing domains. However, until now, the RCF has neither been empirically applied nor tested. In the current study, the structural fit of the model is evaluated using empirical data pertaining to health risks gathered by an exploratory questionnaire (N = 500). For the sake of methodological consistency, the cultural level of implicit factors was not considered due to its methodological specificity. Confirmatory factor analyses were used to analyze the fit of the assumed model structure as well as that of other applicable models. Model indices for the RCF-oriented risk culture model structure were acceptable and better than those for the other models tested. Overall, results support the theoretical-based structure of the RCF, and provide a foundation for further research on risk culture. Future approaches and applications of the RCF to more specific risk subjects are discussed.

Keywords: Risk culture framework, risk psychology, health risks, structure equation modeling

Handling real-world risk can be a complex undertaking that involves many factors that interact resulting in highly complex situations (Streicher et al., 2018). Emerging or systemic risks associated with climate change, financial crises or the COVID-19 pandemic illustrate this complex interdependency impressively. Accordingly, research focusing only on single aspects often fall short of comprehensively explaining, predicting and successfully handling complex risks. Furthermore, risk as such is a very broad and diverse field, which is why even well-established approaches are rarely transferable from one risk domain to another. Therefore, there is a need for new integrative and comprehensive concepts and
approaches that allow for transfer between different domains and practical applications (Aven, 2019; Aven & Flagge, 2020; Schweizer, 2019). Risk culture could be a suitable construct for this undertaking since it comprises shared values, beliefs, knowledge and understanding of risks (Ring et al., 2016), as well as shared perception of risk-related behavior (Sheedy et al., 2017). As such, it can shape risk perceptions and behavior (Sheedy & Griffin, 2018) in all social settings. Also, it applies to many domains (cf. Annandale, 1996; Merz & Emmermann, 2006; Streicher et al., 2018) and encompasses the complexity of real risk situations due to its multi-layered nature (McConnell, 2013; Previati, 2017). However, past studies on risk culture have been criticized for lacking consistent operationalizations that differentiate it from other constructs such as risk climate (e.g., Schneider et al., 2013; Sheedy et al., 2017; Sheedy et al., 2021), or for a lack of conceptual and methodological depth (e.g., Ring et al., 2016; Zeng et al., 2020) resulting in the need for theoretical frameworks (Cimini, 2021). To address these shortcomings, the recently introduced Risk Culture Framework (RCF; Streicher et al., 2022) connects essential elements of culture with risk research. The RCF provides the first categorization of risk factors that incorporates different research perspectives and contents in the concept of risk culture with different influence domains (i.e., person, social context, and risk situation) and cultural levels (i.e., observable factors, non-observable factors, and implicit factors). In doing so the RCF provides a basis for research and practice, but it remains untested. This current study aims to be the first to assess and test the structure of the RCF through an exploratory application in the field of health risk. Thereby, this first empirical evaluation also intends to improve the understanding of risk culture, its structure, and the consistency of risk culture operationalization by application of the RCF.

**Risk Culture**

Social entities including societies, organizations, groups or individuals within a social unit share convictions in their identification, assessment and handling of various aspects of life, particularly, risk (Institute of International Finance, 2009). Shared values, beliefs, knowledge and understanding of risks build a social entity’s risk culture (Ring et al., 2016). Accordingly, risk culture shapes risk perception, assessment, and behavior (Sheedy et al., 2017; Sheedy & Griffin, 2018; Streicher et al., 2018) and is reflected in risk-related decisions and performance (Nguyen et al., 2019). However, since situational understandings and judgments are culturally driven (Schein, 2017), patterns of risk perception are socio-culturally shaped and shared within social entities (Cornia et al., 2014). Hence, risk culture is adaptively influenced by its cultural values and norms (Costanza et al., 2015). The current COVID-19 pandemic is a particularly illustrative example of the influences of risk culture on the perceived appropriateness of risk behavior: cultural parameters such as the sense of social connectedness, the belief in sharing values (Wolf et al., 2020), shared social identities and networks (Rudert et al., 2021), or group membership (Cruwys et al., 2020) are all associated with COVID-19 compliance and risk perception. Therefore, risk perception of COVID-19 is linked to an increased need for security (Kohler et al., 2021), trust in the government (Ye & Lyu, 2020), and protective health behavior (Bruine de Bruin & Bennett, 2020). In addition, the perceived risk of COVID-19 and mental health burdens change over time (e.g., Bäuerle et al., 2020; Teufel et al., 2020, Wong & Alias, 2021), and the initial risk perception predicts later protective behavior (Bruine de Bruin & Bennett, 2020). It can then be assumed that a health-related risk culture influences corresponding behaviors over the course of the pandemic. In summary, social entities can have a specific and dynamic risk culture (Pan et al., 2017), which is stable yet changeable over time. This makes risk culture an attractive concept for understanding the state and dynamics of handling risk.

Using risk culture to better understand risk assessment and behavior of a social entity has attracted increasing interest among practitioners (e.g., Ashby et al., 2012; Carretta et al., 2017; Sheedy & Griffin, 2018; Wood & Lewis, 2017). However, despite this growing interest, there remains a lack of clarity in the construct of risk culture (Hartnell et al., 2011), its differentiation from related concepts, such as climate (Schneider et al., 2013; Sheedy et al., 2017), and the definitional or theoretical basis for
improved consistency in empirical approaches (Ostroff et al., 2013). The theoretical incoherence and lack of an exemplary framework model for research, risk assessment and treatment drive a need for culture-sensitive risk measurement methods (Schmidt et al., 2020). However, considering risk culture's breadth of content, no unique risk culture methodology seems to exist (Cimini, 2021). The recently introduced RCF (Streicher et al., 2022) addresses these shortcomings. Its novel approach aims to integrate aspects of both cultural theory and risk research, and provides a categorization and structure for risk culture research in a 3x3 structure. The RCF provides a theory-driven and empirically-based structure, which aims to serve as a blueprint for comprehensive risk analysis on different levels and contexts. However, the construct validity and the applicability of this theoretical framework need to be evaluated. Therefore, the RCF is systematically operationalized with the preconditions proposed (Streicher et al., 2022).

**Method**

*Application & Operationalization*

The current study tests the RCF structure exploratively. To generate an applicable measure for the operationalization of the RCF, four preconditions from Streicher and colleagues (2022) are considered:

1) The risk subject should be as relevant, universal and global as possible, provide both a certain objectivity to the risk, and be well researched so as to generate applicable results. All research need not be included, but rather aspects relevant to the RCF and the respective risk culture can be systematically selected.

2) A distinction of risk culture in terms of the specific social entity, time and output must be made. The risk culture of interest should be defined in advance using external contextual aspects such as temporal development or general determinants that will allow differentiation from other risk cultures or related constructs such as risk climate.

3) The scope of risk culture needs to be succinctly defined at the scale of the study. For example, the scope can vary from rather general national cultures to rather specific organizational cultures (Gerhart, 2008). This will depend, at least in part, on the aim of the study, further risk culture covariates (e.g., sociodemographics to differentiate between subgroups within one culture), and general cultural memberships.

4) Any methodology of a RCF operationalization must account for the core nature of each influence domain and culture level within the 3x3 RCF grid as adequately as possible. Subject-specific risk perceptions, risk-related values, beliefs, and understandings of the different accessibilities of culture levels as well as their methodological implications should be considered in the respective measurement method.

In our opinion, health risks fulfill these preconditions. The subject of health risks is a broad field of research, enabling the integration of many perspectives, models and studies. Key health-relevant, social behavior is well-defined (Hale & Viner, 2016) and consistent with both an increased knowledge of health aspects and integration of the individual into therapy and health care processes (van de Belt et al., 2010). Shared norms and providers’ embeddedness within the respective health culture are also determinants for health care (Desai et al., 2021) and shape health-related intentions and behaviors (Sheeran et al., 2016). Therefore, it is assumed that people are automatically part of a health-risk culture, with specific health-related risk perceptions, attitudes and behavior. Furthermore, since culture generally influences health risk appraisal (Christopher et al., 2000), culture is often suggested as an evidence-based approach to improve the understanding of health- and disease risk (Dressler, 2004).

Additionally, the objectivity of health risks enables a certain selection and evaluation of risk aspects as well as distinctions of risk culture or subgroups. Risk culture plays a ubiquitous role in the context of health (Annandale, 1996) for both practitioners (Lane, 2015) and patients (Verger et al., 2018). Most recently, responses to COVID-19 illustrate the difference in risk culture between countries or even within regions (Angignard et al., 2014; Cornia, 2015; Cornia et al., 2014), and before or after drastic events (Hasegawa, 2017; Reuter et
Taking lifestyle (e.g., Pickett et al., 2018), as well as the relationship of secular culture to health risk behavior (Svensson et al., 2019). The lesser-studied, less-accessible aspects are considered here using research on health assumptions, beliefs or framing, and their influence, for example, on health behavior (Auster-Gussman & Rothman, 2018; Parent & Alquist, 2016), the obtainment of health-related information (e.g., Kim et al., 2017), and the use of treatment and preventive services (e.g., DiMatteo et al., 2007, DiMatteo et al., 2002). Therefore, assumptions on different health-related influence domains and aspects were variably operationalized, depending on the level of accessibility.

**Measure Development**

There is a lack of instruments that incorporate both multidimensional and evidence-based conceptualizations in culture theory in the areas of health (Evans et al., 2020) and risk research (Schmidt et al., 2020). To our knowledge, there are no established risk culture measures or survey methods for health-related risk culture. Therefore, the measures developed here are mostly explorative. From a methodological point of view, the implicit factors pose the greatest challenge within the RCF. On one hand, implicit factors involve many different definitions, understandings, associated operationalizations and methods (Corneille & Hütter, 2020; Gawronski et al., 2020; Hahn & Goedderz, 2020). On the other, by their very nature, they cannot be explicitly solicited or measured per se. In the absence of standardized methods and only limited transferable measurement instruments, a transfer of the RCF to survey instruments needs to account for differing accessibilities and the methodological peculiarities of implicit factors in particular. Consequently, it would require design of both explicit and implicit measures. Unfortunately, considering implicit factors is deemed beyond the scope of this study due to the exploratory nature of this study and test economy given the extent of explicit levels used in this research.

Firstly, a conceptual model across the RCF grid was created before definition of specific constructs and respective items as recommended in health or medicine related measure development (de
Vet et al., 2011; McCormack et al., 2013). The RCF was then applied to the subject of health. Identification of central health risks and aspects are based on reports (e.g., from WHO), health-related theories and models including the Health Belief Model (Hochbaum, 1958; Lam et al., 2017) and health-related beliefs (e.g., Robertson, 2006). Frameworks within risk culture (e.g., Treating Customers Fairly; Financial Services Authority, 2007; and the Culture Framework; McConnell, 2013) and health (the Gateway Model; Kipping et al., 2012) were also considered. Publications on health risk culture (Lane, 2015; Verger et al., 2018) as well as many specific meta-analyses, reviews and individual studies that link overarching aspects of risk culture with health were also investigated (e.g., Angermeyer et al., 2017; Brady et al, 2013; Lobban et al., 2003; Prins et al., 2008; Sørensen et al., 2012; Walter et al., 2004).

Note, the higher order domains of the RCF are denoted first-order factors (i.e., cultural levels & influence domains; Table 1) whereas those on lower levels are sub-facets. Health-related sub-facets of each first-order factor (i.e., RCF cell) were selected and then transferred as items. Selection was not intended to completely reflect a health risk culture but merely identify good examples to cover two different cultural levels (i.e., observable, non-observable) and the three influence domains (i.e., person, social context, risk situation) of the RCF. Selected sub-facets, therefore, represent a 2x3 matrix of the RCF that includes evidence-based health-related risk aspects that are representative and as general as possible. Due to a lack of published research in health culture, as a common means measures were developed from free interpretation of related literature (Rapisarda et al., 2020). Parts of existing models or measurement methods for some established risk factors were used, but these had to be mostly adapted for a cultural context. Therefore, the items on evidence-based sub-facets were either re-formulated or self-formulated. Note, care was taken to base the items on existing items or survey instruments where possible (for a complete list of items see Supplementary Table 1).

**Measure**

An online questionnaire was created based on the selected items. Assumptions and attitudes towards specific risk factors were sought to assess a risk culture. Questions on health risk culture, therefore, focused on the relevance of a specific item to one’s own health (“How important / relevant is the following regarding your own health?”; answers on a slider scale from 0 = *not important / relevant* to 100 = *very important / relevant*). A first version of the questionnaire was pre-tested and revised qualitatively by free association of several lay subjects as recommended for health-related measures (Hahn et al., 2010; Woudstra et al., 2019). The final version includes 174 items on 39 sub-facets that define a 2x3 RCF-oriented structure. The observable factors of the risk situation have four sub-facets and the other cells have five. There are between 44 and 19 items per first-order factor with 2 to 13 per sub-facet (Table 2).
### Table 1
2x3 RCF Health Framework including sub-facets covered in study

<table>
<thead>
<tr>
<th>Culture level</th>
<th>Influence domain</th>
<th>Factors of Person</th>
<th>Factors of social context</th>
<th>Factors of risk situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observable Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-demographics,</td>
<td>Composition,</td>
<td></td>
<td>Domains,</td>
<td></td>
</tr>
<tr>
<td>Risk behavior,</td>
<td>Hierarchy &amp; leadership,</td>
<td>Potential outcomes &amp; severity,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judgment &amp; decisions,</td>
<td>Narratives &amp; legends,</td>
<td>Psychological distance,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routines,</td>
<td>Roles &amp; responsibilities,</td>
<td>Psychological distance,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical state</td>
<td>Structures</td>
<td></td>
<td>Framing</td>
<td></td>
</tr>
<tr>
<td>Non-observable Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk perception,</td>
<td>Norms &amp; social identity,</td>
<td>Likelihood,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>awareness &amp; attitude,</td>
<td>Shared values &amp; beliefs,</td>
<td>Uncertainty,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values &amp; beliefs,</td>
<td>Trust,</td>
<td></td>
<td>Complexities,</td>
<td></td>
</tr>
<tr>
<td>Experience, knowledge &amp; competence,</td>
<td>Goals &amp; expectations,</td>
<td>Emotionality,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality,</td>
<td>Shared experience &amp; group history</td>
<td>Ambiguities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy &amp; feelings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Several socio-demographic aspects and health parameters including the general state of health, well-being over the last two months as well as current well-being, the affiliation to the social surroundings in region X [name of region is deleted during review process for anonymity reasons] and the affiliation to the place of residence in region X were measured as these could influence the assessment of assumed health relevance. Furthermore, the measures of cultural affiliation (e.g., place of residence) were used as preconditions of participation. Again, a slider scale (from 0 = not important / relevant to 100 = very important / relevant) was used for those measures that were to be freely estimated.
### Table 2

*Scale and Item Parameters of the Risk Culture Measure*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Number of items</th>
<th>$M$</th>
<th>$SD$</th>
<th>Cronbach's $\alpha$</th>
<th>Skew</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Person</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>64.79</td>
<td>13.45</td>
<td>-.955</td>
<td>-0.595</td>
</tr>
<tr>
<td>Social context</td>
<td>48</td>
<td>50.87</td>
<td>15.85</td>
<td>.948</td>
<td>-0.232</td>
</tr>
<tr>
<td>Risk situation</td>
<td>49</td>
<td>58.80</td>
<td>15.97</td>
<td>.949</td>
<td>-0.441</td>
</tr>
<tr>
<td>Observable factors</td>
<td>94</td>
<td>57.90</td>
<td>13.12</td>
<td>.959</td>
<td>-0.318</td>
</tr>
<tr>
<td>Non-observable factors</td>
<td>80</td>
<td>58.40</td>
<td>16.50</td>
<td>.973</td>
<td>-0.510</td>
</tr>
<tr>
<td>Observable person</td>
<td>39</td>
<td>65.40</td>
<td>13.30</td>
<td>.913</td>
<td>-0.628</td>
</tr>
<tr>
<td>Social context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>50.87</td>
<td>15.85</td>
<td>.948</td>
<td>-0.232</td>
</tr>
<tr>
<td>Risk situation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observable factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-observable factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observable person</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-demographics</td>
<td>8</td>
<td>55.34</td>
<td>18.57</td>
<td>.787</td>
<td>-0.300</td>
</tr>
<tr>
<td>Risk behavior</td>
<td>11</td>
<td>69.03</td>
<td>17.18</td>
<td>.823</td>
<td>-0.707</td>
</tr>
<tr>
<td>Judgment &amp; decisions</td>
<td>5</td>
<td>56.72</td>
<td>19.14</td>
<td>.701</td>
<td>-0.289</td>
</tr>
<tr>
<td>Routines</td>
<td>7</td>
<td>67.26</td>
<td>16.51</td>
<td>.733</td>
<td>-0.664</td>
</tr>
<tr>
<td>Physical state</td>
<td>8</td>
<td>78.67</td>
<td>17.30</td>
<td>.856</td>
<td>-1.263</td>
</tr>
<tr>
<td>Non-observable factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observable context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td>3</td>
<td>23.84</td>
<td>21.42</td>
<td>.806</td>
<td>1.079</td>
</tr>
<tr>
<td>Hierarchy &amp; leadership</td>
<td>5</td>
<td>56.43</td>
<td>21.18</td>
<td>.745</td>
<td>-0.245</td>
</tr>
<tr>
<td>Narratives &amp; legends</td>
<td>4</td>
<td>49.92</td>
<td>23.90</td>
<td>.798</td>
<td>-0.153</td>
</tr>
<tr>
<td>Roles &amp; responsibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy &amp; feelings</td>
<td>3</td>
<td>67.52</td>
<td>23.95</td>
<td>.852</td>
<td>-0.818</td>
</tr>
<tr>
<td>Observable context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-observable person</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk perception, awareness &amp; attitude</td>
<td>5</td>
<td>72.89</td>
<td>17.96</td>
<td>.803</td>
<td>-0.932</td>
</tr>
<tr>
<td>Values &amp; beliefs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience, knowledge &amp; competence</td>
<td>10</td>
<td>62.17</td>
<td>20.22</td>
<td>.846</td>
<td>-0.598</td>
</tr>
<tr>
<td>Personality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-observable context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hierarchy &amp; leadership</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narratives &amp; legends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roles &amp; responsibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structures</td>
<td>8</td>
<td>55.64</td>
<td>19.10</td>
<td>.792</td>
<td>-0.287</td>
</tr>
<tr>
<td>Non-observable context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norms &amp; social identity</td>
<td>2</td>
<td>39.41</td>
<td>26.41</td>
<td>.775</td>
<td>0.184</td>
</tr>
<tr>
<td>Shared values &amp; beliefs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goals &amp; expectations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared experience &amp; group history</td>
<td>2</td>
<td>55.19</td>
<td>27.18</td>
<td>.809</td>
<td>-0.271</td>
</tr>
<tr>
<td>Observable risk situation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential outcomes &amp; severity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Framing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-observable risk situation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncertainty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complexities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotionality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambiguities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note. Overview of all factors and their parameters of the risk culture measure.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a Factor excluded in stricter model due to insufficient internal consistency of the scale (Cronbach’s $\alpha < .7$).*
Sample & Participants

Since individuals usually share key values within local cultural clusters such as historical background, language, religion as well as general socio-economic development, geographical distance, and climate (e.g., Akaliyski, 2017), participants from specific regions were targeted. It is assumed to also apply to region X health risk culture. Regional affiliation, defined as spending most days of an average week in one region including any subregions, XX, XY and XZ, was a participation requirement. Only adults within a region were selected so as to avoid excessive possible subgroups within the risk culture and to favor generality and transferability. Participants were approached via mailing lists, local institutions and personal contacts. Students could obtain credit on completion of the study. It should be emphasized that data were collected before the COVID-19 pandemic, so changes or differentiation due to lockdowns, etc. were not expected.

A total of 500 subjects were surveyed, of which 316 were female (63.2%), 181 male (36.2%) and 3 described themselves as others (0.6%). The average age was 29.41 (SD = 11.9) with a range of 18 to 76 years. 301 subjects were AA [name of nationality is deleted during review process for anonymity reasons] (60.2%), 111 BB [name of nationality is deleted during review process for anonymity reasons] (22.2%), 83 CC [name of nationality is deleted during review process for anonymity reasons] (16.6%) and 5 had a different nationality (1%). On average, the test subjects reported a relatively strong sense of connection with their community (M = 75.45, SD = 20.93) and place of residence (M = 75.52, SD = 23.61). Likewise, the general quality of life (M = 82.40, SD = 15.22), the state of health (M = 82.07, SD = 16.87), the well-being in the past two months (M = 75.23, SD = 19.84) and the current well-being (M = 76.18, SD = 21.02) were rated relatively high. Overall, a relatively healthy and culturally-bonded sample is assumed.

Model analysis strategy and criteria

Selection of a model or structure is difficult as there is no evidence-based background yet for the structure of a risk culture. Although the RCF specifies the influence domains and cultural levels as latent factors, no relationship or hierarchy within them is postulated. Therefore, three different models were tested and compared. The first, a risk-oriented model, assumed a hierarchical relationship between influence domains and their accessibility, with influence domains as first-order and culture levels as second order factors (Figure 1). The second, a culture-oriented model, assumed a hierarchical relationship between the accessibility of culture levels and their influence domains, with culture levels as first-order and their influence domains as second order factors (Figure 2). The third model investigated, a non-hierarchical RCF-oriented model, combined all culture levels and influence domains on one level as first-order factors (Figure 3).
Figure 1. Structural equation model assuming influence domains as first-order factors
Figure 2. Structural equation model assuming culture levels as first-order factors
Figure 3. Structural equation model with both influence domains and culture levels combined as first-order factors
The proposed models were tested via confirmatory factor analyses (CFA) using R version 3.5.1 (R Core Team, 2020) and the package lavaan 0.6-3 (Rosseel, 2012). Following Kline (2011), model-fit parameters were assessed using \( \chi^2 \)-statistics and the respective fit indices. Recommended statistics (e.g., Beauducel & Wittmann, 2005, Hu & Bentler, 1999), including the Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Root Mean Squared Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMR), were applied to estimate the degree of model-fit. The common cut-off for RMSEA is .08 (e.g., Brown & Cudeck, 1993), but since the sample size of this study is > 250, a more conservative value of .06 is recommended (Hu & Bentler, 1999). Combinational rules (Hu & Bentler, 1999) were also incorporated to allow good fits to compensate for not so good fits. Accordingly, the following values were used to estimate model-fits: CFI and TLI > .95, RMSEA <0.06 and SRMR < .08. It should be noted that these cut-offs are considered too conservative for questionnaire studies and complex models (e.g. Marsh et al., 2005). Therefore, values should be taken as a relative guide to the fit of a model rather than a basis for model rejection or acceptance (Xia & Yang, 2019). Reported model-fits here correspond to recommended robust sample-corrected model indices (e.g., Brosseau-Liard et al., 2012; Brosseau-Liard & Savalei, 2014). In addition, Satorra-Bentler-corrected chi-squared difference tests were conducted to compare model-fits. For all tests, we set \( \alpha = .05 \), and parameter estimate tests were performed against zero where not otherwise stated.

**Preconditions for factor analysis**

As this is an exploratory study, factors and items were sampled as inclusively as possible leaving the potential for selection and modification in future studies or models. Most factors showed acceptable to excellent internal consistency (Table 2). Only four factors showed problematic internal consistencies (\( \alpha < .7 \)), which can be attributed to the low number of items within these factors (5 or less). Some items showed problems with normal distribution fit and skewness in single items.

Aggregate mean values of sub-facets were used as model indicators due to problems during CFA resulting from the large number of items (e.g., computing time, memory usage). The parcelled indicators of the factor analysis were all suitable, display high correlations (MSA = .96) and all indicator-specific MSAs exceeded .90. Likewise, the Bartlett-Test rejected the null hypothesis, \( \chi^2(df = 406) = 8677, p < .001 \), indicating that the correlation matrix deviated from the identity matrix. The use of aggregate mean factors seemed appropriate for the CFA since the MSA (MSA = .93) and Bartlett-Test were comparable at single-item level, \( \chi^2(df = 15051) = 56556, p < .001 \). Therefore, the indicators were deemed suitable and influential, and allowed for confirmatory factor analysis. The models were fitted using a robust Satorra-Bentler scaled maximum likelihood estimation (MLM), which allowed for some non-normality in the data.

**Results**

**Confirmatory factor analysis**

As a first step, a CFA was completed for a risk-oriented model with first-order factor influence domains subdivided according to culture levels (Figure 4). The model indices were partly good (Table 3). The significant chi-square test as well as the CFI and the TLI indicate that the theoretically assumed model deviated from the real structure of the data. This is relatively common in highly complex models and questionnaire studies (Marsh et al., 2005). However, the RMSEA met the less conservative cut-offs but not the cut-offs recommended for the sample size at hand, and the SRMR showed good fit. This possibly could indicate misspecified paths in this model. The chi-
square test and CFI are sensitive to factor loadings, which ranged from .454 to .850 at the lowest level (all λ estimates $p < .001$). The model-fit analyses indicate that the collected data differed from the applied model, despite acceptable RMSEA and SRMR as well as high loadings. However, taking the questionnaire design and the complexity of the model into account, the model indices matched the cut-offs closely or completely, which can be viewed as a rather good fit for an explorative model. As a second step, CFA was conducted for the culture-oriented model with culture levels as first-order factors subdivided according to their influence domains (Figure 5). Again, the chi square test, CFI and TLI were not acceptable and the RMSEA only satisfied the less conservative cutoffs. However, all fit indices as well as the AIC and BIC improved compared to the risk-oriented model (Table 3). The loadings at the lowest level for this model were also relatively high, ranging from .442 to .858 (all λ estimates $p < .001$). In conclusion, the culture-oriented model yielded similar or, in part, better indices when compared to the risk-oriented model.
Figure 4. Confirmatory Factor Analysis with influence domains as first-order factors subdivided according to their culture levels

Note. See Table 2 for full scale, variable names and according items. For identification purposes, variances of the highest order factors are set to 1 in all models. If not indicated otherwise, modelled correlations and path coefficients are significant (p < .05).
Figure 5. Confirmatory Factor Analysis with culture levels as first-order factors subdivided according to their influence domains

Note. See Table 2 for full scale, variable names and according items. For identification purposes, variances of the highest order factors are set to 1 in all models. If not indicated otherwise, modelled correlations and path coefficients are significant ($p < .05$).
As a third step, the more complex RCF-oriented model without hierarchical subdivision of influence domains and culture levels both as combined first order factors was evaluated (Figure 6) with similar and again partially better indices. Thus, the CFI was close to an acceptable range given compensating fit indices (Marsh & Hau, 1996) which all improved as well as the AIC and BIC (Table 3). All loadings at the lowest level were high, ranging from .447 to .856 (all estimates p < .001). Thus, this model differed significantly from both the risk-oriented model, $\chi^2 (df = 6) = 86, p < .001$, and the culture-oriented model, $\chi^2 (df = 8) = 46.8, p < .001$ and provided the best fit. Comparing model-fits, the RCF-oriented model is preferred based on AIC or BIC and the explanatory power due to the complexity of the models. Therefore, the RCF-oriented model is discussed further.

Table 3

<table>
<thead>
<tr>
<th>Model Description</th>
<th>$\chi^2$</th>
<th>df</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA   (90% CI)</th>
<th>SRMR</th>
<th>AIC</th>
<th>BIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Risk-oriented Model</td>
<td>1244.922***</td>
<td>368</td>
<td>.875</td>
<td>.862</td>
<td>.075 (.071-.080)***</td>
<td>.061</td>
<td>122336.804</td>
<td>122619.182</td>
</tr>
<tr>
<td>B: Culture-oriented Model</td>
<td>1189.946***</td>
<td>370</td>
<td>.883</td>
<td>.872</td>
<td>.073 (.068-.077)***</td>
<td>.059</td>
<td>122263.451</td>
<td>122537.400</td>
</tr>
<tr>
<td>C: RCF-oriented Model</td>
<td>1141.635***</td>
<td>355</td>
<td>.889</td>
<td>.876</td>
<td>.071 (.067-.076)***</td>
<td>.057</td>
<td>122219.912</td>
<td>122527.578</td>
</tr>
<tr>
<td>D: Stricter RCF-oriented Model</td>
<td>891.063***</td>
<td>260</td>
<td>.893</td>
<td>.877</td>
<td>.076 (.070-.081)***</td>
<td>.060</td>
<td>105383.531</td>
<td>105657.480</td>
</tr>
<tr>
<td>E: Single Factor Model</td>
<td>1788.493***</td>
<td>377</td>
<td>.795</td>
<td>.779</td>
<td>.095 (.091-.100)***</td>
<td>.069</td>
<td>123003.413</td>
<td>123247.861</td>
</tr>
<tr>
<td>F: General Factor Model</td>
<td>1248.113***</td>
<td>371</td>
<td>.875</td>
<td>.863</td>
<td>.075 (.070-.080)***</td>
<td>.061</td>
<td>122333.638</td>
<td>122603.373</td>
</tr>
</tbody>
</table>

*Note.* Structural equation modeling was used for the analysis.

CFI = comparative fit index; TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; AIC = Akaike Information Criterion; BIC = Bayes Information Criterion.

***p < .001.

a In Model A, influence domains are first-order factors subdivided according to their culture levels. b In Model B, culture levels are first-order factors subdivided according to their influence domains. c In Model C, influence domains and culture levels are combined as first-order factors. d In Model D, problematic sub-facets are excluded. e In Model E, all sub-facets are loaded as one single factor. f In Model F, the combined influence domains and culture levels are loaded as one general factor.
Figure 6. Confirmatory Factor Analysis of the RCF-oriented risk culture model with combined influence domains and culture levels as first-order factors

Note. See Table 2, for full scale, variable names and according to items. For identification purposes, variances of the highest order factors are set to 1 in all models. If not indicated otherwise, modelled correlations and path coefficients are significant ($p < .05$).
It is recommended that model evaluations should not be based on overall goodness-of-fit indices alone, and that, particularly in the case of larger factor loadings, potential misspecifications should be explored by testing alternative models or modifications (Heene et al., 2011; Saris et al., 2009). Therefore, to further challenge the chosen models, different modifications and simpler models were also tested. Most subscales showed at least acceptable values ($\alpha > 0.7$) in terms of internal consistencies of the individual factors. Only the factors Roles and Responsibility, Shared values and Beliefs, Uncertainty and Ambiguities were problematic (Table 1). First, a version of the RCF-oriented model, excluding these four factors, was tested due to their problems of internal consistencies and partly low numbers of items for certain factors. However, the indices for this reduced model were very similar to those for the RCF-oriented model (Table 3) so the latter is preferred.

Considering the explorative nature of the theoretical-based structure and high covariances at the highest level of each risk culture model tested, the preferred RCF-oriented model was compared to a model based on fewer factors. Initially, a model with only one first-order factor was tested to examine the general differentiation of risk culture in the RCF. The model indices were not acceptable and the model fit was significantly worse than those for the RCF-oriented model, $\chi^2 (df = 15) = 444, p < .001$. Therefore, differentiation into risk culture influence domains and culture levels fitted the data significantly better.

In addition to less differentiating structures, an overarching general factor for risk culture, similar to that assumed for risk preference (e.g., Frey et al., 2017), is also conceivable. Hence, a model assuming a general risk culture factor with one first-order factor above the culture levels and influence domains of the RCF-oriented model was considered. This general factor model showed slightly, but significantly, worse fits than the RCF-oriented model (Table 3), $\chi^2 (df = 9) = 96.5, p < .001$. This suggests that the approach of a general risk culture factor is an interesting alternative, although the RCF-oriented model without an overarching factor fitted better.

Overall, the results show that the three models for different risk culture orientations delivered relatively similar and mostly acceptable fits. Likewise, a general factor for risk culture provided similar fits and posed a viable addition. Comparisons of models indicated that differentiation of risk culture into influence domains and culture levels is clearly superior. Both a risk-oriented and culture-oriented structure are operable, but ultimately, the RCF-oriented model provided the best fit indices and is, therefore, preferred.

**Discussion**

The aim of this study is to test the model structure of the Risk Culture Framework with empirical data for the first time. To do this, a measure was developed for data pertaining to regional health risk culture. Four important findings emerge from this research: First, empirical data support the yet only theory-based structure of the RCF. Second, the fundamental need for a theoretical differentiation in risk culture operationalizations is highlighted. Third, based on empirical evaluation of the RCF, its application and operationalization are demonstrated using certain preconditions (i.e., risk subject, distinction of risk culture, scope of risk culture, methodology) and model tests by CFAs. Fourth, the approach of this study can serve as a blueprint for the application of the RCF to specific risk cultures and identifies avenues for future research. In conclusion, this study supports the RCF as a well-founded and applicable approach for comprehensive risk culture operationalization.

First, the viability of the RCF-oriented model is supported by model analyses. Furthermore, results show the best-fit when
THE STRUCTURE OF THE RISK CULTURE FRAMEWORK

compared with other applicable models with different structural focus. However, it is noted that the RCF-oriented model did not achieve a perfect fit, but the fit is relatively comparable to other health-related models (e.g., Hahn et al., 2010; Rapisarda et al., 2020). One potential reason for this could be a non-differentiation of sociodemographics including age, sex, education or specific social group. These aspects can affect risk perception within separate risk cultures (Angignard et al., 2014) and health assumptions as well as fits of health frameworks (McFadden et al., 2018; Wernitz et al., 2017). Therefore, the model fit may improve with their separation (Woudstra et al., 2019). Nevertheless, the results of this study provide important support for the RCF and more consistent and comprehensive risk culture operationalizations in general. As of yet, the development and application of cultural theory has been considered a promising and versatile approach in risk analysis (Johnson & Swedlow, 2019, Wong et al., 2020) and health care (Rapisarda et al., 2020), but research lacked a theoretical basis and empirical foundation. These results provide the first evidence for relevant risk culture research.

Second, aside from support of the RCF-oriented model, the results recognize the multi-layered nature of risk culture (McConnell, 2013; Previati, 2017) and highlight the general need for conceptual differentiation. The fit of a non-differentiating single-factor model was poor. In contrast, risk culture models that differentiate influence domains and culture levels were clearly a more effective, actual risk culture structure. Furthermore, the significantly best fit of the RCF-oriented model also suggests that both culture levels and influence domains should be considered as interconnected. Health or appearance-related evaluations, preferences and behaviors are strongly related to their accessibility (e.g., Berry et al., 2018; Coricelli et al., 2019; Marini, 2018). The RCF-oriented model combines both perspectives of risk and culture with direct accessibility of risk influence domains as first-order factors. This demonstrates the utility of a comprehensive approach to risk culture for research- and practice-oriented operationalization, and the subsequent benefit of a consistent adaption to theoretical frameworks, such as the RCF, which conceptually integrate both influence domains and their accessibility.

Third, the precondition-guided approach of applying the RCF to a health subject and testing risk culture structures by means of CFAs has several substantive and conceptual implications. Healthcare, in general, is in need of a cultural change towards further inclusion, differentiation, and synergy (e.g., Davies et al., 2000; Parmelli et al., 2011). However, conceptual consensus and empirical knowledge on health-related culture are lacking (Davies et al., 2000). For this purpose, practical implementations are recommended through framework-based instruments, which conceptualize specific health cultures and health beliefs (e.g., Rapisarda et al., 2020), and incorporate an appropriate theoretical basis and supporting evidence (e.g., Bellot, 2011; Scott et al., 2003). Initial validation of such health culture frameworks by CFAs is considered adequate (e.g., Rapisarda et al., 2020). Therefore, the chosen approach to health risk culture seems beneficial for practice and theory as a validated risk culture framework. Subsequently, ongoing method evaluation will enable adjustments and optimization. In this context, it should be noted that systematic development of measures or even standardized measures are recommended. Nevertheless, often only relatively unsystematic developments are possible from free transfer of knowledge from literature due to the lack of research on health culture (Rapisarda et al., 2020). Accordingly, an approach to developing a conceptual framework model by initially identifying specific sub-facets, then items and finally measures, is recommended (de Vet et al., 2011; McCormack et al., 2013). In this regard, the relatively broad risk subject has proven to be useful, not only in providing a comprehensive coverage of RCF, but also as a methodological
basis for more specific, future applications. In summary, the described preconditions as well as the study development has been successful here, but they need to be adapted for the specific research interest and further developed in the future.

Fourth and finally, these results lead to theoretical and practical implications that, at least in part, overcome shortcomings of previous approaches. The current study emphasizes the value of a theory-based operationalization of risk culture, and adds support to the RCF-oriented model structure. It goes some way in addressing both the need for theoretical models in risk culture to deliver a conceptual and methodological depth (Cimini, 2021; Ring et al., 2016; Zeng et al., 2020) and the problem of lack of consistency in operationalizations (Schneider et al., 2013; Sheedy et al., 2017; Sheedy et al., 2021) and empirical approaches (Ostroff et al., 2013). The precondition-guided approach used in this study can be built upon to develop much-needed, unique and specific risk culture methodologies (Cimini, 2021). It provides measures and results that can be used to develop other risk culture domains. In order to achieve this, health risk culture measures could be refined through evidence-based improvements of the items with regard to their selection and methodological aspects. Also, more specific health risk cultures can be developed for more practice-oriented studies. Thus, the results of this study, and their support of the RCF, provide clarification of the risk culture construct (Hartnell et al., 2011) and practical guidance for consideration on how to handle risk culture in different fields.

Limitation and Future Research

The risk culture framework provides a very explorative and novel approach. However, as it is novel, implications from both past research and specific theoretical foundations are missing; hence, the need for an exploratory test. This study is just that and represents a new approach in content and method, but it has some limitations. A large number of factors, partly non-optimal item parameters, as well as differences in item numbers might have impaired the test quality of individual factors, and ultimately, the degree of model-fit of the comprehensive models. Obviously, conceptual theories and models, including those with evidence-based factors, always require generalization and simplification (Cornia et al., 2014). This deficiency is a topic for on-going and future research. With this in mind, and as a follow-up to this study, the reliability of each scale and item, the respective loadings and modification indices, and problematic sub-facets or items that are less relevant to the models could be revised, removed or expanded both for the general RCF and the respective health risk culture measures. Additionally, the fit of the theoretical structure to real data could be improved by specific modifications of the models or differentiating analyses. Such changes will further the standardization of a health risk culture measure and enhance the empirical basis for the RCF and its application to other domains. Furthermore, integration of other aspects from health literature and professionals’ experience will improve the measures, particularly in regard to its practical application. It is conceivable that future research with re-tests and Rasch Analysis will deliver an evaluated, test economic and holistic RCF operationalization in a health context.

It is also important to note that, strictly speaking, the reported risk culture models do not all completely satisfy the model indices’ cut-offs, and that includes the RCF-oriented model. Each risk culture model tested behaved better with merely adopting different structural perspectives and a general RCF-like differentiation of culture levels and influence domains. Addition of structures or operationalizations, such as the overarching general risk culture factor in this study, could be beneficial. Other structural approaches can be identified using exploratory factor analyses. However, based on the current state of research, this model represents the best risk culture model available and should, therefore, be preferred.
The limitations arising from sampling provisions of a culture should also be addressed. How risk cultures differ due to regionality or nationality is questionable. In view of results on national organizational cultures, a region X’s risk culture could be either too broadly (e.g., Gerhart, 2008) or too narrowly (e.g., Xu, 2018) defined. Also, subgroups within one defined culture may differ strongly, and distinction of such subcultures is recommended in the study of culture change in health care (Scott et al., 2003). Therefore, it may be beneficial to identify risk culture clusters within the broader risk culture population. In terms of this research, specific roles or parts such as clients or health care workers could be targeted (e.g., Rapisarda et al., 2020; de Vet et al., 2011), or risk groups and their relation to health associations could be considered, for example, by socio-demographics (McFadden et al., 2018; Wernitz et al., 2017). Still, it is debatable when a person can be considered a full member of a culture. For this reason, factors such as the number of years spent in region X or one’s own identification with region X as well as the defined cultural affiliation and possible regional clusters are collected and checked in the current study.

In addition, different risk culture scopes could be targeted since there is no standardized study design or generally applicable risk culture item formulation. In this study, the assumed relevance and, thus, different shared attitudes towards health-related aspects were determined with the aim of directly addressing the relevance of health-related aspects, which could guide targeted detection of underestimated aspects for health programs and policies. This focus emanates from definitions of risk culture as shared perceptions and understandings of risks (Ring et al., 2016; Sheedy et al., 2017). Attitudes, norms and self-efficacy causally shape health-related intentions and behaviors and are, therefore, evident for health promotion interventions (Sheeran et al., 2016). Other approaches to risk culture assessment could include assumptions about the appropriateness of different behaviors, as well as subgroup analysis to detect differences within a respective risk culture.

It is acknowledged that the RCF is not tested in full as the implicit factors are omitted due to their methodological specificity and the complexity of the approach in this study. It is recommended to define and classify the implicit factors more strongly in terms of understanding the different information processes and measures (e.g., Corneille & Hütter, 2020; Gawronski et al., 2020; Hahn & Goedderz, 2020) in order to achieve consistent methodological access to the relevant factors. For instance, there is a discrepancy between explicit and implicit health-related evaluations and preferences (e.g., Berry et al., 2018), which have been identified as intervention targets through the combination of different health assumptions (Cousineau & Shedler, 2006). Accordingly, using vignettes or specific case studies to measure implicit risk culture factors would be more appropriate than, for example, implicit association tests. Furthermore, the combination of questionnaires and case studies or vignettes could have great potential for operationalization and practical application (Johnson & Swedlow, 2019) since they can combine depicted explicit elements directly with descriptive implicit elements. Future research should specifically combine implicit assumptions or beliefs with explicit research methods.

Finally, future risk culture studies should be methodologically consistent with this first approach but expand the preconditions to thereby enhance their practical applicability. For instance, health-related social norms approaches and interventions are well established, but they need new testable theoretical models with well-defined methods and interventional studies, and robust evaluation of proposed social norms interventions (Dempsey et al., 2018). Thus, for this study, the methodology requires further development, with inclusion of implicit factors and more concise, improved measures that are based on the item and factor parameters. Moreover, with greater distinction of risk culture, any future risk subjects

Bielefeld, M., Streicher, B. & Gürer, C. (2023)
will potentially become more specific and, therefore, more accurate and applicable. This will enable benchmarking and targeted assessments of specific risk cultures. Health or medicine related specific measures are recommended for practical needs (de Vet et al., 2011); e.g., weight including associated subjects, such as overweight or obesity, and weight preferences could be a promising field for RCF application due to the research background on implicit mindsets, evaluations and attitudes (e.g., Hutchison & Müller, 2018; McFadden et al., 2018; Woodward & Treat, 2015) and their connection to culture (Frederick et al., 2016; Ravary et al., 2019). This would allow for more practice- or application-oriented scopes for example, in the prediction of health aspects as a more practical framework test (e.g., Grasso & Bell, 2015), or investigation of determinants for future implementation in health practice (Rapisarda et al., 2020). Such steps would feed into more specific health risk culture designs, prediction of more specific health outcomes (such as weight or BMI by risk culture aspects), and description of risk culture subgroups or clusters (e.g., by socio-demographics), which could, in turn, be incorporated into specific interventions or programs.

**Conclusion**

This study provides initial operationalization, analysis and comparison of the RCF. Of the models tested, the structure of the RCF-oriented model fits best, showing the added value of differentiating risk culture, and study designs in general where the RCF can serve as a foundation for risk culture operationalization. The RCF can accommodate risk research’s demand for an integrative approach by providing both generic knowledge and practical implications for the handling of risks (Aven & Flage, 2020). Risk culture is an appropriate approach of utmost practical relevance (e.g., Jondle et al., 2013; McConnell, 2013; Sheedy & Griffin, 2017; Sinha & Arena, 2020) and meets a great demand (e.g., Ashby et al., 2012; Sheedy et al. 2019), but research to date has lacked a coherent theoretical and empirical foundation (Ring et al., 2016; Zeng et al., 2020). Accordingly, empirical evaluation of the RCF’s theoretical foundation provides important insights and support to risk culture. Future studies to improve the RCF measure, analyze its structure to include implicit factors or allow for more practice-oriented study designs in practical risk culture implementations are still required. Overall, there is great potential in the fundamental analysis of risk cultures and the associated structures to explain and understand behavior, compare cultures, and implement targeted interventions (Sheedy & Griffin, 2017).

**Declarations**

**Conflict of Interest**

The Authors declare that there is no conflict of interest.

**Ethical Approval**

All procedures involving human participants in this study were conducted in accordance with the ethical standards of, and approved prior to conduction by, the institutional research ethics committee, and are in line with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent**

Written informed consent was obtained for all individual participants in the study before admission to the questionnaire was granted.

**References**


THE STRUCTURE OF THE RISK CULTURE FRAMEWORK

288. [https://doi.org/10.3171/2016.9.PEDS16278](https://doi.org/10.3171/2016.9.PEDS16278)


Li, S., Feng, B., Liao, W., & Pan, W. (2020). Internet use, risk awareness, and demographic characteristics associated with engagement in preventive behaviors and testing: Cross-sectional survey on COVID-19 in the United States. *Journal of Medical Internet Research, 22*(6), Article e19782. [https://doi.org/10.2196/19782](https://doi.org/10.2196/19782)


Prati, G., & Mancini, A. D. (2021). The psychological impact of COVID-19 pandemic lockdowns: a review and meta-analysis of longitudinal studies and natural experiments. *Psychological Medicine, 51*(2), 201-211. [https://doi.org/10.1017/S0033291721000015](https://doi.org/10.1017/S0033291721000015)


THE STRUCTURE OF THE RISK CULTURE FRAMEWORK


### Supplements

**Table 1**

Factor, scale and item overview of the health-related risk culture questionnaire

<table>
<thead>
<tr>
<th></th>
<th>Original German item wording</th>
<th>English translation</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Person</strong> (77 items)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social context</td>
<td>(48 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk situation</td>
<td>(49 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observable factors</td>
<td>(94 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-observable factors</td>
<td>(80 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observable person</td>
<td>(39 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-demographics</td>
<td>(8 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Mein Geschlecht</td>
<td>Mein Geschlecht</td>
<td>My gender</td>
<td>31.92</td>
<td>30.84</td>
</tr>
<tr>
<td>2. Mein Alter</td>
<td>Mein Alter</td>
<td>My Age</td>
<td>61.46</td>
<td>26.47</td>
</tr>
<tr>
<td>3. Mein Beruf / meine berufliche Ausbildung</td>
<td>Mein Beruf / meine berufliche Ausbildung</td>
<td>My job / my vocational training</td>
<td>61.64</td>
<td>27.93</td>
</tr>
<tr>
<td>4. Mein Bildungsabschluss</td>
<td>Mein Bildungsabschluss</td>
<td>My education</td>
<td>46.05</td>
<td>31.92</td>
</tr>
<tr>
<td>5. Mein Beziehungsstatus</td>
<td>Mein Beziehungsstatus</td>
<td>My relationship status</td>
<td>54.18</td>
<td>31.60</td>
</tr>
<tr>
<td>6. Mein aktueller Lebensabschnitt (z.B. die letzten zwei Monate)</td>
<td>Mein aktueller Lebensabschnitt (z.B. die letzten zwei Monate)</td>
<td>My current life (e.g., the last two months)</td>
<td>56.98</td>
<td>30.60</td>
</tr>
<tr>
<td>7. Meine finanzielle Situation</td>
<td>Meine finanzielle Situation</td>
<td>My financial situation</td>
<td>58.24</td>
<td>27.96</td>
</tr>
<tr>
<td>8. Mein soziales Umfeld</td>
<td>Mein soziales Umfeld</td>
<td>My social environment</td>
<td>72.22</td>
<td>26.68</td>
</tr>
<tr>
<td><strong>Risk behavior</strong></td>
<td>(11 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Dass ich (nicht) rauche</td>
<td>Dass ich (nicht) rauche</td>
<td>That I do (not) smoke</td>
<td>81.11</td>
<td>25.72</td>
</tr>
<tr>
<td>2. Dass ich Genussmittel (Süßigkeiten, Kaffee, etc.) (nicht) konsumiere</td>
<td>Dass ich Genussmittel (Süßigkeiten, Kaffee, etc.) (nicht) konsumiere</td>
<td>That I do (not) consume stimulants (sweets, coffee, etc.)</td>
<td>59.46</td>
<td>27.20</td>
</tr>
<tr>
<td>3. Dass ich mich (nicht) bewege oder (keinen) Sport treibe</td>
<td>Dass ich mich (nicht) bewege oder (keinen) Sport treibe</td>
<td>That I do (not) exercise or do (no) sports</td>
<td>81.95</td>
<td>22.29</td>
</tr>
<tr>
<td>6. Dass ich (keine) verschreibungspflichtige Medikamente ohne ärztliche Verordnung konsumiere</td>
<td>Dass ich (keine) verschreibungspflichtige Medikamente ohne ärztliche Verordnung konsumiere</td>
<td>That I consume (no) prescription drugs without medical prescription</td>
<td>69.46</td>
<td>32.26</td>
</tr>
<tr>
<td>7. Dass ich (keinen) ungeschützten Sex mit wechselnden Partnern habe</td>
<td>Dass ich (keinen) ungeschützten Sex mit wechselnden Partnern habe</td>
<td>That I have (not) unprotected sex with changing partners</td>
<td>72.43</td>
<td>32.56</td>
</tr>
<tr>
<td>8. Dass ich (nicht) lange Sitze</td>
<td>Dass ich (nicht) lange Sitze</td>
<td>That I do (not) sit for a long time</td>
<td>59.15</td>
<td>29.66</td>
</tr>
<tr>
<td>9. Meine tägliche Ernährung</td>
<td>Meine tägliche Ernährung</td>
<td>My daily diet</td>
<td>79.30</td>
<td>21.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10. Meine Arbeitssituation</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---------------------------</td>
</tr>
<tr>
<td>11. Mein Fahrverhalten im Straßenverkehr</td>
<td>11. My driving behavior in traffic</td>
<td>53.61</td>
<td>33.06</td>
<td></td>
</tr>
<tr>
<td>Judgment &amp; decisions (5 items)</td>
<td>Judgment &amp; decisions (5 items)</td>
<td>56.72</td>
<td>19.14</td>
<td></td>
</tr>
<tr>
<td>1. Meine geplanten Entscheidungen</td>
<td>1. My planned decisions</td>
<td>62.66</td>
<td>26.34</td>
<td></td>
</tr>
<tr>
<td>2. Meine spontanen Entscheidungen</td>
<td>2. My spontaneous decisions</td>
<td>55.35</td>
<td>27.98</td>
<td></td>
</tr>
<tr>
<td>3. Dass ich gesundheitliche Risiken &amp; Folgen auf mich selbst beziehe</td>
<td>3. That I relate health risks &amp; consequences to myself</td>
<td>63.53</td>
<td>27.53</td>
<td></td>
</tr>
<tr>
<td>5. Dass ich Behandlungen / Medikationen (nicht) einhalte</td>
<td>5. That I do (not) comply with treatments / medications</td>
<td>65.43</td>
<td>30.60</td>
<td></td>
</tr>
<tr>
<td>Routines (7 items)</td>
<td>Routines (7 items)</td>
<td>67.26</td>
<td>16.51</td>
<td></td>
</tr>
<tr>
<td>1. Meine festen Gewohnheiten / Routinen</td>
<td>1. My fixed habits / routines ()</td>
<td>67.20</td>
<td>25.45</td>
<td></td>
</tr>
<tr>
<td>3. Dass ich mich (nicht) regelmäßig sportliche betätige</td>
<td>3. That I do (not) do sports regularly</td>
<td>78.30</td>
<td>24.09</td>
<td></td>
</tr>
<tr>
<td>4. Dass ich (nicht) zu festen Zeiten schlafe</td>
<td>4. That I do (not) sleep at fixed times</td>
<td>71.14</td>
<td>26.49</td>
<td></td>
</tr>
<tr>
<td>5. Dass ich (keine) Gewohnheiten beim Konsum von Genussmitteln (Süßigkeiten, Kaffee, etc.) habe</td>
<td>5. That I have (no) habits in the consumption of stimulants (sweets, coffee, etc.)</td>
<td>74.31</td>
<td>26.25</td>
<td></td>
</tr>
<tr>
<td>6. Dass ich (keine) Gewohnheiten bei der Hygiene (Duschen, Waschen, Zähneputzen, etc.) habe</td>
<td>6. That I have (no) habits in hygiene (showering, washing, brushing, etc.)</td>
<td>81.25</td>
<td>23.03</td>
<td></td>
</tr>
<tr>
<td>7. Dass ich (nicht) regelmäßig zum Arzt gehe</td>
<td>7. That I do (not) go regularly to the doctor</td>
<td>83.67</td>
<td>19.92</td>
<td></td>
</tr>
<tr>
<td>Physical state (8 items)</td>
<td>Physical state (8 items)</td>
<td>78.67</td>
<td>17.30</td>
<td></td>
</tr>
<tr>
<td>1. Dass ich (keine) Beschwerden durch körperliche Krankheiten habe</td>
<td>1. That I have (no) complaints from physical illness</td>
<td>79.67</td>
<td>23.95</td>
<td></td>
</tr>
<tr>
<td>2. Dass ich (keine) psychischen Krankheiten / Beschwerden habe</td>
<td>2. That I have (no) mental illness / discomfort</td>
<td>80.60</td>
<td>26.14</td>
<td></td>
</tr>
<tr>
<td>3. Das ich (nicht) arbeitsfähig bin</td>
<td>3. That I am (not) able to work</td>
<td>73.76</td>
<td>27.53</td>
<td></td>
</tr>
<tr>
<td>4. Dass ich (keine) Beeinträchtigungen in meiner Lebensführung durch Schmerzen / Beschwerden habe</td>
<td>4. That I have (no) impairments in my lifestyle through pain / discomfort</td>
<td>80.03</td>
<td>25.16</td>
<td></td>
</tr>
<tr>
<td>5. Mein Schlaf</td>
<td>5. My sleep</td>
<td>81.25</td>
<td>23.03</td>
<td></td>
</tr>
<tr>
<td>6. Meine Energie (körperlich, geistig)</td>
<td>6. My energy (physically, mentally)</td>
<td>83.67</td>
<td>19.92</td>
<td></td>
</tr>
<tr>
<td>7. Mein Stress</td>
<td>7. My stress</td>
<td>77.40</td>
<td>24.05</td>
<td></td>
</tr>
<tr>
<td>Nr.</td>
<td>Item (Deutsch)</td>
<td>Item (Englisch)</td>
<td>Wert 1</td>
<td>Wert 2</td>
</tr>
<tr>
<td>-----</td>
<td>---------------</td>
<td>----------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>8.</td>
<td>Meine Sorgen und Ängste</td>
<td>8. My worries and fears</td>
<td>73.00</td>
<td>25.66</td>
</tr>
<tr>
<td></td>
<td>Non-observable person (38 items)</td>
<td>Risk perception, awareness &amp; attitude (5 items)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Meine eigene Lebensqualität</td>
<td>1. My own quality of life</td>
<td>84.13</td>
<td>18.87</td>
</tr>
<tr>
<td>2.</td>
<td>Dass ich (nicht) bewusst mit meiner Gesundheit umgehe</td>
<td>2. That I do (not) consciously deal with my health</td>
<td>80.56</td>
<td>20.95</td>
</tr>
<tr>
<td>3.</td>
<td>Dass ich (nicht) aufmerksam mit gesundheitlichen Risiken umgehe</td>
<td>3. That I do (not) attentively deal with health risks</td>
<td>73.52</td>
<td>23.55</td>
</tr>
<tr>
<td>4.</td>
<td>Dass ich Experten / Autoritäten (nicht) vertraue</td>
<td>4. That I trust (no) experts / authorities</td>
<td>57.28</td>
<td>29.85</td>
</tr>
<tr>
<td>5.</td>
<td>Dass ich gesundheitlichen Bedrohungen (nicht) frühzeitig wahrnehme</td>
<td>5. That I do (not) perceive health threats early</td>
<td>68.94</td>
<td>25.35</td>
</tr>
<tr>
<td></td>
<td>Values &amp; beliefs (7 items)</td>
<td>Experience, knowledge &amp; competence (10 items)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Dass ich (nicht) zuversichtlich / optimistisch bin</td>
<td>1. That I am (not) confident / optimistic</td>
<td>75.25</td>
<td>25.90</td>
</tr>
<tr>
<td>2.</td>
<td>Dass ich davon überzeugt bin (nicht) in einer gerechten Welt zu leben</td>
<td>2. That I am (not) convinced to live in a just world</td>
<td>46.99</td>
<td>31.07</td>
</tr>
<tr>
<td>3.</td>
<td>Dass ich (nicht) davon überzeugt bin, dass äußere Faktoren für meinen Erfolg / Misserfolg verantwortlich sind</td>
<td>3. That I (not) am convinced that external factors are responsible for my success / failure</td>
<td>41.85</td>
<td>30.09</td>
</tr>
<tr>
<td>4.</td>
<td>Dass ich (nicht) davon überzeugt bin, für meinen Erfolg / Misserfolg selbst verantwortlich zu sein</td>
<td>4. That I (not) am convinced that I am responsible for my own success / failure</td>
<td>67.77</td>
<td>27.90</td>
</tr>
<tr>
<td>5.</td>
<td>Dass ich (nicht) davon überzeugt bin, dass ich meine Gesundheit verdiene</td>
<td>5. That I (not) am convinced that I deserve my health</td>
<td>56.11</td>
<td>34.55</td>
</tr>
<tr>
<td>6.</td>
<td>Dass ich davon überzeugt bin meine Gesundheit / Krankheit (nicht) selbst beeinflussen zu können</td>
<td>6. That I am (not) convinced to influence my health / illness by myself</td>
<td>68.86</td>
<td>28.59</td>
</tr>
<tr>
<td>7.</td>
<td>Dass ich (nicht) davon überzeugt bin, beschützt zu werden (z.B. durch eine höhere Macht / Gott)</td>
<td>7. That I am (not) convinced that I am protected (e.g., by a higher power / God)</td>
<td>37.70</td>
<td>34.84</td>
</tr>
<tr>
<td></td>
<td>Experience, knowledge &amp; competence (10 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Mein eigenes Wissen und meine eigenen Erfahrungen</td>
<td>1. My own knowledge and my own experiences</td>
<td>74.68</td>
<td>22.85</td>
</tr>
<tr>
<td>2.</td>
<td>Dass ich (keine) Zugehörigkeit empfinde</td>
<td>2. That I have (no) affiliation</td>
<td>54.72</td>
<td>32.19</td>
</tr>
<tr>
<td>3.</td>
<td>Dass ich (keine) Autonomie empfinde</td>
<td>3. That I have (no) autonomy</td>
<td>57.66</td>
<td>32.21</td>
</tr>
</tbody>
</table>
5. Dass ich (keine) Hoffnung empfinde
6. Dass ich (keine) Hilflosigkeit empfinde
7. Dass ich (keine) besonders prägende oder einschneidende Erfahrungen gemacht habe
8. Dass ich gegenüber Krisen (nicht) robust bin
9. Dass ich (kein) Gesundheit fördernden Talente habe (z.B. Sportlichkeit, Talent beim Kochen, etc.)
10. Dass ich (nicht) die Erfahrung gemacht habe, meine eigene Gesundheit beeinflussen zu können

Personality (13 items)
1. Meine eigene Persönlichkeit
2. Mein eigenes Temperament
3. Meine Risikobereitschaft
4. Mein Ausmaß an Impulsivität
5. Dass ich (nicht) nach Grenzerfahrungen strebe
6. Dass ich (nicht) sozial verträglich bin
7. Dass ich (nicht) gewissenhaft bin
8. Dass ich (nicht) vernünftig bin
9. Dass ich (nicht) unbeschwert bin
10. Dass ich (nicht) emotional stabil bin
11. Dass ich (keine) offene und auf andere zugehende Art habe
12. Dass ich (nicht) offen für Neues bin
13. Dass ich (nicht) Risiken frühzeitig abwehre

Self-efficacy & feelings (3 items)
1. Dass ich mich (nicht) kompetent & fähig fühle
2. Dass ich das (kein) Gefühl habe, mich selbst kontrollieren & regulieren zu können
3. Dass ich (nicht) das Gefühl habe, Probleme selbstständig & zuverlässig lösen zu können
THE STRUCTURE OF THE RISK CULTURE FRAMEWORK

Observable context (25 items)
Composition (3 items)
1. Das Geschlecht der Personen meiner sozialen Gruppen
   1. The gender of the persons of my social groups
   19.40 24.33
2. Die Anzahl der Personen meiner sozialen Gruppen
   2. The number of people in my social groups
   27.63 26.20
3. Das Alter der Personen meiner sozialen Gruppen
   3. The age of the persons of my social groups
   24.47 25.12

Hierarchy & leadership (5 items)
1. Meine Versorgungssituation durch Systeme (z.B. Krankenkassen, Arbeitgeber, medizinische Versorgung am Arbeitsplatz, etc.)
   1. My supply situation through systems (e.g., health insurances, employers, medical care in the workplace, etc.)
   70.29 26.95
2. Dass ich (keine) privaten mich gesundheitlich motivierenden Personen habe (z.B. Freunde, die mich zu gesunder Ernährung auffordern)
   2. That I have (no) private persons who are motivated by my health
   55.22 31.16
3. Dass ich (keine) professionelle(n) mich gesundheitlich motivierenden Personen habe (z.B. Fitness-Coaches, Trainer, etc.)
   3. That I have (no) professionally health-motivating persons (e.g., fitness coaches, trainers, etc.)
   35.12 31.11
   4. That I get (no) help from others in my health care
   52.59 31.98
5. Dass ich mich (nicht) selbstständig gesundheitlichen versorge
   4. That I do (not) provide health care on my own
   68.92 29.10

Narratives & legends (4 items)
1. Meine familiären Krankheitsgeschichten
   1. My family illness stories
   56.04 29.96
2. Meine familiären Gesundheits-/Heilungsgeschichten
   2. My family health / healing stories
   53.19 30.44
3. Die auf Gesundheit bezogenen Erfahrungen meiner Familienangehörigen / Bekannten
   3. The health-related experiences of my family members / acquaintances
   51.85 30.20
4. Die auf Gesundheit bezogenen Maßnahmen meines Arbeitgebers
   4. The health-related measures of my employer
   38.58 30.56

Roles & responsibility (5 items)
1. Dass ich mich (nicht) in einer aktiven Rolle bezüglich meiner Gesundheit sehe
   1. That I see myself (not) in an active role in my health
   72.20 26.50
2. Dass ich mich (nicht) geschlechter-typisch verhalte  2. That I do (not) behave gender-typical  29.89 30.93
3. Dass ich mich (nicht) meinem Selbstbild entsprechend verhalte  3. That I do (not) behave in accordance with my self-image  58.09 31.04
4. Dass ich mich (nicht) für meinen aktuellen Lebensabschnitt (z.B. die letzten zwei Monate) typisch verhalte  4. That I do (not) behave typically for my current stage of life (e.g., the last two months)  47.06 31.35
5. Dass ich (nicht) selbstlos mit meiner Gesundheit umgehe  5. That I am (not) selfless in my health  66.55 30.75

Structures (8 items)
1. Dass ich (keine) Informationen aus den Medien erhalte  1. That I receive (no) information from the media  40.33 29.07
2. Dass ich (keine) Informationen aus dem Umfeld erhalte  2. That I receive (no) information from the environment  49.10 28.46
3. Dass ich (keine) Informationen von gesundheitlichen Fachkräften (Ärzten, Therapeuten, Beratungen, etc.) erhalte  3. That I receive (no) information from health professionals (doctors, therapists, counseling, etc.)  63.87 29.09
4. Dass ich (keine) gesundheitsfördernde Programme & Initiativen in meinem Umfeld habe  4. That I have (no) health promoting programs & initiatives in my environment  45.89 30.87
5. Dass ich (keine) umfangreiche und ansprechende Sportangebote in meinem Umfeld habe  5. That I have (no) extensive and appealing sports offers in my environment  63.76 30.31
6. Dass ich (keine) umfangreiche und ansprechende Lebensmittelversorgung habe  6. That I have (no) extensive and attractive food supply  73.41 27.03
7. Mein Versicherungsschutz  7. My insurance cover  59.51 32.69
8. Die Abläufe an meinem Arbeitsplatz  8. The processes at my workplace  49.22 31.67

Non-observable context (23 items)
Norms & social identity (2 items)
1. Dass ich mich (nicht) Gruppen-konform verhalte  1. That I do (not) behave in a group-conform way  39.95 29.53
2. Dass ich mich (nicht) durch mein Verhalten von anderen abhebe  2. That I do (not) stand out from others by my behavior  38.87 29.39

Shared values & beliefs * (5 items)
1. Dass ich mich (nicht) von dem Gesundheits-/Risikoverhalten von meinen sozialen Gruppen unterscheide  1. That I am (not) different from the health / risk behavior of my social groups  40.29 29.30
2. Dass meine Eltern / Bekannten Gesundheit bezogene Werte & Überzeugungen (nicht) vorleben  
   2. That my parents / acquaintances do (not) exemplify health-related values & beliefs  
   56.21  29.27

3. Dass ich mich (nicht) an wissenschaftlichem & gesundheitlichem Wissen orientiere  
   3. That I do (not) focus on scientific and health knowledge  
   59.72  28.66

4. Dass ich mich (nicht) selber um meine Gesundheit kümmere  
   4. Th I do (not) take care of my own health  
   76.66  24.30

5. Dass sich andere Personen (nicht) um meine Gesundheit kümmern  
   5. That other people do (not) take care of my health  
   42.34  30.18

Trust (5 items)  
   60.96  22.63

1. Dass ich (kein) Vertrauen in Ärzte & Rettungssanitäter habe  
   1. That I have (no) confidence in doctors & paramedics  
   66.53  28.81

2. Dass ich (kein) Vertrauen in Krankenkassen & Sozialsysteme habe  
   2. That I have (no) confidence in health insurance & social systems  
   56.95  30.28

3. Dass ich (kein) Vertrauen in die Hilfe durch Mitmenschen habe  
   3. That I have (no) confidence in the help of fellow human beings  
   60.38  29.46

4. Dass ich (kein) Vertrauen in Produzenten meiner Lebensmittel habe  
   4. That I have (no) confidence in producers of my food  
   56.15  30.12

5. Dass ich (kein) Vertrauen in bestehendes gesundheitliches Wissen habe  
   5. That I have (no) confidence in existing health knowledge  
   64.80  27.77

Goals & expectations (9 items)  
   57.54  23.74

1. Dass ich mir selber (keine) gesundheitsbezogene Ziele & Erwartungen setze  
   1. That I set myself (no) health-related goals & expectations  
   64.57  28.82

2. Dass ich meine gesundheitsbezogenen Ziele & Erwartungen (nicht) erreiche  
   2. That I do (not) achieve my health-related goals & expectations  
   65.08  28.57

3. Dass ich (nicht) das Ziel eines langen und gesunden Lebens habe  
   3. That I have (not) the goal of a long and healthy life  
   69.97  30.04

4. Dass ich (nicht) das Ziel habe Anerkennung in sozialen Beziehungen zu finden  
   4. That I have (not) the goal to find recognition in social relationships  
   49.67  32.25

5. Dass ich (nicht) das Ziel habe wichtig für andere zu sein  
   5. That I have (not) the goal to be important for others  
   52.42  32.64

6. Dass ich (nicht) das Ziel habe in sozialen Beziehungen verlässlich zu sein  
   6. That I have (not) the goal to be reliable in social relationships  
   59.21  32.11

7. Dass ich (nicht) das Ziel habe in sozialen Beziehungen solidarisch zu sein  
   7. That I have (not) the goal to be solidary in social relationships  
   53.07  32.09

8. Dass ich (nicht) das Ziel habe in sozialen Beziehungen autonom zu sein  
   8. That I have (not) the goal of being autonomous in social relationships  
   51.17  32.82
9. That I have (not) the goal to find protection and limits in social relationships

Shared experience & group history (2 items)
1. That I do (not) exchange with others about health-related experiences
2. That I do (not) experience health-related experiences with others

Observable risk situation (30 items)

1. That I take (no) risks, in which I feel joy
2. That I take (no) risks, in which I receive recognition
3. That I take (no) risks, in which I reduce stress
4. That I take (no) risks, in which I feel a zest for life
5. That I take (no) risks in which I realize myself
6. Natural disasters and climate change
7. My everyday risks
8. My unique special risks

Potential outcomes & severity (8 items)
1. That I am (not) aware of getting hurt through my behavior
2. That I am (not) aware of getting ill through my behavior
3. That I am (not) aware of dying through my behavior
4. That I am (not) aware of being marginalized by my behavior
5. That I am (not) aware of being able to receive recognition through my behavior
6. Dass ich mir (nicht) bewusst bin, durch mein Verhalten gesünder werden zu können
   6. That I am (not) aware of being able to become healthier through my behavior
   69.02  26.94

7. Dass ich mir (nicht) bewusst bin, durch mein Verhalten glücklicher werden zu können
   7. That I am (not) aware of being able to become happier through my behavior
   71.49  26.51

8. Dass ich mir (nicht) bewusst bin, durch mein Verhalten mein Gewicht verändern zu können
   8. That I am (not) aware of being able to change my weight through my behavior
   58.08  32.57

Psychological distance (5 items)
1. Dass ich mich (nicht) rechtzeitig gesundheitlich Vorsorge
   1. That I do (not) take health precautions timely
   70.70  25.71

2. Dass ich mich (nicht) frühzeitig Schutz-Impfen lasse
   2. That I do (not) get protective shots timely
   61.61  32.58

3. Dass ich (nicht) frühzeitig gesundheitliche Screenings auf suche
   3. That I do not (early) seek out health screenings
   58.25  30.38

4. Dass ich (keine) gesundheitlichen Maßnahmen durchführe, die jetzt wirken
   4. That I am not making (any) health improvements that are now working
   62.98  29.03

5. Dass ich (keine) gesundheitlichen Maßnahmen durchführe, die in der Zukunft wirken
   5. That I am not making (any) health improvements that are working in the future
   62.33  29.75

Framing (9 items)
1. Mein eigenes Verhalten
   1. My own behavior
   85.28  18.16

2. Das Verhalten meines sozialen Umfeldes
   2. The behavior of my social environment
   53.37  28.86

3. Mein eigener Körper (Genetik, Physiologie, etc.)
   3. My own body (genetics, physiology, etc.)
   78.03  23.23

4. Viele kleine Aspekte / Maßnahmen zur Verbesserung meiner Gesundheit
   4. Many little aspects / measures to improve my health
   70.56  24.24

5. Wenige große Aspekte / Maßnahmen zur Verbesserung meiner Gesundheit
   5. Few big aspects / measures to improve my health
   56.28  29.03

6. Dass ich (nicht) selber Einfluss auf meine Gesundheit nehme
   6. That I have (no) influence on my health
   78.81  23.52

7. Dass das Schicksal / der Zufall (keinen) Einfluss auf mein Leben hat
   7. That fate / chance has (no) impact on my life
   49.64  33.06

8. Dass ich (nicht) versuche gesünder zu werden
   8. That I do (not) try to become
   73.59  24.79
<table>
<thead>
<tr>
<th>Item</th>
<th>English Translation</th>
<th>Likelihood</th>
<th>Uncertainty</th>
<th>Complexities</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Dass ich (nicht) versuche krank zu werden</td>
<td>That I do (not) try to get sick</td>
<td>57.76</td>
<td>34.90</td>
<td></td>
</tr>
<tr>
<td>Non-observable risk situation (19 items)</td>
<td></td>
<td>57.40</td>
<td>18.73</td>
<td></td>
</tr>
<tr>
<td>1. Dass ich die Wahrscheinlichkeit krank zu werden (nicht) kenne</td>
<td>That I do (not) know the probability to get sick</td>
<td>54.89</td>
<td>31.02</td>
<td></td>
</tr>
<tr>
<td>Likelihood (7 items)</td>
<td></td>
<td>53.44</td>
<td>25.24</td>
<td></td>
</tr>
<tr>
<td>2. Dass ich die Wahrscheinlichkeit des eigenen Todes (nicht) kenne</td>
<td>That I do (not) know the probability of my own death</td>
<td>48.19</td>
<td>34.73</td>
<td></td>
</tr>
<tr>
<td>3. Dass ich die Wahrscheinlichkeit gesund zu bleiben (nicht) kenne</td>
<td>That I do (not) know the probability to stay healthy</td>
<td>57.66</td>
<td>31.70</td>
<td></td>
</tr>
<tr>
<td>4. Dass ich die Wahrscheinlichkeit einer eigenen Verletzung (nicht) kenne</td>
<td>That I do (not) know the probability of my own injury</td>
<td>53.30</td>
<td>31.53</td>
<td></td>
</tr>
<tr>
<td>5. Dass ich die Wahrscheinlichkeit von Nebenwirkungen (Medikamente / Behandlungen) (nicht) kenne</td>
<td>That I do (not) know the probability of side effects (medicines / treatments)</td>
<td>56.84</td>
<td>31.22</td>
<td></td>
</tr>
<tr>
<td>6. Dass ich die Wahrscheinlichkeit eines Therapieerfolges (nicht) kenne</td>
<td>That I do (not) know the probability of a therapeutic success</td>
<td>57.82</td>
<td>30.73</td>
<td></td>
</tr>
<tr>
<td>7. Dass ich mich generell (nicht) an Wahrscheinlichkeiten orientiere</td>
<td>That I do (not) orientate to probabilities in general</td>
<td>45.36</td>
<td>31.38</td>
<td></td>
</tr>
<tr>
<td>Uncertainty (3 items)</td>
<td></td>
<td>53.61</td>
<td>22.97</td>
<td></td>
</tr>
<tr>
<td>1. Dass ich (keine) eigene Regeln oder Faustformeln für mein Verhalten habe</td>
<td>That I have (no) own rules or rule of thumb for my behavior</td>
<td>55.90</td>
<td>29.48</td>
<td></td>
</tr>
<tr>
<td>2. Dass ich Unsicherheiten (nicht) ausblende</td>
<td>That I do (not) hide uncertainties</td>
<td>48.72</td>
<td>30.15</td>
<td></td>
</tr>
<tr>
<td>3. Dass ich von einer sicheren / unsicheren Zukunft ausgehe</td>
<td>That I do (not) assume a secure / uncertain future</td>
<td>56.20</td>
<td>30.10</td>
<td></td>
</tr>
<tr>
<td>4. Dass ich eigene gesundheitsbezogener Annahmen (nicht) in meinem Verhalten umsetze</td>
<td>That I do (not) implement my own health-related assumptions in my behavior</td>
<td>60.37</td>
<td>27.89</td>
<td></td>
</tr>
<tr>
<td>Emotinality (3 items)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Meine situativen Emotionen (z.B. Wut, Frust, Freude, etc.)</td>
<td>1. My situational emotions (e.g., anger, frustration, joy, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Meine allgemeinen emotionalen Tendenzen (z.B. für mich typische Reaktionen)</td>
<td>2. My general emotional tendencies (e.g., typical reactions for me)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambiguities a (2 items)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dass ich einen (/keinen) Zwiespalt zwischen gewünschtem Gesundheitsverhalten (z.B. Sport, Essen, etc.) und gegenläufigen Motiven (z.B. Spaß, Gemütlichkeit, etc.) spüre</td>
<td>1. That I feel a (/ no) discord between desired health behavior (e.g., sports, food, etc.) and opposing motives (e.g., fun, comfort, etc.)</td>
</tr>
<tr>
<td>2. Dass ich mich (nicht) zu dem von mir gewünschtem Gesundheitsverhalten passend verhalte</td>
<td>2. That I do (not) behave appropriately to my desired health behavior</td>
</tr>
</tbody>
</table>

Note. Items were translated into English for the purposes of publication and the benefit of non-German-speaking readers, but the English version was not re-translated, validated or used for study purposes. Framing for each item of RCF factors was to what extent participants believed the statement was relevant or irrelevant for health issues, regardless of whether participants actually implemented the statement in daily life. All answers on RCF factor items are on a slider scale from 0 = not important / relevant to 100 = very important / relevant.

a Factor excluded in stricter model due to insufficient internal consistency of the scale (Cronbach’s α < .7).