



REVIEW ARTICLE

Development of an Index in Social Science: A Systematic Literature Review

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Abstract

In the social sciences, indices are vital tools for summarizing and interpreting complex social phenomena by aggregating various indicators into a composite measure. This systematic literature review explores the methodologies employed in developing such indices, emphasizing the challenges of operationalizing abstract social concepts like well-being and inequality. The review identifies common practices in selecting and weighting indicators, with methodologies ranging from simple equal weighting to advanced statistical techniques like principal component analysis (PCA) and the analytic hierarchy process (AHP). Despite the widespread use of these indices, academic literature on their development remains sparse, with much of the existing work carried out by agencies rather than academic researchers. This review fills this gap by analyzing diverse studies across different social science domains, offering insights into best practices for future research. The findings underscore the importance of methodological rigor in ensuring the validity and reliability of indices, which are increasingly relied upon to inform policy and guide social interventions.

Keywords: Social sciences, Analytic hierarchy process, Principal component analysis

Introduction

In the realm of social sciences, indices have become indispensable tools for summarizing and interpreting complex social phenomena. These indices aggregate various indicators into a single composite measure, offering a comprehensive overview that facilitates comparison, trend analysis, and policy formulation. For example, the human development index (HDI) is widely used to assess overall societal progress by combining metrics such as life expectancy, education levels, and income (UNDP, 2021). Such indices provide standardized benchmarks that are critical for understanding and addressing societies' multifaceted challenges.

The process of developing a social science index is both intricate and multifaceted. Unlike the natural sciences, where variables are often concrete and measurable, social sciences deal with abstract concepts like well-being, social cohesion, and inequality. These abstract concepts require careful operationalization, which involves defining the concept in measurable terms, selecting appropriate indicators, and determining the methodology for combining these indicators into a cohesive index. The selection of indicators is a critical step that often involves balancing theoretical relevance with data availability and reliability. For instance, in the development of the India Patriarchy Index, challenges were faced in selecting indicators that accurately reflect the nuances of patriarchal structures in the Indian context, such as son preference and socio-economic domination (Singh *et al.*, 2022).

The weighting of indicators is another significant challenge in index development. Various methodologies are employed, ranging from simple equal weighting to more complex statistical techniques like principal component analysis (PCA) and the analytic hierarchy process (AHP). For instance, PCA was utilized in developing the local index of need (LIN) to decrease the number of variables in the data and emphasize the most statistically critical components (McCrone *et al.*, 2006). The sustainable livelihood security index in Uttar Pradesh, India, utilized a variance-based weighting method to determine the significance of each

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indicator in relation to the total variability in the data (Singh & Nayak, 2020). The complexity of these methodologies underscores the intricate nature of index development.

Despite the increasing importance of indices in social sciences, the academic literature on their development is relatively sparse. Much of the existing work has been carried out by national and international agencies, leaving a gap in the academic understanding of the methodologies and challenges involved in index development. This gap is particularly pronounced in the social sciences, where the subjective nature of many concepts introduces an additional level of difficulty to the index development process. For example, the development of a comprehensive regional vulnerability index for greater London integrated various socio-economic indicators but faced challenges in balancing data availability with the theoretical relevance of the indicators (Cao *et al.*, 2023).

To address these complexities, this systematic literature review seeks to explore and answer the following key research questions:

1. What are the prevailing methodologies used in developing indices within the social sciences?
2. What weighting techniques are most commonly employed in social science indices, and how do they impact the final index outcomes?
3. What challenges are encountered in operationalizing and validating indices in social sciences?

By examining a diverse range of studies, this paper identifies common practices, highlights methodological challenges, and proposes best practices for future research. The review covers a broad spectrum of indices, from those measuring vulnerability and social development to those assessing specific phenomena like patriarchy and drought risk. Through this analysis, we aim to contribute to the field by offering insights to help researchers and practitioners develop more robust and reliable indices.

The significance of this review is underscored by the growing demand for multidimensional indices that can accurately capture the complexities of social phenomena. As social scientists increasingly rely on indices to inform policy and guide interventions, it is crucial to ensure that these tools are developed using rigorous methodologies that enhance their validity and reliability. By systematically reviewing the existing literature, this paper provides a roadmap for future research in this critical area, helping to ensure that social science indices continue to evolve and improve in their ability to capture and represent the realities of the social world.

Research methodology for this study

Inclusion criterion

This study includes all studies that discuss the methodology of developing an index within the social science domain,

sourced from the Scopus database. Only studies written in English are included in this review.

Literature Identification

In the Scopus search box, the keywords “Development” and “Index” were applied using the ‘title’ field only, rather than the title, abstract, and keywords fields, as this approach retrieves studies that primarily focus on the development of indices. This search yielded 344 open-access documents. After applying a filter for the English language, 305 documents remained.

Screening for inclusion

We also excluded studies focused on specific development indices, such as the human development index, rather than on the process of developing an index. We reviewed the abstracts of all 305 research articles in our database to identify those relevant to our study. Following the screening process, a total of 140 articles were chosen for further investigation. The entire texts of these articles were then

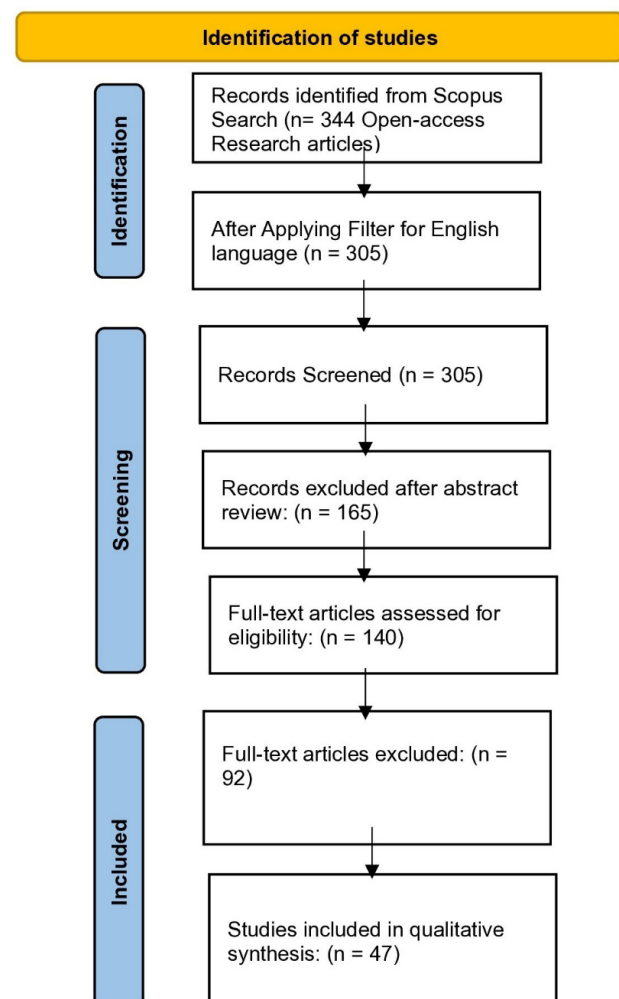


Figure 1: PRISMA technique process for the search criteria

Table 1: Missing caption

Sr. No	Title of the article developing an index	Citation of the Paper	Methods to Identify Indicators	Weighting Technique
1.	"Comparing degrees of 'publicness' and 'privateness' in school systems: the development and application of a public-private index"	Gutiérrez <i>et al.</i> (2023)	The study started by reviewing conceptual literature from various disciplines, including political economy, public policy, and education, to understand how «publicness» and «privateness» are conceptualized in education systems. Four broad domains were identified: Delivery, Access/Inclusion, Finance, and Decision. Each domain was divided into dimensions reflecting the key aspects of publicness and privateness.	Each dimension within a domain was given equal weight in the index construction. This decision was made because there was no clear basis to prioritize one dimension over another. Each dimension was scored on an ordinal scale from 0 to 5, with 0 representing a fully public feature and 5 representing a fully private feature. The domain scores were calculated by averaging the dimensions' scores within that domain, ensuring equal contribution from each dimension.
2.	"Development of the India Patriarchy Index: Validation and Testing of Temporal and Spatial Patterning"	A. Singh <i>et al.</i> (2022)	The study examined the conceptual and empirical literature on patriarchy, gender inequality, and gender roles. This review identified key dimensions that define patriarchal structures, particularly within the Indian context. The selection process aimed to ensure that the indicators were comprehensive and reflected India's broader social and cultural context. The IPA adapts and modifies an existing Patriarchy Index developed for the European context by Gruber and Szołtysek (2016). This adaptation included additional variables relevant to the Indian context, such as son preference and socio-economic domination, while excluding variables less applicable, like the prevalence of young women living independently.	To calculate the India Patriarchy Index, each variable was given a score based on its relative importance compared to the highest value observed across Indian states. For variables positively associated with patriarchy, the score was determined by comparing each state's proportion to the highest observed proportion. For those negatively associated with patriarchy, the scoring was adjusted so that higher values corresponded to lower index scores. Due to their unique characteristics, special adjustments were made for «son preference» variables. The scores for each variable were then summed within specific domains to create domain scores. Each domain was assigned a different weight based on its significance, and these weighted domain scores were combined to form the overall India Patriarchy Index.
3.	"Development of a composite regional vulnerability index and its relationship with the impacts of the COVID-19 pandemic"	Cao <i>et al.</i> (2023)	The study extensively reviewed literature on vulnerability, particularly on travel, housing, and socio-economic factors. The literature provided the foundation for identifying key indicators related to socio-spatial vulnerability. Indicators were selected based on data availability and relevance to the study's focus on Greater London. The study incorporated elements from indices such as the Car Dependence and Housing Affordability (CDHA) index, which had been produced in prior research, to construct a more comprehensive measure encompassing the combined factors of transportation, housing, and socio-economic vulnerability.	The study used an equal weighting approach to combine the selected indicators. Both travel vulnerability and housing/social vulnerability were assigned equal weights (50% each) in the calculation of the composite index. Previous studies and the need for simplicity in the index construction influenced this decision.

4. "Development of a Multiple-Drought Index for Comprehensive Drought Risk Assessment Using a Dynamic Naive Bayesian Classifier" *H. Kim et al. (2022)*

The study began by reviewing various drought indices for monitoring meteorological, agricultural, and hydrological droughts. These indices included the Streamflow Drought Index (SDI), Standardized Precipitation Index (SPI), Evaporative Stress Index (ESI), and the Water Supply Capacity Index (WSCCI). The goal was to develop a multiple drought index (MDI) that could comprehensively represent drought characteristics by combining these pre-developed indices. The selected indicators were chosen to capture different aspects of drought, including hydrological, meteorological, and agricultural impacts, as well as water supply capacity. The Water Supply Capacity Index (WSCCI) was specifically incorporated to account for the regional ability to meet water demand during drought conditions, which is critical for accurately assessing drought risk.

The Dynamic Naive Bayesian Classifier (DNBC) method was used to calculate the multiple drought index (DNBC-MDI). This probabilistic approach allows for combining various drought indices (SDI, SPI, ESI, and WSCCI) to represent different dimensions of drought severity. The DNBC assumes that the input drought indices are mutually independent, and it uses a Gaussian distribution to model the emission frequency of very parameter.
5. "Assessment of the results and methodology of the sustainable development index for Spanish cities" *(López et al., 2021)*

A comprehensive literature review was conducted to identify relevant indicators for sustainable development. This included examining international and national reports on sustainable development goals (SDGs) and existing methodologies used by the Sustainable Development Solutions Network (SDSN). Experts from various fields, including ecology, urban planning, and sustainability, were consulted to validate and refine the list of indicators. A public consultation process was conducted to gather feedback on the selected indicators from local entities and stakeholders. This helped in ensuring the indicators' relevance and acceptance by the local communities.

Equal weighting was initially applied to all SDGs. An alternative weighting method based on expert opinions and municipal competencies was also tested. Correlation analysis was performed to evaluate the indicators' statistical coherence and identify and remove redundant indicators. This ensured that the indicators were not overly collinear and that they effectively represented different aspects of sustainable development. PCA was used to assign weights to individual variables and reduce multicollinearity's effects.
6. "Supporting pandemic disease preparedness: Development of a composite index of area vulnerability" *(Saghapour et al., 2021)*

The study employed a deductive approach to identify the relevant vulnerability domains. This approach involved defining different variables or domains from existing literature and combining them to measure the overall vulnerability at a geographic level.

The COVID-19 Pandemic Vulnerability Index (CPVI) was developed by first using CFA within a structural equation modeling framework. CFA helped identify and validate the four latent factors (medical conditions, sociodemographic, land use and transportation) that contribute to pandemic vulnerability. After identifying the variables, PCA with Varimax rotation was employed to estimate scores for each latent factor. These estimated latent factors were subsequently merged to form the CPVI. As no explicit rationale existed for varying weightings, each latent factor was equally weighted when combining them to generate the final CPVI score.
7. "Sensing the destination: Development of the destination sensescape index" *(Buzova et al., 2021)*

A comprehensive analysis of existing multisensory tourism literature was conducted to compile a list of sensory descriptors. The review resulted in a collection of 194 sensory words, which were then grouped and categorized to form the initial set of indicators. The proposed indicators were evaluated by an expert panel, including five scholars in tourism marketing and three experienced professionals in the tourism industry. Based on their recommendations, indicators were refined, and some were removed or reworded to ensure relevance and clarity. A concept mapping method was used to establish further the content validity and dimensionality of the proposed measurement instrument. Participants with extensive tourism experience grouped the items, which were then analyzed using multidimensional scaling (MDS) and hierarchical clustering to confirm the structure.

PLS-SEM was used to analyze data collected from pilot testing and to assess the psychometric properties of the proposed measurement index. The evaluation involved checking for convergent validity, collinearity among indicators, and significance and magnitude of item weights.

8. "Development of a fish-based multimetric index for the assessment of lagoons' ecological quality in northern Greece" (Sapounidis & Kourtrakis, 2021)

The development of the Lagoon Fish-based Index (LFI) was derived from the ideas of the Indices of Biotic Integrity (IBIs), which are widely employed instruments for evaluating the health of aquatic ecosystems. A total of 25 potential metrics were initially selected. These metrics quantify characteristics such as the composition, abundance, feeding preferences, and the existence of sentinel species in fish fauna.

The initial list of 25 metrics was reduced to 8 through a series of statistical tests, including Spearman Rank Correlation, VIF analysis, and PCA. These tests identified metrics with low responsiveness or high correlation, which were excluded to avoid redundancy and ensure the robustness of the final index.

The weighting of each dimension was implicitly determined by the factor loadings in the CFA, which assessed the strength of the relationship between the observed variables and the underlying identity resilience construct.
9. "The Identity Resilience Index: Development and Validation in Two UK Samples" (Breakwell *et al.*, 2022)

The Identity Resilience Index (IRI) was developed by integrating items from four well-established scales, each measuring different aspects of identity resilience as conceptualized in Identity Process Theory. These scales include the General Self-Efficacy Scale, the Rosenberg Self-Esteem Scale, the Southampton Self-Continuity Index, and the Sense of Uniqueness Scale. The indicators were chosen based on the concepts of IPT, which suggests that identity resilience is defined by elevated levels of self-esteem, self-efficacy, Positive distinctiveness and continuity.
10. "The Development of a Life-Cycle-Based Sustainability Index That Incorporates Patient-Centredness for Assessing and Reporting the Sustainability of Healthcare Buildings in Saudi Arabia" (Alhaji *et al.*, 2023)

The research began by establishing macro-objectives and their corresponding indicators from the European Level(s) framework for assessing and reporting the sustainability performance of buildings. This provided an initial reference, utilizing a previously undertaken literature review focused on sustainable building practices in Saudi Arabia.

Semi-structured interviews were conducted with 14 experts, including academics, consultants, designers, contractors, and government officials. A supplementary data collection tool was used, involving a questionnaire survey to gather perceptions from different experts and end-users. This helped in refining the indicators by incorporating a broader range of views and practical insights.
11. "Measuring self-reliance among refugee and internally displaced households: the development of an index in humanitarian settings" (Seff *et al.*, 2021)

The Self-Reliance Index was created following an extensive examination of the literature and current instruments used to assess self-reliance in resettlement and internally displaced communities. The review helped identify 12 key domains relevant to self-reliance: housing, security, education, food, healthcare, employment, social capital, and financial resources. Data was collected from refugee households in multiple sites. The instrument underwent iterative testing and refinement using this data and input from refugees, experts, and practitioners in the field.
12. "What is Inclusive Development? Introducing the Multidimensional Inclusiveness Index" (Dörffel and Schuhmann 2022)

The development of the MDI involved an extensive review of existing indices and approaches to measuring development, including the Human Development Index (HDI) and the Inclusive Development Index (IDI).

The review helped identify relevant variables covering a broad spectrum of inclusive development, including equity, health, education, income, and environmental sustainability. The MDI includes various variables to capture the multidimensional nature of inclusive development. These variables are divided into two main subindices: the Equity Index and the Achievement Index.

The scoring rubric was initially designed based on an average of the 12 domain scores, where each domain was scored from 1 to 5, with higher scores indicating greater self-reliance. The final SRI score was calculated by averaging all scored domains and then applying specific deductions based on scores in critical domains like Food, Health Status, and Assistance. The modifications made guaranteed that the index accurately reflected the level of self-sufficiency of a household.

To minimize the normative aspects of the index construction, the study employed Principal Component Analysis to determine the weights of the variables. PCA was used to reduce the data's dimensionality and identify the most significant components that explain the variations in the data. The weights for the individual variables were determined based on the variance they contributed to the overall principal components.

13. "The Coastal Tourism Climate Index (CTCI): Development, Validation, and Application for Chinese Coastal Cities" (Gao *et al.*, 2022)

The development of the CTCI began with an extensive review of existing tourism climate indices such as the Beach Climate Index, Tourism Climate Index, and Holiday Climate Index: Beach. The literature review helped identify key climatic variables that are crucial for coastal tourism, including sunshine, thermal comfort, precipitation, wind, and air quality.

The CTCI employs the Information Entropy Weight method to objectively determine the five sub-indices weightings. Entropy is a statistical technique used to evaluate the influence of individual variables on the total index by considering the extent of variability present in the provided data. The entropy method is used to assess the impact of each variable on the overall index based on the degree of variation within the data. This approach helps in avoiding subjective biases in assigning weights.

EFA was conducted using the unweighted least squares estimation method with promax rotation to identify the factors measured by the Japanese version of the ISS. The analysis resulted in the identification of two factors: sexual satisfaction and sexual dissatisfaction. The final scale did not include items with major floor effects or those that did not load heavily onto any factor. CFA was performed on the data from a separate sample to confirm the factor structure identified by the EFA. The weighting of each item in the final scale was determined based on its factor loadings, with higher loadings indicating greater importance within the identified factors.

All eight indicators were weighted equally when calculating the overall SRHBI score. The equal weighting approach was chosen to simplify the index's calculation and ensure its replicability and comparability across different cities and urban areas. Each indicator was standardized, with scores ranging from 0 to 100. Calculating the final SRHBI score for each community area involved averaging the standardized scores of all eight indicators.

The qualitative and quantitative indicators were dichotomized to fit into a binary format for ease of analysis. Cut-point analysis was used to establish thresholds for these indicators based on the natural breaks in the frequency distribution of the data. This approach ensured that each indicator could effectively distinguish between different levels of exposure to SEA. The final index was constructed by summing the scores of the eight identified indicators. Each indicator contributed equally to the overall index score, reflecting a comprehensive measure of SEA exposure.
14. "Development of a Japanese Version of the Index of Sexual Satisfaction for Use in Couples with Young Children" (Hidaka *et al.*, 2022)

The development of the Japanese version of ISS began with a review of existing measures and literature on sexual satisfaction. The ISS was selected due to its comprehensive nature and previous validation in various cultural contexts. The original ISS was translated into Japanese following the World Health Organization's guidelines, which included back-translation, forward-translation, and expert panel review to ensure cultural relevance and accuracy. The translation was carefully reviewed to ensure that the items were appropriate and understandable in the Japanese cultural context, particularly for couples with young children.
15. "The Sexual and Reproductive Health Burden Index: Development, Validity, and Community-Level Analyses of a Composite Spatial Measure" (Rosentel *et al.*, 2021)

The SRHBI was developed by evaluating public health data and taking the aims of sexual and reproductive health organizations. The selection of the indicators was based on their capacity to satisfy criteria including validity, consensus, sensitivity, specificity, and timeliness. The chosen variables are the common measures of SRH and are commonly collected by urban public health agencies.
16. "Development of an Index to Measure the Exposure Level of UN Peacekeeper-Perpetrated Sexual Exploitation/Abuse in Women/Girls in the Democratic Republic of Congo" (Gray *et al.*, 2022)

The study commenced by examining the current definitions and frameworks of sexual exploitation and abuse as established by the United Nations and other important regulatory entities. This review provided a foundation for understanding the various forms of SEA and their manifestations in peacekeeping contexts. A thematic analysis of 1,822 micronarratives was conducted to gain deeper insights into the contextual nature of peacekeeper-perpetrated SEA. This process resulted in the identification of six qualitative indicators related to SEA. The study also utilized data from a cross-sectional survey that included 33 variables related to interactions between UN peacekeepers and local women/girls. Two quantitative indicators were identified and integrated into the index from these variables.

17. "Development of an Index of Socio-Emotional Competence for Preschool Children in the Growing Up in New Zealand Study" (Ahmad *et al.*, 2019)

The development of the Socio-Emotional Competence Index was guided by existing literature on socio-emotional development. Variables were chosen based on their conceptual relevance and empirical properties, including internal consistency and discriminatory power. EFA was conducted to identify underlying dimensions of socio-emotional competence. As a result of this investigation, three main dimensions were identified: Easy-going, Regulation, and Exuberance. These dimensions surfaced consistently across the different data collection waves.

Three different weighting approaches were used to calculate the index: equal weighting, empirical weighting based on factor analysis (FA), and time-based weighting. The final index was tested against external outcomes such as pragmatic language and school readiness, with the time-weighted version showing the strongest empirical support. The Time-based Weighting method assigned weights to scores from various time points according to their temporal proximity to the 4.5-year data compilation wave. This approach gives more weight to the most recent and presumably most relevant data.
18. "Development of planning index for evaluating climate change protocols: analysis of Mumbai Metropolitan Region's Regional Plan 1996–2011" (Sahu & Saizen, 2018)

A series of field surveys were carried out in the Mumbai Metropolitan Region to identify the indicators for the index, understand factors influencing climate change, and examine the temporal variations in land cover. Planning authorities were interviewed to gain insights into the region's climate change strategy. Discussions were also held with stakeholders to assess the real impacts of each element of the regional plan on the mitigation and adoption of climate change. The Regional Plan 1996–2011 was thoroughly examined, focusing on the planning strategies outlined in the document. The study aimed to ascertain how well these strategies aligned with climate change protocols.

A content analysis method was employed to evaluate the policies of the regional plan. Each chapter in the planning document was treated as a component, and its subsections were evaluated as sub-components. The relative importance of each component was established via questionnaires administered to planners from the MMRDA and other local bodies engaged in the planning process. The survey results provided insights into the importance of each element in relation to climate change protocols.
19. "Design of a development index for Spanish municipalities" (Masot *et al.*, 2020)

The study began by collecting various demographic, economic, agricultural, and accessibility variables from multiple sources, including the Spanish National Statistics Institute, Agricultural Census, and Common Agricultural Policy (CAP) investments. A total of 45 variables were initially selected for analysis, including population density, old-age, and youth indices, unemployment rates by sector, income per capita, main roads, accessibility to towns, percentage of irrigated hectares, and agricultural employment. These variables were chosen based on their relevance to the municipalities' economic, social, and demographic conditions, ensuring a comprehensive assessment of development levels.

PCA was employed to decrease the number of dimensions in the data and determine the most important components that account for the variation in the development levels of the municipalities. The PCA allowed for extracting six principal components, with the first component explaining 31.78% of the variance. The Development Index was calculated by assigning weights to the variables based on their factor loadings in the first principal component.
20. "Development of the project-level Women's Empowerment in Agriculture Index (pro-WEAI)" (Malapit *et al.*, 2019)

The pro-WEAI was developed by adapting the existing WEAI. The development of pro-WEAI was guided by empowerment theory and involved feedback from 13 agricultural development projects to identify relevant empowerment indicators. The development process involved collecting both qualitative and quantitative data from the participating projects. Qualitative research included focus groups, interviews, and document reviews to understand local empowerment contexts. This qualitative input was used to refine the survey questions and identify relevant indicators for the pro-WEAI.

Sensitivity tests were performed to evaluate the robustness of the index under different weighting schemes, but equal weighting was chosen to ensure comparability across different projects and contexts.

21. "The development of an index of rural deprivation: A case study of Norfolk, England" (Burke & Jones, 2019)

The study began by reviewing existing deprivation indices, including the English Index of Multiple Deprivation (IMD) and other indices like the Carstairs and Townsend indices. These were analyzed to understand their applicability to rural areas. consultations were conducted with the Directors of Public Health and other stakeholders to ensure the selection of indicators was relevant to rural deprivation.

PCA was used to group related indicators into principal components or domains. This statistical technique helped identify the underlying structure of the indicators, ensuring that the variables were grouped based on their correlations. After identifying the relevant dimensions, different weightings were tested. The weightings were adjusted through sensitivity testing to determine their impact on the index's ability to identify deprivation in rural areas.
22. "Measuring stalking: the development and evaluation of the Stalking Assessment Indices (SAI)" (McEwan *et al.*, 2021)

The development of the SAI began with a comprehensive review of existing tools and literature on stalking measurement. Behavioral descriptors for the SAI were developed based on items from existing measures of unwanted pursuit and stalking, including tools like the Obsessive Relational Intrusion Questionnaire, the Stalking Behavior Checklist, and the Unwanted Pursuit Behavior Inventory. The final selection of items was informed by research into stalking behaviors and was reviewed by psychologists experienced in working with stalking cases to ensure comprehensive coverage of the construct. PCA was used to identify the underlying structure of the stalking behaviors reported by victims. This analysis helped reduce the original list of behavioral descriptors by collapsing items with high multicollinearity and refining the final set of items to ensure they captured the essential aspects of stalking.

The final index structure comprised two components, which were connected to each other: intimidation and communication. These components were derived from the PCA and were used to weigh the behaviors according to their contribution to the overall stalking construct.
23. "Development of Sidewalk Block Pavement Condition Index (SBPCI) using Analytical Hierarchy Process" (J. Kim *et al.*, 2019)

Classification was made of the distress patterns of the sidewalk pavements into four primary categories: Pop-out, Surface Abrasion, Roughness, and Corner Break. These classifications were derived from a field investigation conducted with maintenance and management experts. Definitions and causes of each distress type were also established, which helped categorize and understand the impact of each type on the overall pavement condition.

This study employed the Analytic Hierarchy Process technique to examine the influence of different distress types on the condition of the sidewalk pavement. This involved a questionnaire survey of 31 pavement management officers who provided their input on the relative importance of the different distress types. A pairwise comparison method was employed to compute the weights for each distress type. The weights were calculated based on the responses from the survey, with Pop-out receiving the highest weight, followed by Roughness, Surface Abrasion, and Corner Break.
24. "Development of a Program Definition Rating Index for the performance prediction of construction programs" (Cha *et al.*, 2018)

The study began by identifying Critical Success Factors through a comprehensive literature review and expert interviews. A total of 43 CSFs were initially identified from previous research related to program management, especially focusing on large-scale and complex projects. To ensure reliability, the identified CSFs were reviewed and refined through interviews with three experts who had extensive experience in construction programs. This process led to the modification of nine CSFs and the addition of two new CSFs, resulting in a total of 45 CSFs. Factor analysis was used to group the CSFs into eight categories across these three sections. This analysis helped organize the CSFs into meaningful groups that reflect program management's different stages and aspects.

Weights were assigned to each CSF based on the standardized regression weights obtained from SEM. These weights were then used to calculate the overall Program Definition Rating Index (PgDRI).

25. "Evaluating the quality of care received in long-term care facilities from a consumer perspective: Development and construct validity of the Consumer Choice Index - Six Dimension instrument" (Milte *et al.*, 2019)
A literature review was conducted to identify current conceptual frameworks for assessing the quality of care in long-term care facilities, which served as the foundation for developing the CCI-6D. The qualitative research included individual interviews with residents and focus groups with family members, particularly targeting those with moderate to severe cognitive impairment. The themes identified in this study were analyzed to develop the candidate dimensions for the CCI-6D.
Although the initial phase of the CCI-6D development did not include a preference-weighted scoring algorithm, the study team plans to develop this in a subsequent phase. This algorithm will complement the descriptive system, incorporating the instrument into an economic evaluation framework.
26. "Application of multivariate statistical analysis in the development of a surrogate water quality index (WQI) for South African watersheds" (Banda & Kumarasamy, 2020)
The development of the surrogate WQI began with a Delphi method involving a group of thirty water experts who identified and rated the significance of twenty-one water quality parameters. These parameters were then reduced to thirteen based on their relevance and significance ratings, informed by both expert opinion and literature. The thirteen parameters identified were further reduced to four proxy variables by applying multivariate statistical techniques. These techniques included PCA for pattern recognition and hierarchical clustering analysis (HCA) to determine the most significant and interrelated variables.
PCA was employed to decrease the number of dimensions in the data and determine the most important components. About 69% of the overall variance was explained by the first five components. The weights for each parameter were derived based on their loadings in these components, with the most significant variables contributing more to the surrogate WQI. The final surrogate WQI was calculated using a weighted arithmetic sum model, an enhancement over the conventional weighted sum method. The weights for each of the four proxy variables were assigned based on their significance as determined by the PCA and HCA.
27. "Development of a robust customer satisfaction index for domestic air journeys" (Munoz *et al.*, 2020)
The Robust Customer Satisfaction Index (RCSI) development began with a review of existing customer satisfaction index models, particularly the American Customer Satisfaction Index. The study aimed to adapt and improve these models to suit the context of domestic air journeys better. Key variables related to traveler satisfaction were identified from the literature. Data collected through the survey were employed to verify the suggested model and refine the indicators used in the RCSI.
The weights were derived from the standardized regression coefficients in the SEM model, which quantified the impact of each indicator on overall satisfaction.
28. "Development of a composite sustainability index for roadway intersection design alternatives in the UAE" (Al-Kaabi *et al.*, 2020)
A comprehensive literature review was conducted to identify sustainability indicators relevant to roadway intersection design. Indicators were chosen based on their relevance to the three primary sustainability dimensions: economic, environmental, and social. These indicators were selected for their ability to be measured, ease of availability, and interpretability, ensuring they are theoretically sound and practical for use in assessing intersection sustainability. Experts in transportation sustainability were consulted to validate the indicators selected from the literature.
The study employed the MCDM method, specifically the Technique of Order Preference by Similarity to Ideal Solution, to assign weights to the selected indicators. The TOPSIS method involved calculating the indicators' relative weights based on stakeholders' preferences, which were then used to determine the Composite Sustainability Index for each design alternative. The sensitivity analysis examined how variations in weight assignments affected sustainability rankings across the design alternatives.

- 29 "Development of a sustainability index for an energy management system in Thailand" (Nakthong & Kubaha, 2019)
 The indicators were selected based on their relevance to organizational energy efficiency and EnMS effectiveness. A focus group meeting was held with eight specialists in the ISO 50001 field, representing public agencies, professional associations, educational institutions, and the industrial sector. These experts reviewed the initial selection of indicators and validated their relevance and applicability to the sustainability of energy management systems.
- 30 "Sustainable development goals indicators: A methodological proposal for a multidimensional fuzzy index in the mediterranean area" (Casini *et al.*, 2019)
 Indicators were selected based on their policy relevance, admissibility requirements (such as availability and statistical process adequacy), and data quality, including criteria like timeliness and comparability over time. Experts in sustainable development and the Mediterranean region were consulted to ensure the relevance and applicability of the selected indicators. The consultation helped refine the list of indicators to reflect better the specific sustainability challenges Mediterranean countries face.
- 31 "Development of sustainable livelihood security index for different agro-climatic zones of Uttar Pradesh, India" (S. Singh & Nayak, 2020)
 A detailed literature review was conducted to select indicators for the SLSI. The selection was based on the relevance of these indicators to the agro-climatic zones of Uttar Pradesh. Indicators were specifically chosen to reflect the unique conditions of different agro-climatic zones (ACZs) in Uttar Pradesh. These indicators were then grouped into relevant sub-components aligning with the seven livelihood security dimensions.
- 32 "Development of a generic domestic water security index, and its application in Addis Ababa, Ethiopia" (Assefa *et al.*, 2018)
 Indicators were selected based on their relevance to domestic water security and applicability to urban areas like Addis Ababa. Indicators were refined to reflect the specific challenges of Addis Ababa, such as water loss (non-revenue water), per capita water consumption, and the percentage of the population that is connected to sewer facilities. These indicators were selected to capture the city's critical sanitation, water supply, and hygiene aspects.
- 33 "Development of composite road environment safety index" (Hussain *et al.*, 2016)
 A thorough literature review was conducted to identify potential indicators reflecting road environment conditions contributing to crash risks. This review helped compile an initial list of indicators relevant to the Malaysian road environment. Preliminary studies were conducted to refine the list of indicators based on specific criteria, including the measurement methods, objectives, quality, and expected outcomes.
- The Analytic Hierarchy Process methodology was employed to determine the weights of the selected indicators. This process involved creating individual comparison matrices from questionnaire responses by 15 experts from ISO 50001-certified firms. The weights were calculated using the maximum eigenvalue vector method, and the reliability of the AHP model was validated using a consistency ratio with a threshold of 0.1 for acceptable consistency. The WAM approach consolidates the indicators into a final sustainability index.
- The EFA process involved analyzing the correlation matrix of the indicators and selecting factors based on criteria such as eigenvalues >1 and the cumulative proportion of variance explained. An innovative fuzzy logic approach was employed to assign weights to the indicators. Unlike traditional crisp approaches, this method allowed indicators to belong to multiple dimensions with varying degrees of membership. The fuzzy approach considered factor loadings from the EFA as weights, with the flexibility to include indicators in multiple dimensions based on their loadings.
- The study employed the Iyenger and Sudharshan (1982) methodology for normalizing indicators on a scale from 0 (minimum) to 1 (maximum). This process accounted for whether the indicator had a positive or negative relationship with livelihood security. Weights were assigned to each indicator based on their variance, which reflects the contribution of each indicator to the overall variability in the data. The weighted values of the indicators were then used to calculate the SLSI for each agro-climatic zone.
- The study applied equal weights to all indicators to avoid bias. This approach was chosen because of the diverse nature of the indicators and the complexities involved in assigning different weights. The equal weighting ensured that all aspects of domestic water security were equally important in the final assessment.
- PCA was employed to statistically determine the weights of the indicators. These weights were used to calculate a composite index and are based on their loading in the PCA, reflecting their importance in the overall safety assessment.

- 34 "The construction and application of functional indexes of colleges and universities in the development of sports industry - Analysis based on fuzzy comprehensive evaluation method" (Wang & Lu, 2017)
- The initial indicators were identified through a literature review, expert visits, and field investigations. The Delphi method was employed to gather insights from relevant experts, refining the indicators based on two rounds of feedback, achieving over 90% expert consensus. A field investigation was conducted to validate the indicators and their relevance in real-world settings, focusing on the utility function of colleges and universities in promoting the sports industry.
- The weight of each indicator within the developed index system was estimated using the Analytic Hierarchy Process. Fifteen experts from relevant fields, including sports industry research, management, and university administration, were consulted. The experts used a 1-9 scale to compare the indications and create judgment matrices, from which the weights were computed. The fuzzy comprehensive evaluation method involved constructing a single-factor fuzzy evaluation matrix, calculating the index weights, and synthesizing these with the fuzzy evaluation matrix to obtain the comprehensive evaluation vector.
- 35 "Development, Validity, and Reliability of the Women's Capabilities Index" (Greco *et al.*, 2018)
- A participatory approach was used to select capabilities, gathering the perspectives, values, and assessments of 129 women from Mchinji, Malawi, using focus group discussions (FGDs). The capabilities that the participants valued were included in the final list of indicators. The research and field team selected the capability indicators and questionnaire design. The indicators were developed to assess six main capabilities.
- Four distinct aggregation methods were employed to examine the consequences of various assumptions in assigning weights to the dimensions and sub-dimensions. The four weighting techniques are: Equal Weighting, Collective Value Judgments, Survey-Based Individual Preferences, and PCA (based on the variance explained by each indicator)
- 36 "Assessing Child Development: A Critical Review and the Sustainable Child Development Index (SCDI)" (Chang *et al.*, 2015)
- The study analyzed existing child development and well-being indexes, such as the Child Development Index and the Human Development Index. This analysis helped select indicators that would address the identified gaps, such as including environmental aspects. The study aligned the selected indicators with the Sustainable Development Goals (SDGs)
- The study did not specify a detailed statistical method for determining the weightage of indicators but emphasized the importance of considering both outcome and context levels in the assessment.
- 37 "The development of a Local Index of Need (LIN) and its use to explain variations in social services expenditure on mental health care in England" (McCrone *et al.*, 2006)
- Developing the LIN involved identifying sociodemographic variables considered indicators of mental health needs. This was done by reviewing existing literature and theoretical considerations that informed the choice of variables.
- PCA produced uncorrelated factors from the selected indicators. Four distinct factors were identified, each representing different aspects of sociodemographic profiles that influence mental health needs. In order to improve interpretability, the factors were rotated using the Varimax technique. The weight of each factor was based on the proportion of variance explained in the data, and these weights were used to create the LIN by computing a weighted sum of the factors.
- 38 "Modified Index Method in Scenarios of Regional Socio-Economic Development" (Panasyuk *et al.*, 2014)
- The process began with a preliminary study that involved selecting prior components and preparing indicators based on a retrospective examination. This stage helped identify the critical indicators relevant to the socio-economic conditions of the region. The study introduced a modified mathematical-statistical index method, which included a sequence of stages, from selecting indicators to analyzing forecast scenarios
- The modified index method incorporated a scenario-based weighting system. This approach involved assigning weights to indicators based on their significance within each forecasted scenario. The generalized characteristic «degree of indicators' changes» was calculated using a formula that integrated the various weighted factors.

- 39 "Development of a Children's Version of the SCORE Index of Family Function and Change" (Jewell *et al.*, 2013)
 The Index was adapted from an already present 29-item version of the SCORE used for adults and adolescents aged 12 and above. The adaptation process involved simplifying language and modifying items to make them more accessible to children aged 7–10. A pilot test was conducted with a small group of children aged 8–10 years. These children were instructed to fill out the original 29-item SCORE, and their feedback was gathered through group discussions to identify items that were difficult to understand. The pilot test findings and involved consultation with an expert panel, including physicians and researchers influenced the revision of the children's version of the SCORE. This consultation led to developing a draft version of the Child SCORE, which included 15 items deemed most suitable for children.
- 40 "Development of crash-severity-index models for the measurement of work zone risk levels" (Li & Bai, 2008)
 A comprehensive literature review and data analysis were undertaken in this study to identify possible risk factors linked to the severity of crashes in highway work zones. The study utilized chi-square statistics to identify variables significantly associated with crash severity. Variables that were not significant individually but might interact with other variables were further analyzed using CMH statistics. This process identified 18 important risk factors.
- 41 "Development and preliminary psychometric properties of a well-being index for medical students" (Dyrbye *et al.*, 2010)
 Items for the index were generated based on the identified domains. The items were derived from validated instruments assessing burnout, quality of life, and depression. The generated items were further refined through feedback from medical students and additional experts to ensure clarity and relevance.
- 42 "Development of a Liveable City Index (LCI) Using Multi-Criteria Geospatial Modelling for Medium Class Cities in Developing Countries" (Onnom *et al.*, 2018)
 The identification of indicators for the LCI was primarily derived from the opinions of local residents and the suggestions provided by experts. An initial open-ended questionnaire survey was conducted among residents of the Muang district in Khon Kaen, Thailand, to gather their perspectives on the factors contributing to city liveability. This was followed by a closed-ended questionnaire derived from the most frequently mentioned factors. Experts and city managers were consulted to validate the selected factors and decide on the sub-factors used in the Analytical Hierarchy Process (AHP).
- 43 "Welfare State Development in Latin America and the Caribbean (1970s–2000s): Multidimensional Welfare Index, Its Methodology and Results" (Cruz-Martínez, 2014)
 The indicators for the multidimensional welfare index were selected through a detailed review of existing literature and a comparative analysis of welfare state development in both countries. The study sought to improve upon the Welfare Effort Index developed by Segura-Ubierno by incorporating additional indicators that reflect the multidimensional nature of welfare states.
- The Child SCORE was divided into three distinct dimensions. Each dimension comprised five items, and scores were determined by summing the items within each dimension and dividing by the number of items. The total score was the average of all 15 items.
- Logistic regression was used in the study to construct the CSI models. Two categories of models were developed: driver-independent (DI-CSI) and driver-dependent (DD-CSI). The logistic regression provided a probability estimate (CSI) for the likelihood of a fatal crash, ranging from 0 (low risk) to 1 (high risk). The CSI models were verified using crash data from 2004, comprising 18 fatal impacts and 337 injuries.
- Eleven experts rated each item's relevance, clarity, and representativeness in the well-being index. The Content Validity Index was calculated for each item, indicating how well the items represented the intended domains.
- The AHP method assigned weights to each component based on pair-wise comparisons. This process involved experts ranking each factor and its sub-factors. The rankings were then converted into weights using Saaty's scaling method, designed to reflect each factor's relative importance in determining city liveability.
- The PCA helped identify the most significant factors contributing to welfare state development and provided weights for each dimension based on their explained variance.

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| 44. | "Identification of Domains for Malaysian University Staff Happiness Index Development" | (Yassin, 2014) | Data was collected from five clusters within a Malaysian institution using a qualitative approach, including the Nominal Group Technique. This method facilitated the identification of relevant domains by allowing participants to freely express their insights and experiences in response to specific questions about happiness at work. The identified domains were cross-referenced with existing literature to ensure relevance and comprehensiveness. This process also allowed for discovering new domains not previously highlighted in the literature. | After identifying domains through the NGT, a ranking system was employed to determine the priority of these domains among the participants, which provided an interim preference for domains and helped refine the selection of key factors for the happiness index. |
| 45. | "An index to measure rural diversity in the light of rural resilience and rural development debate" | (Quaranta & Salvia, 2014) | The literature provided a theoretical basis for selecting indicators reflecting rural areas' natural, social, economic, and institutional diversity. Indicators were selected to cover three perspectives: diversity of agricultural activities, non-agricultural activities, and economic activities. Specific indicators included cropping mix, irrigation water availability, farm size, educational level, land tenure, availability of territorial natural resources, farm diversification, employment profile, and land protection, among others. | The RDI was constructed without applying explicit weights to individual indicators. The study emphasized that the value of the RDI is influenced by the presence or absence of diversity attributes and their relative balance rather than specific weights. This approach was chosen to avoid introducing arbitrary elements into the analysis. |
| 46. | "Development of safety performance index for intercity buses: An exploratory factor analysis approach" | (Law <i>et al.</i> , 2017) | A thorough examination of existing literature was undertaken to identify pertinent risk indicators associated with intercity bus safety. Indicators were selected based on their analytical consistency, measurability, and importance to the studied phenomenon. Experts in road safety and transportation were consulted to validate the chosen indicators. Indicators within these domains were chosen based on their significance and data availability. | An EFA was employed to investigate the covariance correlations of the variables and extract latent components that explain these associations. Relevant components and their weights of intercity bus safety were identified using principal component factor extraction with Varimax (orthogonal) rotation. |
| 47. | "The Development of a Provincial Green and Happy Society Index in Thailand: The Richer You Are, the Happier You Are" | (Santipolwut, 2015) | The study applies the Index indicators based on a national approach, with adaptations to represent the specific circumstances of each provincial area. Indicators are classified into two categories: generic indicators (G) at the national level and specific indicators (S) that are chosen by the public and relevant authorities to represent well-being and happiness at the provincial level. | The index was calculated using simple and composite methods, resulting in an equally weighted Index. Different methods, including planning, strategy, and international benchmarks, were employed to calculate each indicator's benchmarks at both the national and provincial levels. A five-level classification of the Index was established according to the coefficient of variation (CV). The levels were determined by the CV, which allowed for differentiation between low, moderately low, moderate, moderately high, and high levels of Index. |

acquired to conduct quality and eligibility assessments. Ultimately, 48 high-quality articles met all the eligibility criteria.

Quality and eligibility assessment

The authors thoroughly reviewed all the full-text articles and included only those research papers that were of very high quality and most relevant to the methodology of developing an index.

Data Analysis

The information such as the title of the article developing an index, citation of the paper, methods to identify the indicators and the weightage of the indicators for developing an index is extracted from all the full-text articles of our dataset for SLR. Further, all the methods to identify the indicators and the weighting techniques are discussed in detail in Figure 1.

Results

The systematic review of literature on index development in social sciences revealed various methodologies and techniques employed across different studies. In order to provide a clear and concise summary of the findings, we have compiled the relevant studies that focus on index development, along with the methods used to identify indicators and the techniques applied for weighting these indicators. Table 1 outlines the key details of each study, including the title of the article, citation, methods to identify indicators, and the weighting techniques employed. This summary serves as a foundation for understanding the diverse approaches taken in developing indices within the social sciences.

Discussion

One of the key findings from this review is the variety of methodologies employed in the development of social science indices. The combination of literature reviews, expert consultations, and statistical techniques like PCA and the AHP underscores the multidisciplinary nature of index construction. Literature reviews and expert input are particularly important in the initial stages, ensuring that the selected indicators are both theoretically sound and contextually relevant. For example, the development of the India Patriarchy Index demonstrated how careful selection of culturally relevant indicators is crucial for capturing the nuances of complex social constructs (Singh *et al.*, 2022).

In terms of weighting techniques, the review identified equal weighting, PCA, and AHP as the most commonly used methods. Each technique has its strengths and limitations, which can significantly impact the final outcomes of the indices. Equal weighting is often preferred for its simplicity and comparability, but it may not always reflect the true importance of each indicator. PCA offers a data-driven approach that can effectively highlight the most significant

components, as seen in indices like the sustainable livelihood security index (Singh & Nayak, 2020). Meanwhile, AHP allows for nuanced weighting based on expert judgment, making it suitable for indices where qualitative insights are essential, such as the Sidewalk Block Pavement Condition Index (Kim *et al.*, 2019).

Limitations

While this systematic review offers valuable insights into the methodologies and weighting techniques used in the development of indices within the social sciences, several limitations must be acknowledged. First, the review is limited by the selection criteria, which focused exclusively on studies published in English and accessible through the Scopus database. This may have resulted in the exclusion of relevant studies published in other languages or indexed in other databases, potentially limiting the comprehensiveness of the review. Second, the studies included in this review vary widely in terms of their methodological rigor and transparency, particularly in the selection and weighting of indicators. This variability makes it challenging to draw definitive conclusions about the effectiveness of different approaches. Additionally, the reliance on published literature means that the review may be subject to publication bias, with a potential overrepresentation of studies reporting positive or significant findings. Finally, the heterogeneity of the indices reviewed—ranging from those focused on specific social phenomena to broader multidimensional indices—makes direct comparisons difficult. The diversity of contexts, objectives, and methodologies used across these studies further complicates the generalizability of the findings.

Conclusion

This systematic literature review has highlighted the diversity of methodologies and weighting techniques employed in the development of indices within the social sciences. The review underscores the complexity involved in selecting appropriate indicators and the importance of choosing suitable weighting techniques to ensure the accuracy and reliability of the indices. While equal weighting and PCA emerged as the most commonly used methods, other techniques such as the AHP and dynamic probabilistic approaches were also employed, reflecting the varying contexts and objectives of different studies. The findings of this review suggest that there is no one-size-fits-all approach to index development in the social sciences; instead, the choice of methodology and weighting technique should be tailored to the specific goals and data availability of each study. Moreover, this review highlights the need for greater transparency in the index development process, particularly in the selection and weighting of indicators, to enhance the validity and replicability of social science indices. Future research should focus on further refining

these methodologies, exploring the impact of different weighting techniques on index outcomes, and developing more sophisticated tools that can handle the complex, multidimensional nature of social phenomena. Additionally, there is a need for more comprehensive guidelines and best practices to assist researchers in navigating the challenges of index development, ensuring that these indices provide meaningful and actionable insights for policymakers and practitioners.

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