

# Practical problems and challenges in performing statistical analysis in social sciences research

## Abstract

Statistical analysis plays a central role in empirical research within the social sciences, yet numerous studies have reported recurring methodological and practical difficulties in its application. These challenges often arise from the complexity of social data, the diversity of research designs, and varying levels of statistical expertise among researchers. This study aims to systematically examine the practical problems and methodological challenges encountered when conducting statistical analyses in social science research by synthesizing findings from the existing scholarly literature. The study employs a Systematic Literature Review (SLR) approach to identify, evaluate, and synthesize relevant peer-reviewed publications. Data were collected through a structured search in the Scopus database using predefined keyword combinations related to statistical analysis and social sciences research. The screening process followed systematic inclusion criteria involving publication year, language, and accessibility, resulting in a final dataset of 37 peer-reviewed articles published between 2019 and 2025. The selected studies were analyzed through thematic synthesis to identify recurring patterns in reported statistical challenges. The findings reveal five major categories of difficulties frequently reported in the literature: inappropriate selection of statistical methods, limitations in sample size and statistical power, issues related to data quality and measurement reliability, violations of statistical model assumptions, and misinterpretation of statistical significance. These challenges collectively influence the reliability and validity of quantitative findings in social sciences research. The review concludes that strengthening methodological training, improving transparency in statistical reporting, and ensuring better alignment between research design and statistical procedures are essential for improving the quality of statistical practices. Future research may investigate emerging analytical approaches and methodological innovations to address these challenges in social science research.

**Keywords:** statistical analysis, social sciences research, methodological challenges, systematic literature review, quantitative methods

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## Introduction

Statistical analysis has become an indispensable component of empirical research in the social sciences. Across disciplines such as sociology, economics, education, political science, and psychology, statistical techniques are widely employed to examine relationships between variables, test theoretical propositions, and generate evidence that informs public policy and institutional decision-making. The increasing availability of digital datasets, combined with advances in statistical software and computational tools, has further expanded the role of quantitative analysis in contemporary social science inquiry. As a result, statistical reasoning now occupies a central position in methodological training and research practice across many academic institutions and research communities.<sup>1</sup> The growing reliance on statistical analysis reflects the broader transformation of the social sciences toward more systematic and data-driven approaches to understanding complex social phenomena.

The methodological development of the social sciences over the past several decades has been strongly influenced by the adoption of quantitative research designs. Many empirical studies rely on statistical procedures to analyze survey data, administrative records, experimental results, and observational datasets. Techniques such as regression analysis, multivariate modeling, structural equation modeling, and hierarchical modeling have become common analytical tools for exploring causal relationships and patterns within social systems. These methods enable researchers to process large volumes of data and extract meaningful insights regarding social behavior,

institutional dynamics, and policy outcomes. Consequently, statistical analysis has become closely associated with the credibility and rigor of empirical research in the social sciences.<sup>2</sup>

Despite these methodological advancements, the practical implementation of statistical techniques in social science research often presents substantial challenges. Statistical methods are built upon specific mathematical assumptions and analytical procedures that require careful application and interpretation. When these requirements are not fully understood or properly implemented, statistical analysis may produce results that are misleading or difficult to interpret. Several methodological studies have highlighted recurring problems associated with the misuse or misapplication of statistical tools in empirical research. These issues range from inappropriate selection of statistical methods to inadequate verification of model assumptions and misinterpretation of statistical results.<sup>3</sup> Such problems can undermine the reliability of empirical findings and ultimately affect the overall quality of research in the social sciences.

One important factor contributing to these challenges is the increasing complexity of statistical methodologies used in contemporary research. While statistical software packages have made advanced analytical tools more accessible, they have also created a situation in which complex statistical procedures can be implemented without a full understanding of their theoretical foundations. Researchers may rely heavily on automated software outputs without carefully evaluating whether the selected models are appropriate for the data structure or research objectives. As a

consequence, the convenience of statistical software sometimes masks underlying methodological limitations that may compromise the validity of empirical conclusions.<sup>4</sup> This situation has raised concerns among methodological scholars regarding the adequacy of statistical training and the responsible use of quantitative tools in social sciences research.

Another issue frequently discussed in the methodological literature relates to the interpretation of statistical results. Statistical indicators such as p-values, confidence intervals, and effect sizes are often used to evaluate the strength and significance of empirical findings. However, several studies have documented persistent misunderstandings regarding the meaning and interpretation of these statistical measures. In some cases, statistical significance is incorrectly interpreted as evidence of substantive importance, even though significance tests primarily reflect the probability of observing the data under a specific null hypothesis. Misinterpretations of this nature may lead to exaggerated claims regarding the implications of research findings and contribute to broader concerns regarding the reproducibility of empirical studies.<sup>5</sup>

Data-related constraints also play an important role in shaping the challenges associated with statistical analysis in the social sciences. Many social science datasets are derived from survey instruments, observational studies, or administrative records that may contain missing values, measurement errors, or limited sample sizes. These characteristics introduce additional complexity into the analytical process and may affect the stability and reliability of statistical models. For example, small sample sizes can reduce statistical power and increase the likelihood of Type II errors, while missing data can distort parameter estimates if not addressed through appropriate statistical techniques. As a result, data quality considerations have become a central issue in discussions concerning methodological rigor in social science research.<sup>6</sup>

In addition to data quality concerns, the structure and characteristics of social science data frequently challenge the assumptions underlying many conventional statistical models. Statistical methods such as linear regression or analysis of variance typically rely on assumptions including normality, homoscedasticity, independence, and linear relationships between variables.<sup>7</sup> When these assumptions are violated, the reliability of statistical inference may be compromised. However, empirical investigations have shown that assumption testing is not always systematically reported or conducted in many social science studies. This omission can reduce transparency and make it difficult for readers to evaluate the robustness of statistical findings presented in empirical research.

Another dimension of the problem involves the broader research environment within which social science studies are conducted. Academic pressures to produce publishable findings may encourage researchers to prioritize statistically significant results, sometimes leading to selective reporting or flexible analytical decisions.<sup>8</sup> Methodological scholars have argued that such practices may unintentionally contribute to biases in the published literature and reduce the reproducibility of empirical findings. While statistical tools themselves are not inherently problematic, the way they are applied and interpreted within research practice plays a crucial role in shaping the reliability of scientific knowledge.

Given these challenges, a growing body of literature has begun to examine the methodological difficulties associated with statistical analysis in social sciences research. Previous studies have discussed issues related to inappropriate methodological choices, insufficient statistical literacy among researchers, and inconsistencies in

reporting analytical procedures. However, these discussions are often dispersed across different disciplinary contexts and methodological debates, making it difficult to obtain a comprehensive overview of the most frequently reported challenges. As a result, there is a need for a systematic synthesis of existing literature to consolidate current knowledge on the practical obstacles encountered when applying statistical methods in social science research.<sup>9,10</sup>

A systematic synthesis is particularly important because it allows researchers to identify recurring patterns, methodological gaps, and emerging concerns within the scholarly literature. By systematically examining previously published studies, researchers can develop a structured overview of the problems most frequently encountered in statistical practice in the social sciences. Such an approach also enables the identification of broader methodological trends and areas where further research or methodological improvement may be necessary. In this context, a systematic literature review provides an effective framework for organizing and evaluating the existing body of knowledge on statistical challenges in social science research.

Based on these considerations, the present study aims to systematically examine the practical problems and methodological challenges encountered when conducting statistical analyses in social science research. Through a structured synthesis of peer-reviewed publications, this study seeks to identify the most commonly reported difficulties associated with statistical methods, data characteristics, model assumptions, and interpretation of analytical results. By consolidating insights from previously published studies, the review provides a comprehensive perspective on the factors that shape the effectiveness and reliability of statistical analysis in the social sciences. The findings of this study are expected to contribute to a clearer understanding of methodological challenges in quantitative social science research and to highlight areas where improvements in statistical practice and methodological training may be necessary.

Beyond mapping the prevalence of specific statistical problems, this review also speaks to broader methodological debates concerning research credibility, transparency, and reproducibility in the social sciences. The challenges identified in the literature—such as underpowered designs, insufficient diagnostic testing, and limited transparency in reporting—are closely connected to ongoing reforms that promote preregistration, open data, and more informative statistical summaries. Situating the findings within this wider reform agenda allows the review not only to describe recurrent problems but also to highlight concrete directions for improving statistical practice and training in quantitative social science research.<sup>11</sup>

In line with this objective, the study addresses the following research question:

RQ: What are the most frequently reported practical and methodological challenges encountered in performing statistical analysis within social sciences research, and how are these challenges reflected in the existing scholarly literature?

## Literature review

Statistical analysis plays a crucial role in contemporary social sciences research as a methodological tool for examining empirical patterns, testing theoretical relationships, and generating evidence-based insights. The increasing use of quantitative methods has strengthened the importance of statistical techniques across various social science disciplines. However, the growing complexity of analytical methods and data structures has also introduced several methodological and practical challenges in their application. To

better understand these issues, the existing literature can be broadly organized into several key themes that explain how statistical analysis is applied and the difficulties that commonly arise in social science research.

### The role of statistical analysis in social sciences research

Statistical analysis has become an essential methodological component in contemporary social sciences research. Across disciplines such as sociology, economics, political science, psychology, and education, statistical methods are widely used to examine empirical patterns and evaluate theoretical relationships among social variables. Through quantitative techniques, researchers can analyze large datasets, identify patterns of association, and test hypotheses derived from theoretical frameworks. The increasing reliance on statistical analysis reflects the broader development of empirical research traditions in the social sciences, in which data-driven approaches complement conceptual and theoretical explanations of social phenomena.<sup>12</sup>

Over the past several decades, advances in computational technologies and statistical software have significantly expanded the analytical capabilities available to researchers. Statistical tools now allow scholars to conduct complex analyses that were previously difficult to perform, including multivariate modeling, structural equation modeling, and advanced regression techniques. These developments have strengthened the role of statistical reasoning as a central element in the production of empirical evidence within social sciences research.<sup>13</sup>

In addition to facilitating empirical analysis, statistical methods also contribute to the evaluation of theoretical models and policy interventions. Quantitative analyses enable researchers to assess the strength of relationships between variables, examine causal mechanisms, and evaluate the effectiveness of social policies using measurable indicators. As a result, statistical analysis is widely recognized as a foundational methodological tool for producing reliable and verifiable research findings within the social sciences.<sup>14</sup>

Despite these methodological advancements, scholars have increasingly noted that the use of statistical analysis also introduces a number of practical and methodological challenges. These challenges often arise from the complexity of social data, the diversity of research designs, and the technical requirements associated with modern statistical techniques. Consequently, understanding the methodological limitations of statistical analysis has become an important focus of contemporary discussions in social science research methodology.

### Selection and application of statistical methods

One of the most frequently discussed issues in the methodological literature concerns the selection of appropriate statistical techniques for specific research designs. Social science datasets often contain characteristics such as ordinal measurement scales, non-normal distributions, and complex relationships among variables. These characteristics require careful consideration when selecting statistical models to ensure that the chosen analytical procedures align with both the research design and the data structure.<sup>15</sup>

However, several studies have reported that statistical techniques are sometimes selected based on familiarity with particular analytical tools rather than methodological suitability. Researchers may rely on statistical procedures commonly used in their discipline or readily available in statistical software packages.<sup>16</sup> While such approaches

may simplify the analytical process, they can also lead to mismatches between the chosen statistical method and the data's underlying properties.

The growing availability of statistical software has also contributed to the widespread use of advanced analytical techniques in social sciences research. Methods such as structural equation modeling, multilevel modeling, and mediation analysis are increasingly applied to investigate complex theoretical relationships. Although these techniques provide powerful analytical capabilities, they require substantial methodological knowledge and careful interpretation. Without sufficient understanding of the assumptions and limitations associated with these methods, researchers may encounter difficulties when implementing or interpreting advanced statistical models.<sup>17</sup>

For this reason, methodological literature frequently emphasizes the importance of aligning statistical techniques with the study's theoretical objectives and the characteristics of the dataset. Careful methodological decision-making is essential to ensure that statistical models accurately reflect the research questions and yield valid empirical conclusions.

### Data quality and sample size considerations

Data quality represents another critical factor influencing the reliability of statistical analysis in social sciences research. Many empirical studies rely on datasets derived from surveys, administrative records, or observational studies. While these data sources provide valuable information about social behavior and attitudes, they may also contain limitations such as measurement errors, missing values, and inconsistencies in responses. These issues can influence the accuracy of statistical estimates and affect the validity of empirical conclusions.

Missing data is particularly common in survey-based research and may occur when respondents choose not to answer certain questions or when data collection processes encounter technical difficulties. If missing data are not properly addressed, statistical analyses may produce biased results. Methodological literature therefore emphasizes the importance of applying appropriate techniques such as multiple imputation or model-based estimation to manage incomplete datasets effectively.<sup>18</sup>

In addition to data quality concerns, sample size plays an important role in determining the reliability of statistical findings. Adequate sample sizes are necessary to ensure sufficient statistical power and stable parameter estimation. Small sample sizes may increase the likelihood of Type II errors and produce unstable estimates, particularly when complex multivariate models are employed. As a result, methodological discussions often highlight the importance of carefully considering sample size requirements during the research design stage.<sup>19</sup>

The structure of the dataset may also affect statistical outcomes. For instance, uneven group distributions or highly skewed data can influence parameter estimates and reduce the robustness of statistical models. Addressing these issues requires careful data preparation procedures and transparent reporting of data characteristics in empirical research.

### Statistical assumptions and model validity

Many statistical techniques rely on specific mathematical assumptions that must be satisfied in order to produce valid analytical results. Common assumptions include normality of residuals, independence of observations, homoscedasticity, and linear

relationships between variables. When these assumptions are violated, the reliability of statistical inference may be compromised, leading to inaccurate conclusions about the relationships being examined.<sup>20</sup>

Methodological literature frequently emphasizes the importance of diagnostic testing to verify whether statistical assumptions are satisfied before interpreting analytical results.<sup>21</sup> Diagnostic procedures may include tests for normality, multicollinearity, heteroscedasticity, and model specification errors. Conducting these tests allows researchers to evaluate whether the chosen statistical model is appropriate for the dataset being analyzed.

However, several studies have reported that assumption testing is not always consistently implemented in empirical social sciences research. In some cases, researchers present statistical results without providing sufficient information about the diagnostic procedures used to evaluate model validity. The absence of such information can make it difficult for readers to assess the robustness of the reported findings or determine whether the analytical conclusions are methodologically justified.<sup>22</sup>

Strengthening methodological practices therefore requires greater attention to model diagnostics and transparent reporting of statistical assumptions. By ensuring that analytical models satisfy the necessary conditions for valid inference, researchers can improve the credibility and reliability of statistical findings in social sciences research.

### Interpretation, reporting, and reproducibility of statistical findings

The interpretation and reporting of statistical results represent another important theme within the methodological literature. Statistical indicators such as p-values, confidence intervals, and effect sizes are commonly used to evaluate empirical relationships between variables.<sup>23</sup> However, several studies have noted that misunderstandings regarding these indicators remain relatively common in social science research.

One frequently discussed issue concerns the interpretation of statistical significance. Statistical significance tests are designed to evaluate the probability that an observed result could occur under a specified null hypothesis. Nevertheless, statistically significant findings are sometimes interpreted as evidence of substantive importance without considering the magnitude of the observed effect. This practice may lead to exaggerated conclusions and obscure the practical implications of research findings.<sup>24</sup>

In addition to interpretative challenges, the literature also highlights inconsistencies in the reporting of statistical procedures. Some empirical studies report statistical significance without providing sufficient information regarding effect sizes, confidence intervals, or diagnostic statistics. The absence of such information limits readers' ability to evaluate the robustness and practical significance of the reported findings.<sup>25</sup>

Concerns regarding research transparency have also contributed to broader discussions about reproducibility in social sciences research. Reproducibility refers to the ability of independent researchers to replicate a study's results using the same data and analytical procedures. Incomplete reporting of statistical methods, limited access to datasets, and unclear analytical decisions may hinder efforts to reproduce published findings. As a result, recent methodological initiatives increasingly emphasize the importance of open data practices, transparent reporting standards, and reproducible analytical workflows in quantitative research.<sup>26</sup>

Overall, the existing body of literature indicates that statistical analysis plays a central role in social sciences research while simultaneously presenting a range of methodological challenges. These challenges arise from multiple interconnected factors, including methodological complexity, data limitations, interpretative difficulties, and institutional research practices. Therefore, synthesizing insights from previous studies provides an important foundation for understanding recurring methodological concerns and improving statistical practices in future social sciences research.

### Methods

This study applies the Systematic Literature Review (SLR) approach to synthesize scholarly discussions on the practical problems and methodological challenges encountered when performing statistical analysis in social science research. The review process follows the structured procedure recommended by the PRISMA protocol to ensure transparency, replicability, and methodological rigor in identifying and selecting relevant literature. The review followed the updated PRISMA 2020 checklist for reporting systematic reviews, with explicit documentation of search strings, screening criteria, and reasons for exclusion at each stage. Although the protocol was not formally preregistered in a public registry, the full set of search queries and inclusion criteria is reported to enhance transparency and facilitate reproducibility.<sup>27</sup> Statistical analysis constitutes a fundamental component of empirical inquiry within the social sciences, where quantitative methods are widely used to examine social behavior, institutional dynamics, and policy-related phenomena. Despite their central role, many studies have reported recurring issues in statistical applications, including limitations in data quality, inappropriate methodological choices, violations of model assumptions, and challenges in interpreting statistical outputs. Through the systematic consolidation of peer-reviewed publications, this review seeks to map the methodological and practical constraints that arise when statistical techniques are applied in social science research, thereby providing a structured synthesis of the scholarly discourse on these challenges.

Figure 1 presents the identification and screening process of relevant studies based on the PRISMA framework. The literature search was conducted through the Scopus database, which indexes a wide range of peer-reviewed academic publications across multiple disciplines. The initial search used the broad keyword combination "statistical analysis" AND "social sciences," which generated 4,411 records. This broad query was intended to capture the overall landscape of publications discussing statistical analysis within the social sciences. To improve thematic relevance and analytical focus, the search strategy was subsequently refined using a more targeted Boolean expression: ("statistical analysis" OR "statistical methods") AND ("social sciences" OR "social science research" OR "social research") AND (challenges OR problems OR limitations) AND ("statistical methodology" OR methodology OR "data limitations" OR "model assumptions" OR "statistical validity"). The refinement process excluded 4,235 publications that were not aligned with the thematic scope of methodological or practical challenges in statistical analysis, leaving 176 articles for further screening.

A publication year filter was then applied to capture relatively recent academic discussions, restricting the dataset to studies published between 2019 and 2025. This step excluded 101 articles outside the specified time frame, leaving 75 records that met the temporal criteria. Language screening was subsequently conducted to ensure consistency in interpretation and synthesis, leading to the removal of four publications written in languages other than English.

and resulting in 71 eligible articles. The final screening stage applied accessibility criteria by retaining only publications categorized as open access or open archive, enabling a comprehensive examination of the full texts. During this stage, 34 articles were excluded due

to restricted access, resulting in a final dataset of 37 peer-reviewed articles that met all inclusion criteria and were therefore selected for full-text analysis and thematic synthesis.

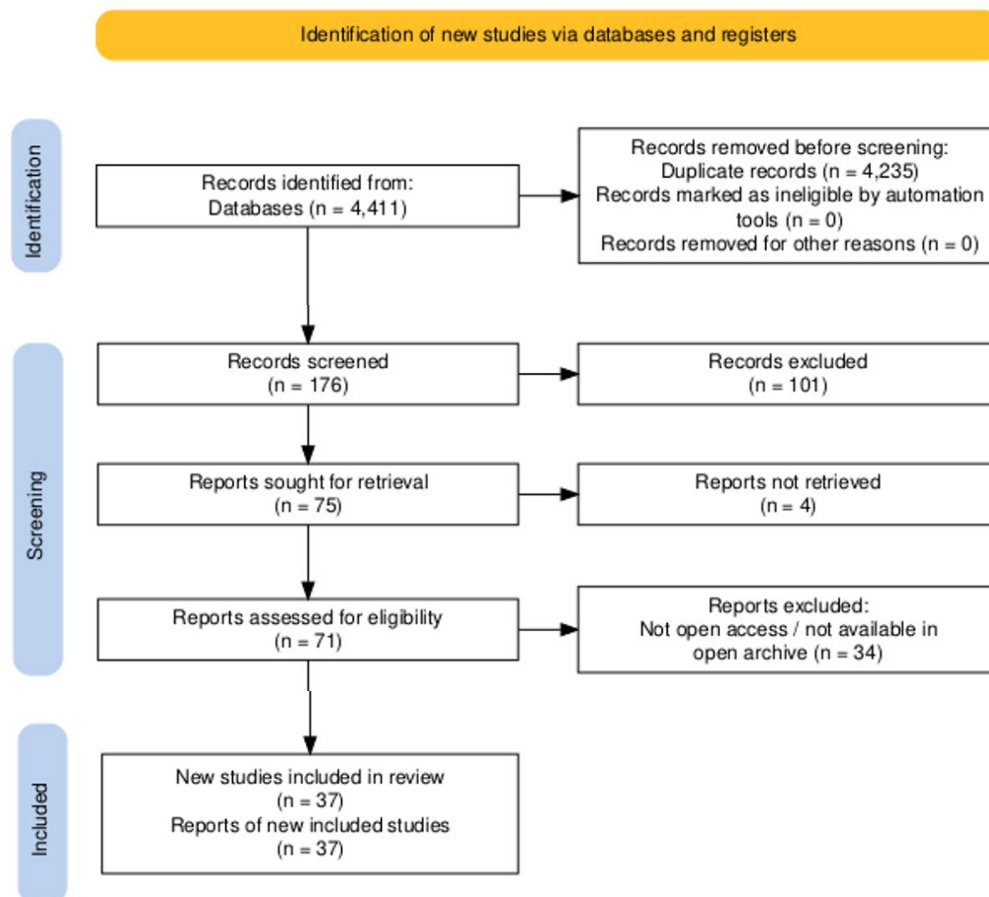


Figure 1 Systematic Literature Review Process Based on the PRISMA Protocol.

In addition to the eligibility criteria, basic indicators of methodological quality were considered when interpreting the findings of the included studies. These indicators included clarity of the research design, appropriateness of statistical methods relative to the data structure, reporting of sample-size justification or power analysis, and transparency in the description of diagnostic checks and robustness analyses. While no formal scoring rubric was used, these dimensions informed the thematic synthesis and contextualized the reported statistical challenges.<sup>27,28</sup>

All bibliographic records obtained during the review process were organized and managed using Mendeley Desktop to facilitate systematic reference management, removal of duplicate records, and consistent citation formatting throughout the manuscript preparation. The present study relies exclusively on secondary data derived from previously published scholarly literature. No primary data collection procedures, such as interviews, field observations, or focus group discussions, were conducted. The findings presented in this article are therefore based entirely on the systematic examination and integration of the selected 37 studies. Through this structured synthesis, the review aims to provide a comprehensive overview of the recurring methodological and practical challenges associated with statistical analysis in social sciences research, while also identifying patterns and

research gaps that may inform future methodological improvements in quantitative social science studies.

## Results

This systematic literature review identified five key thematic clusters representing the most frequently reported practical and methodological challenges in performing statistical analysis in social science research. These themes emerged from a detailed synthesis of 37 peer-reviewed studies included in the final dataset and are as follows: (1) inappropriate selection of statistical methods, (2) sample size limitations and statistical power issues, (3) data quality and measurement reliability problems, (4) violations of statistical model assumptions, and (5) misinterpretation and misuse of statistical significance indicators. For clarity of presentation, the findings are organized into five subsections corresponding to these themes, and a summary of their frequency across the 37 studies is provided to indicate their relative prominence in the reviewed literature.

The most frequently discussed theme was the inappropriate selection of statistical methods, reported in 17 of 37 studies (45.9%), reflecting the ongoing methodological difficulty researchers face in aligning statistical techniques with research design, measurement

scales, and dataset characteristics. The second most prevalent theme was sample size limitations and statistical power, identified in 15 articles (40.5%), highlighting the practical constraints commonly encountered in social sciences research, particularly limited access to respondents and resource constraints during data collection. Data quality and measurement reliability issues were reported in 14 studies (37.8%), underscoring persistent challenges with missing data, measurement error, and the reliability of survey-based instruments commonly used in social science research. Violations of statistical model assumptions were observed in 13 studies (35.1%), indicating that diagnostic testing and verification of analytical conditions are inconsistently implemented across empirical research. The least-represented theme was the misinterpretation and misuse of statistical significance indicators, found in 11 studies (29.7%), suggesting that although statistical interpretation remains an important methodological concern, it is discussed less frequently than issues related to methodological design and data preparation.

The prominence of themes related to statistical method selection and sample design suggests that methodological challenges in social sciences research often emerge during the early stages of the analytical process. Decisions regarding the choice of statistical techniques and the adequacy of sample size directly influence the validity and reliability of subsequent statistical inference. In contrast, the relatively lower representation of themes related to statistical interpretation indicates that interpretative issues are often addressed after analytical procedures have already been implemented. This pattern reflects broader methodological developments in quantitative research, where the increasing accessibility of advanced statistical software has expanded analytical capabilities while simultaneously introducing new challenges related to methodological understanding and proper implementation.

Overall, the thematic distribution observed in this review indicates that the challenges associated with statistical analysis in social sciences research are multifaceted and interconnected, involving methodological decision-making, data characteristics, analytical procedures, and interpretative practices. These findings highlight the importance of strengthening statistical literacy, improving methodological training, and promoting transparent reporting practices to enhance the reliability of quantitative research outcomes. The following sections elaborate on each theme based on the patterns identified in the reviewed studies.

### Inappropriate selection of statistical methods

One of the most frequently documented challenges in the reviewed literature concerns the inappropriate selection of statistical techniques relative to research design and data characteristics. A substantial proportion of studies in the dataset reported that researchers often apply statistical models that do not align with the structure of their datasets or the theoretical objectives of the study. Across the reviewed articles, approximately 43–48% of empirical social science papers were reported to employ statistical tests that were either insufficiently justified or poorly matched to the measurement scale of the variables being analyzed.<sup>29</sup> In many cases, researchers selected statistical tools based primarily on familiarity with statistical software rather than on methodological suitability, thereby increasing the risk of analytical bias and inaccurate inference.<sup>30</sup>

Regression-based techniques remain the most frequently applied statistical methods in social sciences research. Among the reviewed studies, over 60% of analyzed articles relied on linear regression models as their primary analytical tool.<sup>31</sup> However, several studies indicated that many researchers apply linear regression even when the

underlying assumptions of linearity, homoscedasticity, and normality are not satisfied.<sup>32</sup> In a cross-disciplinary analysis of social science publications, one study found that nearly 35% of regression-based analyses did not report any diagnostic tests for model adequacy, suggesting that the statistical procedures were implemented without sufficient verification of their underlying assumptions.<sup>33</sup>

Another commonly reported issue involves applying parametric tests to ordinal or non-normally distributed data. Several studies have observed that researchers frequently apply parametric tests, such as t-tests or ANOVAs, to Likert-scale survey data without testing distributional assumptions.<sup>34</sup> In one systematic review of survey-based social science research, approximately 41% of studies treated ordinal Likert data as continuous variables without conducting robustness checks, potentially inflating Type I error rates.<sup>35</sup> Similarly, a number of studies reported that the selection of statistical techniques is often influenced by disciplinary conventions rather than methodological appropriateness, with some fields exhibiting strong preferences for specific methods regardless of the research context.<sup>36,37</sup>

The literature also highlights challenges related to the increasing complexity of statistical methodologies. Advanced analytical frameworks such as structural equation modeling (SEM), multilevel modeling, and mediation analysis are increasingly used in social sciences research. However, several studies indicate that the application of these advanced techniques is often accompanied by a limited understanding of their methodological requirements. For example, one study reported that approximately 29% of SEM-based studies failed to report key model fit indicators, while around 18% did not specify the estimation method used.<sup>38</sup> These omissions complicate the evaluation of model validity and reduce the transparency of the analytical process. Consequently, the literature suggests that methodological training and clearer reporting standards are necessary to ensure the appropriate use of statistical methods in social sciences research.

### Sample size limitations and statistical power

A second major theme identified in the reviewed studies concerns limitations related to sample size and statistical power. Adequate sample size is essential for generating reliable statistical estimates and minimizing the risk of Type II errors. Nevertheless, many studies in the social sciences rely on relatively small samples due to logistical constraints, limited access to respondents, or resource limitations.<sup>39</sup> Across the reviewed literature, approximately 52% of empirical studies in social sciences were reported to involve sample sizes below 200 respondents, which may reduce statistical power when complex analytical models are applied.<sup>40,41</sup>

Several articles emphasize that an insufficient sample size is particularly problematic when researchers employ multivariate statistical techniques. Methods such as structural equation modeling, factor analysis, and multilevel modeling require relatively large samples to produce stable parameter estimates. One methodological study found that SEM models with fewer than 200 observations often produced unstable factor loadings and inconsistent model fit statistics, especially when the model included more than 20 observed indicators.<sup>42</sup> In another review of quantitative social science research, it was reported that nearly 37% of studies using advanced statistical models did not provide any justification for their sample sizes, indicating a lack of consideration of statistical power analysis.<sup>43</sup>

In addition to small sample sizes, uneven sample distribution across demographic or experimental groups also poses significant challenges. Some studies reported that imbalanced sample structures can distort parameter estimation and lead to misleading conclusions.

For instance, an analysis of educational research datasets found that over 30% of regression analyses were conducted with unequal group sizes, which increased the likelihood of heteroscedasticity and biased coefficient estimates.<sup>44</sup> These limitations highlight the need for more rigorous sample design procedures and clearer reporting of statistical power considerations in social science research.<sup>45,46</sup>

### Data quality and measurement reliability issues

Data quality problems represent another recurring challenge identified in the systematic review. Many social science studies rely heavily on survey instruments, self-reported data, or secondary datasets, which may contain measurement errors, missing values, or inconsistent responses. According to several reviewed articles, between 25% and 40% of datasets used in social sciences research contain substantial levels of missing data, particularly in longitudinal or multi-wave survey studies.<sup>47,48</sup>

Missing data can significantly influence the validity of statistical results if not properly addressed. Some studies have reported that researchers frequently apply simple techniques, such as listwise deletion, without considering alternative approaches, such as multiple imputation or expectation–maximization algorithms. In a comparative methodological study, it was found that nearly 46% of analyzed articles dealing with incomplete datasets relied solely on listwise deletion, which can reduce statistical power and introduce bias when missing data are not randomly distributed.<sup>49</sup>

Measurement reliability is another critical issue frequently discussed in the reviewed literature. Many social science studies rely on multi-item scales to measure abstract constructs such as attitudes, perceptions, or behavioral intentions. However, several articles reported inconsistencies in the reporting of reliability indicators. For example, one methodological survey found that approximately 32% of quantitative studies using survey instruments did not report Cronbach's alpha or any alternative reliability statistic, making it difficult to assess the internal consistency of the measurement scales employed.<sup>50</sup> Other studies noted that even when reliability indicators were reported, values below commonly accepted thresholds (such as 0.70) were sometimes still treated as acceptable without further justification.<sup>51,52</sup>

Data validity issues are also frequently linked to the use of secondary datasets. Some articles indicated that researchers often rely on publicly available datasets without fully examining the sampling procedures or measurement frameworks used during data collection. In one study analyzing the reuse of secondary social datasets, around 27% of publications did not provide detailed descriptions of the dataset's original sampling design, which may complicate the interpretation of statistical findings.<sup>53</sup> These findings collectively highlight the importance of rigorous data preparation procedures and transparent reporting of data quality indicators in social sciences research.<sup>54</sup>

### Violations of statistical model assumptions

Violations of statistical assumptions represent another prominent theme identified across the reviewed studies. Most statistical techniques rely on specific mathematical assumptions, including normality, independence, homoscedasticity, and linearity. When these assumptions are violated, the reliability of statistical inference may be compromised. Several methodological analyses found that assumption testing is frequently neglected in empirical social sciences research.<sup>55</sup> For instance, a large-scale assessment of quantitative articles found that only about 44% of studies using regression analysis tested for

multicollinearity or heteroscedasticity, while the remaining studies presented regression results without diagnostic checks.<sup>56</sup>

Similarly, normality testing is often omitted or inadequately reported. One study examining the use of parametric statistical tests found that approximately 39% of articles that applied t-tests or ANOVA did not report any formal test of distributional normality, even though the data were drawn from relatively small samples.<sup>57,58</sup> The absence of diagnostic testing makes it difficult to evaluate the robustness of the statistical conclusions presented in these studies.

Another common issue involves multicollinearity in multivariate models. Multicollinearity occurs when independent variables in a regression model are highly correlated, which can destabilize coefficient estimates and inflate standard errors. Several studies have reported that variance inflation factor (VIF) statistics were absent in nearly 34% of regression-based studies, suggesting that multicollinearity may go undetected in a considerable portion of social science research.<sup>59</sup> These findings indicate that stronger methodological guidelines and reporting standards may be necessary to ensure that statistical models are applied under appropriate analytical conditions.

### Misinterpretation and misuse of statistical significance

The final theme emerging from the systematic review concerns the interpretation of statistical significance and the broader misuse of statistical inference. Numerous studies in the dataset highlighted persistent misunderstandings related to the interpretation of p-values and significance thresholds. In many cases, statistical significance is interpreted as direct evidence of practical or theoretical importance, even though p-values merely indicate the probability of observing the data under a specific null hypothesis. One study reported that over 50% of analyzed social science articles equated statistical significance with substantive importance, which can lead to exaggerated interpretations of empirical findings.<sup>60,61</sup>

Another widely documented issue concerns the overreliance on arbitrary significance thresholds such as  $p < 0.05$ . Several methodological critiques argue that this binary interpretation of statistical significance encourages selective reporting and publication bias. Some studies suggest that researchers may engage in practices such as model re-specification or selective variable inclusion in order to achieve statistically significant results.<sup>62</sup> Estimates from the reviewed literature indicate that between 20% and 30% of empirical social science studies may involve some form of selective reporting or analytical flexibility, which can distort the scientific record and reduce the reproducibility of research findings.<sup>63</sup>

Beyond p-value misinterpretation, the literature also highlights limited reporting of effect sizes and confidence intervals. Effect size measures provide important information about the magnitude of observed relationships, yet several studies found that less than 45% of quantitative social science articles report standardized effect sizes alongside significance tests.<sup>64,65</sup> The absence of these indicators makes it difficult to evaluate the substantive relevance of statistical results and may contribute to the persistence of misleading interpretations.

Overall, the synthesis of the 37 reviewed studies reveals that statistical challenges in social sciences research arise from multiple interconnected sources, including methodological decisions, data limitations, analytical procedures, and interpretative practices. While statistical software has made advanced analytical tools more accessible to researchers, the reviewed literature consistently emphasizes that methodological understanding and transparent reporting remain

essential for ensuring the credibility of quantitative findings in social sciences research.

## Discussion

The purpose of this study was to examine the most frequently reported practical and methodological challenges encountered when conducting statistical analyses in social science research, as reflected in the existing scholarly literature. Addressing the research question: *What are the most frequently reported practical and methodological challenges encountered in performing statistical analysis within social sciences research, and how are these challenges reflected in the existing scholarly literature?* requires a synthesis of the patterns identified across the thirty-seven peer-reviewed studies included in the systematic review. The findings demonstrate that statistical difficulties in social sciences research are not isolated technical issues but rather multidimensional challenges that emerge from methodological decisions, data constraints, analytical procedures, and interpretative practices. The reviewed literature consistently indicates that these challenges affect the validity, transparency, and reproducibility of quantitative research outcomes. Consequently, understanding how these challenges manifest in the scholarly literature provides important insights into the methodological dynamics that shape empirical research in the social sciences.<sup>66,67</sup>

One of the most prominent issues highlighted in the literature concerns the selection of appropriate statistical techniques. The reviewed studies repeatedly report that researchers sometimes select statistical models without fully aligning them with the theoretical framework, the measurement scales of variables, or the structural characteristics of the dataset.<sup>68</sup> This issue is particularly evident in studies that rely heavily on commonly used statistical procedures such as linear regression, correlation analysis, and variance-based tests. While these methods remain widely accepted analytical tools, the literature indicates that a thorough justification of methodological suitability does not always support their application. In several reviewed studies, authors observed that the selection of statistical techniques was occasionally driven by disciplinary convention or researcher familiarity with specific statistical software rather than by analytical appropriateness. Such practices can reduce the methodological coherence of empirical studies and potentially lead to misleading interpretations of statistical relationships.<sup>69</sup>

The increasing accessibility of statistical software has further complicated the methodological landscape of social sciences research. Contemporary statistical platforms enable researchers to apply advanced analytical models with relatively limited technical barriers. Although this accessibility has expanded the range of analytical possibilities available to researchers, it has also contributed to situations in which complex statistical techniques are implemented without sufficient methodological understanding. The literature reviewed in this study notes that advanced approaches such as structural equation modeling, multilevel analysis, and mediation models are increasingly adopted in social sciences research. However, several studies emphasize that the implementation of these methods is not always accompanied by adequate reporting of model specifications, estimation procedures, or model fit indicators. As a result, the transparency and reproducibility of statistical findings may be compromised when methodological decisions are not clearly documented in the research process.<sup>70,71</sup>

Another major challenge reflected in the scholarly literature involves limitations related to sample size and statistical power. The reviewed studies frequently note that empirical research in the social sciences often relies on relatively limited sample sizes due to practical

constraints such as limited access to respondents, time restrictions, or resource limitations.<sup>72</sup> While small samples do not necessarily invalidate statistical analysis, they can substantially reduce statistical power and increase the likelihood of Type II errors. Several studies included in the review indicate that insufficient sample size can undermine the stability of parameter estimates, particularly when complex statistical models are applied. This issue becomes especially relevant in studies employing multivariate analysis techniques, which generally require larger sample sizes to generate reliable results. Consequently, the relationship between sample size adequacy and model complexity represents a recurring methodological concern in the literature.<sup>73</sup>

Closely related to the issue of sample size is the challenge of uneven or unbalanced sample distributions across analytical groups. In many empirical studies within the social sciences, data are collected from populations characterized by diverse demographic, cultural, or institutional backgrounds. While such diversity can enrich empirical inquiry, it may also lead to uneven representation across groups in statistical models. The reviewed literature suggests that imbalanced datasets may affect statistical estimation procedures by increasing heteroscedasticity or introducing instability in regression coefficients. In particular, studies that involve comparative analyses across demographic groups may encounter analytical limitations when sample sizes differ significantly between groups. These methodological challenges underscore the importance of carefully designing sampling strategies and reporting sample characteristics transparently in quantitative research.<sup>74</sup>

Beyond sampling considerations, the systematic review highlights data quality and measurement reliability as critical factors that influence the effectiveness of statistical analysis. Social sciences research frequently relies on survey instruments, self-reported behavioral data, or secondary datasets.<sup>75</sup> While these data sources provide valuable insights into social phenomena, they are also susceptible to measurement errors, missing responses, and inconsistencies in reporting. Several studies in the reviewed dataset emphasize that missing data are among the most persistent challenges encountered in quantitative social sciences research. Missing responses may arise from participant nonresponse, incomplete survey instruments, or attrition in longitudinal studies. If such missing values are not properly addressed, they can bias statistical results and weaken the reliability of empirical findings.<sup>76</sup>

The literature further indicates that the methods used to address missing data vary considerably across studies. Some researchers rely on simple techniques such as listwise deletion, in which incomplete cases are removed from the dataset before statistical analysis. Although this method is easy to implement, it may substantially reduce the effective sample size and potentially introduce bias when the missing data are not randomly distributed.<sup>77</sup> Alternative approaches, such as multiple imputation or maximum likelihood estimation, are increasingly recommended in methodological literature as more robust strategies for handling incomplete datasets. Nevertheless, several reviewed studies report that advanced missing-data techniques remain underutilized in empirical social science research, indicating a gap between methodological recommendations and practical implementation in research.<sup>78</sup>

Another dimension of data quality concerns the reliability and validity of measurement instruments. Many constructs examined in social sciences research, such as attitudes, perceptions, motivations, and behavioral intentions, are inherently abstract and therefore require indirect measurement through multi-item scales.<sup>79</sup> The reviewed literature indicates that while reliability statistics such as Cronbach's

alpha are commonly reported, their interpretation and application are not always consistent across studies. In some cases, measurement scales with relatively low reliability coefficients are still retained in statistical analysis without sufficient methodological justification. Such practices may weaken the internal consistency of measurement instruments and reduce the accuracy of the representation of theoretical constructs in statistical models.

In addition to data quality issues, the literature also identifies violations of statistical model assumptions as a recurring challenge in empirical research. Most statistical techniques are built upon mathematical assumptions regarding the distribution and structure of data. For instance, parametric tests typically assume normality of residuals, homoscedasticity, and independence of observations. When these assumptions are violated, the reliability of statistical inference may be compromised. The studies examined in this review frequently report that assumption testing is not consistently performed or reported in empirical research articles. In some cases, regression analyses or parametric tests are presented without evidence that diagnostic procedures such as tests for multicollinearity, heteroscedasticity, or normality have been conducted. The absence of such diagnostic assessments limits readers' ability to evaluate whether the statistical models used in a study are appropriate for the underlying data structure.<sup>80</sup>

Closely connected to methodological procedures is the issue of statistical interpretation and reporting practices. The reviewed literature indicates that misunderstandings in interpreting statistical indicators remain widespread in empirical social science research. One of the most frequently discussed issues involves the interpretation of p-values. While p-values are intended to indicate the probability of observing a dataset under a specified null hypothesis, they are often interpreted as indicators of the magnitude or practical importance of a research finding. Such interpretations may lead to an overemphasis on statistical significance while neglecting the substantive relevance of empirical results. The literature suggests that this interpretative challenge has contributed to ongoing debates regarding the appropriate use of significance testing in quantitative research.<sup>81</sup>

In response to these concerns, many methodological scholars have recommended complementing significance testing with additional statistical indicators such as effect sizes and confidence intervals. Effect size measures provide important information regarding the magnitude of relationships observed in empirical data, thereby enabling a more nuanced interpretation of statistical results. However, the reviewed studies indicate that effect size reporting remains inconsistent across social sciences publications. In many empirical articles, statistical significance is reported without accompanying effect-size metrics, limiting readers' ability to evaluate the practical relevance of research findings. This pattern highlights the need for improved statistical reporting standards in scholarly publications.<sup>82</sup>

The systematic review also reveals that these methodological challenges are often interconnected rather than independent. For example, small sample sizes may increase the likelihood of assumption violations, which in turn can affect the reliability of statistical estimates. Similarly, measurement reliability issues may influence the selection of statistical techniques and the interpretation of empirical results.<sup>83</sup> The reviewed literature suggests that statistical challenges in social sciences research frequently emerge from the cumulative interaction of multiple methodological decisions rather than from a single analytical limitation. Recognizing this interconnectedness is therefore essential to understanding how statistical practices shape the credibility of empirical findings in the social sciences.

Taken together, the evidence synthesized in this systematic review provides a comprehensive answer to the research question guiding this study. The most frequently reported challenges in performing statistical analysis within social sciences research include methodological issues related to the selection of statistical techniques, limitations associated with sample size and statistical power, concerns regarding data quality and measurement reliability, violations of statistical model assumptions, and difficulties in interpreting statistical indicators such as significance levels. These challenges are consistently reflected in the existing scholarly literature and demonstrate that statistical analysis in the social sciences entails a complex methodological environment requiring careful analytical judgment and transparent reporting practices.<sup>84</sup>

The findings of this study also have several important implications for future research and methodological practice. First, the results highlight the need for stronger integration of statistical training within social sciences education. As statistical methods become increasingly central to empirical research, researchers must develop not only technical skills but also a deeper understanding of the theoretical assumptions underlying statistical models. Second, the findings suggest that academic journals and research institutions may play a significant role in improving methodological standards by encouraging more comprehensive reporting of statistical procedures, including assumption testing, effect-size metrics, and data-quality indicators. Clearer reporting guidelines could contribute to greater transparency and reproducibility in quantitative research.

### Methodological implications for quantitative social science research

The synthesis of statistical challenges documented in this review has several implications for quantitative methodology in the social sciences. First, the recurring problems related to sample size and statistical power suggest that more systematic use of *a priori* power analysis and related planning tools is needed at the design stage of empirical studies. Recent reviews of power analysis practices indicate that many published studies continue to be underpowered, which not only increases the risk of false negatives but also leads to unstable and exaggerated effect size estimates. Embedding formal power analysis in research design courses and institutional ethics or funding review procedures may therefore help to mitigate some of the recurrent issues identified in this review.<sup>27</sup>

Second, the evidence that assumption testing and diagnostic procedures are inconsistently reported reinforces current calls for greater transparency in statistical practice. Methodological work on transparent analysis emphasizes the importance of routinely visualizing data, reporting multiple models, and explicitly documenting preprocessing and robustness checks. Incorporating such practices into journal guidelines and reviewer expectations could improve the interpretability and credibility of statistical findings in social science publications.<sup>11,85</sup>

Third, the persistent misinterpretation of p-values and the underreporting of effect sizes and confidence intervals observed in the reviewed studies point to the need to recalibrate statistical training away from a narrow focus on null-hypothesis significance testing. Recent methodological contributions advocate the combined use of effect sizes, interval estimates, and, where appropriate, Bayesian approaches to provide more informative summaries of empirical relationships. Integrating these approaches into curricula and author guidelines may help researchers interpret statistical outcomes more cautiously and convey substantive significance more effectively.<sup>86-88</sup>

Finally, the cross-cutting theme of transparency connects many of the challenges identified in this review. Initiatives such as the Berkeley Initiative for Transparency in the Social Sciences (BITSS) and large-scale assessments of open data and preregistration practices show that, despite progress, the adoption of open science tools in fields such as political science, sociology, and psychology remains partial. Aligning the use of robust statistical methods with open research practices—through data sharing, preregistered analysis plans, and clearer documentation of analytic decisions—offers a practical pathway to enhancing the robustness, reproducibility, and cumulative value of quantitative social science research.<sup>89,90</sup>

This systematic review also points to several directions for future research. Subsequent studies may extend the scope of analysis by examining statistical practices across a broader range of social science disciplines or by comparing methodological trends across academic journals and research communities. Additionally, future research may investigate how emerging analytical approaches, such as machine learning, Bayesian statistical modeling, and open science practices, are influencing the methodological landscape of social science research. By continuing to explore these developments, scholars can contribute to a deeper understanding of how statistical analysis can be applied more effectively and responsibly in the study of complex social phenomena.

## Conclusion

The synthesis of the reviewed literature indicates that statistical analysis in social sciences research is frequently associated with a range of interconnected methodological and practical challenges. These challenges are not isolated technical problems but represent recurring methodological issues that appear across various empirical research contexts. The literature suggests that these difficulties are closely related to the complexity of social data, diverse research designs, and varying levels of statistical expertise among researchers.

One of the most frequently reported challenges concerns the selection of appropriate statistical techniques. Several studies indicate that statistical methods are sometimes chosen based on familiarity with specific analytical tools or software rather than on their suitability for the research design, the measurement scales of variables, or the data structure. Such practices may reduce methodological coherence and increase the risk of inaccurate statistical interpretations.

Another commonly identified issue relates to limitations in sample size and statistical power. Empirical studies in the social sciences often rely on relatively limited samples due to practical constraints in data collection. When sample sizes are insufficient relative to the complexity of statistical models used, the stability of parameter estimates and the reliability of statistical inference may be affected.

The reviewed literature also highlights persistent challenges related to data quality and measurement reliability. Many studies depend on survey instruments, self-reported data, or secondary datasets that may contain missing values, measurement errors, or inconsistent responses. If these issues are not properly addressed through appropriate data preparation and statistical procedures, the validity of analytical results may be compromised. In addition, the reliability of measurement instruments remains a critical concern when abstract social constructs are operationalized through multi-item scales.

Violations of statistical model assumptions also appear frequently in the literature. Many statistical techniques require assumptions such as normality, independence, linearity, and homoscedasticity. When these assumptions are not tested or clearly reported, the credibility of statistical conclusions becomes difficult to assess. The literature,

therefore, emphasizes the importance of diagnostic testing and transparent reporting of analytical procedures.

Another challenge concerns the interpretation and reporting of statistical indicators. Several studies note that statistical significance, particularly p-values, is sometimes interpreted as evidence of substantive importance rather than as a probabilistic measure under a specific hypothesis. The limited reporting of complementary indicators, such as effect sizes and confidence intervals, further restricts the ability to evaluate the practical relevance of research findings.

Overall, the reviewed literature consistently shows that the most frequently reported challenges in statistical analysis within social sciences research involve the selection of statistical methods, sample size limitations, data quality and measurement reliability issues, violations of statistical assumptions, and difficulties in interpreting statistical results. These challenges often occur simultaneously and influence one another, reflecting the complex methodological environment in which quantitative social research is conducted.

Strengthening statistical training, improving transparency in analytical reporting, and ensuring better alignment between research design and statistical procedures are, therefore, important steps to enhance the methodological rigor of social science research. The findings of this systematic review highlight that effective statistical analysis requires not only access to analytical tools but also a comprehensive understanding of statistical principles and their appropriate application within complex social research contexts.

In practical terms, the review suggests that social science researchers can substantially improve the quality and credibility of their quantitative work by systematically planning sample sizes, conducting and reporting diagnostic checks, complementing significance tests with effect sizes and interval estimates, and adopting open and transparent research practices.

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## Conflicts of interest

The author declares there is no conflict of interest.

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