

# SATISTICAL DATA ANALYSIS AS A TOOL FOR EVIDENCE- BASED RESEARCH

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## Abstract

*“Without data, you’re just another person with an opinion.”*

*- W. Edwards Deming*

The importance of statistical data analysis as a key tool for advancing evidence-based research is examined in this paper. Statistical techniques are essential in today's research environment for converting unstructured data into insightful knowledge that supports sensible findings and sensible strategies. The study highlights the necessity for scientifically based methods while addressing the dearth of empirical rigor in some fields of social and policy research. Its primary goal is to investigate the ways in which statistical tools support data-driven policymaking by improving the validity, accuracy, and trustworthiness of research findings. The study illustrates how the appropriate use of statistical analysis can close the gap between theory and practice through a review of the literature, case studies, and the development of a conceptual model. The results imply that statistical analysis not only improves research accuracy but also facilitates well-informed decision-making and efficient use of resources, which eventually results in more impactful and transparent policy frameworks.

**Keywords:** Statistical Analysis, Evidence-Based Research, Data Analytics, Policy Decision-Making, Empirical Methods, Research Methodology, Data Interpretation.

## 1. Introduction

In the current era of research and policymaking, statistical data analysis has become a crucial instrument for guaranteeing the precision, impartiality, and dependability of results. It converts unstructured data into knowledge that makes sense and informs defensible choices. Such analytical methods are crucial to evidence-based research because they allow for the measurement of correlations within data, the identification of patterns, and the validation of hypotheses. Researchers can reduce prejudice, build trust, and give policy-making and social planning a strong empirical basis by using statistical tools. Therefore, fostering data-driven, evidence-based research and expanding knowledge depend heavily on knowing and applying statistical analysis.

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## 1.1 Background of the Study

Evidence-Based Research is the methodical and open use of previous research to guide a new study to provide credible, effective, and easily available answers to important topics<sup>3</sup>. A thorough analysis of past research that tackles issues related to the one the new study will be examining can reveal evidentiary gaps and the existence of an "overlap with demonstrated outcomes"<sup>4</sup>. This will guarantee that any additional research is required. To ensure that the new study is relevant to the people it affects and to society, evaluations of value should consider both the discovery of an evidence gap and the opinions of the end users. It might not be necessary to close an identified evidentiary gap if it cannot be demonstrated to be pertinent (from the viewpoints of the end users). Furthermore, a need that end users have recognized does not by itself represent a knowledge gap<sup>5</sup>.

Statistics are the foundation of contemporary evidence-based research because they offer the instruments required for the objective collection, analysis, and interpretation of data. By using statistical techniques, researchers can find trends, test theories, and gauge how strongly variables relate to one another, ensuring that findings are supported by verifiable data rather than conjecture. Credible scientific research requires that researchers progress beyond subjective interpretation and toward objective validation of findings, which is made possible by statistical analysis<sup>6</sup>. Like this, Trochim, Donnelly, and Arora<sup>7</sup> stress that statistics serve as the cornerstone of evidence-based decision-making by enabling researchers to draw conclusions about populations from sample data, so bridging the theory-practice divide. Without the use of statistical methods, research is imprecise, unreliable, and unable to guide wise practice or policy. Consequently, statistics continue to be a crucial component in the creation of factual, verifiable, and influential information.

## 1.2 Objectives of the Study

- To investigate the use of statistical data analysis in research that is grounded in evidence.
- To investigate the kinds and techniques of statistical analysis employed in different fields.
- To examine how statistical evidence affects decision-making and real-world results.
- To pinpoint restrictions and difficulties when using statistical techniques

## 1.3 Research Question

- In what ways does statistical analysis improve the caliber and consistency of study findings?
- Which statistical methods and instruments are most useful in evidence-based research?
- What restrictions and moral dilemmas surround statistical inference?

<sup>3</sup> Robinson KA. Use of prior research in the justification and interpretation of clinical trials: Johns Hopkins University; 2009. (last visited October 16, 2025)

<sup>4</sup> Emanuel EJ, Wendler D, Grady C. What makes clinical research ethical? JAMA 2000; 283:2701-11. (last visited October 15, 2025)

<sup>5</sup> Robinson KA, Saldanha IJ, McKoy NA. Development of a framework to identify research gaps from systematic reviews. J Clin Epi-demiol 2011;64: 1325—30 (last visited October 15, 2025)

<sup>6</sup> Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (4th ed.). SAGE Publications.

<sup>7</sup> Trochim, W. M., Donnelly, J. P., & Arora, K. (2016). *Research Methods: The Essential Knowledge Base*. Cengage Learning.

## 1.4 Significance of the Study

The data analysis using statistical data is a pillar of evidenced based research as it helps a researcher to bring data together in a systematic way, interpret it, and draw valid conclusions about the data. It is important because it will increase the reliability and precision of the research results, ease of making informed judgments, and intensify the scientific rigor of studies in all fields. Statistical analysis allows researchers to go beyond anecdotal evidence by offering quantitative data to test hypotheses and measure relationships, as well as soundly determine the relationship between variables.

**1.4.1 Relevance to Education:** It enhances the basis of academic disciplines' empirical and evidence-based research. It increases the validity, precision, and repeatability of research findings while fostering methodological rigor. It promotes the use of data-driven methods by academics and students, developing their capacity for critical and analytical thought. It advances scientific understanding through methodical and verifiable research procedures.

**1.4.2 Relevance to the Development of Policy:** It favour the transition of governance from intuition to evidence. It aids legislators in determining the demands of society, creating successful public initiatives, and assessing their results. It increases decision-making's fairness, accountability, and transparency by utilizing trustworthy data. It makes it easier to allocate resources effectively and implement statistically supported policy changes.

**1.4.3 Link to Sustainable Development Goals (SDGs)<sup>8</sup>:** By encouraging data literacy and research integrity, it helps achieve (*Goal 4*) of Quality Education. By using evidence-based innovation, it promotes industry, innovation, and infrastructure (*Goal 9*). encourages openness and responsible government, which helps achieve Peace, Justice, and Strong Institutions (*Goal 16*) and Reduced Inequalities (*Goal 10*). promotes development planning that is data-driven and in line with international sustainability goals.

**1.4.4 Encouragement of Reproducibility and Transparency:** Makes sure that study results are trustworthy, verifiable, and available for external validation. Through accountability and transparency, it increases public confidence in scientific and policy research. promotes an international culture of transparency, ethical integrity, and ongoing learning in research methods.

## 2.Literature Review

The literature review is an overview of existing studies in the field of data analysis in statistics and its instrumental role in evidence-based research. It also draws attention to various statistical procedures used in different fields to promote the validity, reliability and interpretability of data. The review outlines the shift of descriptive to sophisticated inferential methods and omissions in the use of sound statistical models in empirical research.

<sup>8</sup> Sustainable Development Goals, available on <https://unric.org/en/united-nations-sustainable-development-goals/> (last visited October 16, 2025)

## 2.1 Conceptual framework of Evidence-based research

Evidence-based Research<sup>9</sup> (EBR) stands for "the systematic and transparent use of prior research to inform a new study so that it is answering questions that matter in a valid, efficient, and accessible manner."

This method guarantees that all new research projects are planned and carried out with a comprehensive grasp of the available data, enhancing their scientific validity, social worth, and ethical rationale.

Two primary actions are highlighted by the EBR approach:

- To utilizing previous research and systematic reviews to support and guide the creation of new investigations.
- After the investigation is finished, putting fresh findings in the context of existing knowledge

**2.1.1 Ethical Basis of Research Based on Evidence:** The difference between validity and value is the ethical foundation of EBR. A study may be methodologically good but yet be "of no value if its hypothesis is trivial or already resolved," according to Robinson et al. (2021), who quote Freedman (1987) and Emanuel et al. (2000) (p. 4).

They contend that two essential requirements for ethical research must be met:

- scientific validity, guaranteeing proper planning and implementation.
- social value, making certain that the research question is significant and advances knowledge that is beneficial (Robinson et al., 2021, p. 5).

EBR thus creates an ethical duty to steer clear of redundant research and to make sure that new research is valuable, pertinent, and supported by the body of evidence.

**2.1.2 Justification and Importance of Evidence-Based Research:** It is a considerable amount of research done worldwide is redundant and lacks empirical support, which results in a significant waste of resources. Since such research "puts patients at avoidable risk, limits funding for relevant studies, and may diminish society's trust in research," they characterize repetitive or unneeded investigations as "unethical". The authors' study of meta-research studies shows that many investigators merely cite a limited and selected collection of previous studies that support their opinions, failing to take systematic reviews into account when designing new trials. When "statistically significant or supportive studies are cited more often than those with non-significant or contradictory results," this practice leads to citation bias.

To solve this problem, EBR mandates that each research topic be specifically supported by a methodical synthesis of the available data. This guarantees that fresh research is not only legitimate but also beneficial to society and the scientific community.

<sup>9</sup> Robinson, Karen A; Brunnhuber, Klara; Ciliska, Donna; Juhl, Carsten Bogh; Christensen, Robin; Lund, Hans, "What Evidence-Based Research is and why is it important", Journal of Clinical Epidemiology, 2021, available on <https://doi.org/10.1016/j.jclinepi.2020.07.020>

**2.1.3 International Advancements and Institutional Assistance:** EBR's increasing popularity around the world is evidence of its expanding significance.

- Authors must now specifically state "what evidence existed before their study, what new value it adds, and what are the implications of all available evidence," according to the Lancet Initiative (2014).
- According to established guidelines, funding organizations as ZonMW (Netherlands), PCORI (USA), and NIHR (UK) only provide funding for research that is contextualized within pre-existing systematic reviews (p. 10).
- To advance the EBR concept, the European Union's COST Action (2018) established a network of 39 nations around Europe.

These programs demonstrate an increasing institutional commitment to making sure that fresh research adds to the body of evidence in a positive way.

**2.1.4 Application and Real-World Use:** Both technical proficiency and a shift in the scientific community's culture are necessary for EBR implementation. In contrast to previous centuries when there was a dearth of literature, the authors trace the development of research procedures back to the 1600s and observe that the digital revolution of the 1990s today enables researchers to find nearly all papers pertinent to any clinical concern.

Many researchers still do not employ systematic evidence syntheses in spite of these advancements. The Evidence-Based Research Network (EBR Network) was established in 2014 to address this issue and encourage the worldwide application of EBR principles. The authors contend that in addition to researchers, funding organizations, ethics committees, and journal editors should also adopt EBR as they are all accountable for making sure that new research is both required and supported by evidence.

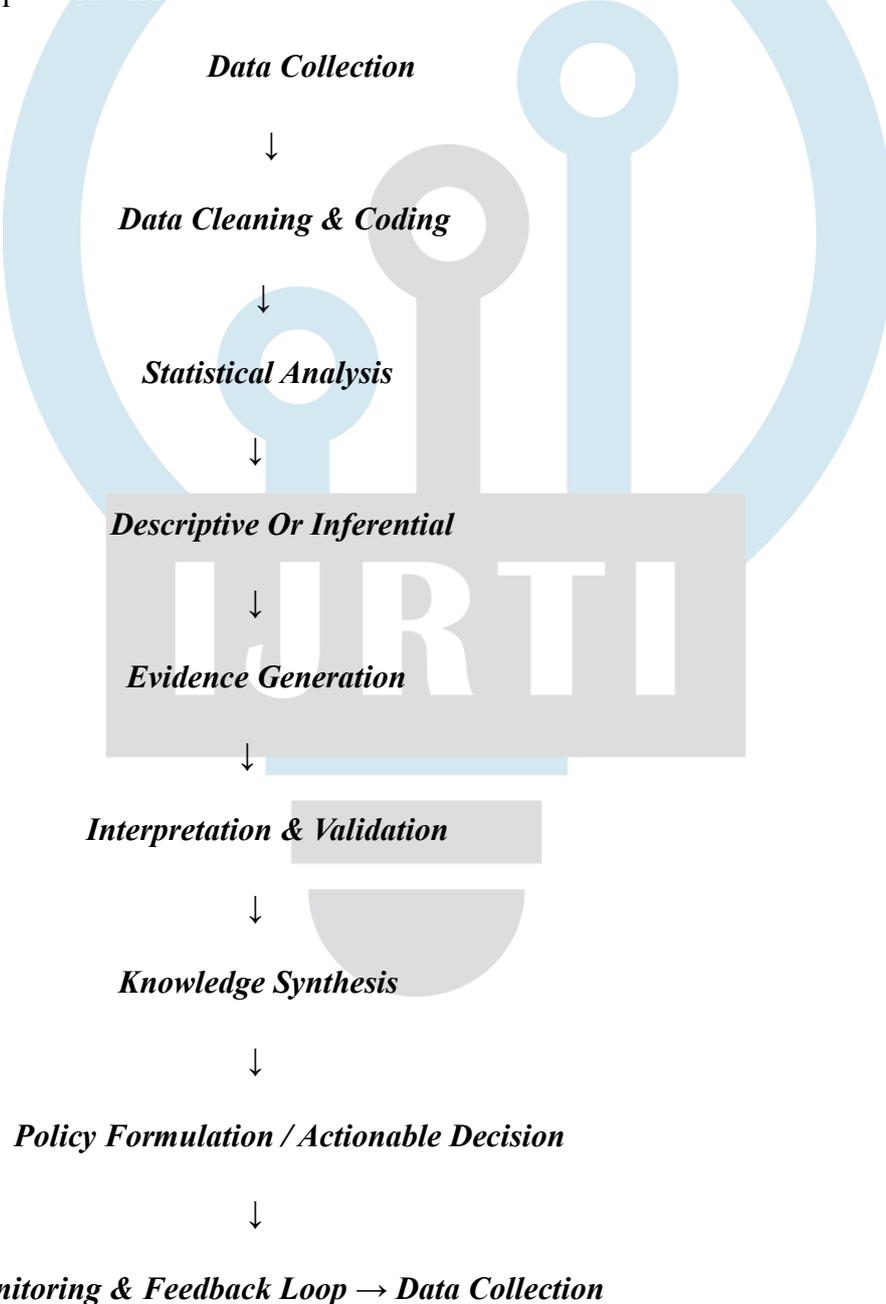
**2.1.5 Phases and Framework of the EBR:** A systematic three-phase approach for implementing evidence-based research (EBR) is presented.

- **Phase of Planning:** To support the new study topic and strategy, researchers first carry out or locate a systematic review of previous studies. incorporates end-user viewpoints to guarantee methodological rigor, relevance, and connection with practical needs.
- **Phase of Execution and Reporting:** After the study is finished, the results are analysed and presented considering earlier data. The new findings may be incorporated into an earlier systematic review, preserving the body of scientific knowledge.
- **Phase of Synthesis and Decision:** A methodical synthesis of the collected data from several investigations is conducted. While inconclusive results aid in identifying areas that need more research, clear data can directly inform clinical or policy decisions.

## 2.2 Role of statistics in research

The following conceptual model illustrates how crucial statistical data analysis is to the evidence-based research (EBR) cycle, which starts with the collecting of raw data and ends with the creation of policies and input for additional study.

The fundamental link between observation and evidence-based action is statistics, which guarantees that every phase of research is informed by empirical validation and quantitative reasoning. This cyclical model highlights that evidence-based research is iterative rather than linear, with new discoveries always improving subsequent studies.



**Figure 1: Conceptual Model – Statistics as the Core of Evidence-Based Research**

**2.2.1 Data Collection:** The foundation of any evidence-based research lies in collecting reliable, valid, and representative data whether through surveys, experiments, sensors, or administrative records.

**2.2.2 Data Cleaning & Coding:** Raw data often contain missing values, inconsistencies, or outliers. Data preprocessing ensures accuracy and prepares the dataset for meaningful statistical analysis.

**2.2.3 Statistical Analysis:** This phase includes descriptive statistics (summarizing and visualizing data) and inferential statistics (drawing conclusions, hypothesis testing, regression modelling).

**2.2.4 Evidence Generation:** Statistical results translate observations into quantified evidence, revealing patterns, relationships, or effects.

**2.2.5 Interpretation & Validation:** The researcher interprets results in context, validates them through replication, and checks robustness (e.g., sensitivity analysis)

**2.2.6 Knowledge Synthesis:** Practical insights are produced by combining statistical evidence with theory and earlier studies.

**2.2.7 Developing Policies and Making Decisions:** Evidence is used by governments, organizations, or practitioners to develop or alter business plans, actions, or policies.

**2.2.8 Monitoring and Feedback:** The evidence–policy feedback loop is completed when policies are put into place and fresh data is produced. This cycle encourages ongoing development.

### 2.3 Identify the research gap

- Insufficient comprehension of ethical and interpretative constraints.
- Absence of multidisciplinary integration of statistical tools.

## 3. Statistical Data Analysis and Discussion

The section explains systematic procedures that are followed in statistical data analysis, including data collection and preparation through hypothesis testing and modelling. The discussion of analytical findings is presented in terms of the research objectives and the role of statistical tools in identifying patterns, relations and causal inferences of complex data sets. The discussion relates practical implications and theoretical constructs to quantitative evidence.

### 3.1 Statistical Data Analysis

The process of collecting, analysing, and presenting data to identify trends and correlations that can guide our decision-making is known as statistical analysis<sup>10</sup>. It covers a wide range of approaches to data analysis, from straightforward concepts like fundamental facts to more intricate techniques for interpreting those facts.

The purpose of statistical analysis is to:

- Compile the information: A dataset's central patterns can be inferred from descriptive statistics like mean, median, and mode.

<sup>10</sup> Statistical Data Analysis, available <https://www.geeksforgeeks.org/data-analysis/what-is-statistical-analysis/> (last visited October 17,2025)

- Infer insights: Using a sample, inferential statistics allow researchers to infer or forecast information about the population.

### 3.1.1 Importance of Statistical Analysis

- **Data-Driven Decision Making:** Statistical analysis provides precise facts and evidence, enabling decision-makers to make well-informed decisions backed by data rather than relying solely on intuition or conjecture. It's like using a trustworthy map to direct you rather than choosing a haphazard route.
- **Risk Assessment and Management:** In fields like banking, insurance, and engineering, statistical techniques like probability distributions and risk analysis are helpful for comprehending and lowering risks. They assist in determining the likelihood of a negative event and how to reduce that likelihood. It functions similarly to a safety net to guard against unforeseen issues in several domains.
- **Quality Improvement:** By identifying and correcting any modifications to the way things are done, statistical process control (SPC) techniques assist businesses in monitoring and improving the quality of their products or services. It's like putting in place a system to ensure that things continue course and improve with time.
- **Research and Innovation:** Statistical analysis is crucial for conducting research, validating hypotheses, and advancing knowledge in fields including science, medicine, and the social sciences. It functions similarly to a strong instrument that advances our understanding of these areas.
- **Performance Evaluation:** Statistical analysis is used in businesses to examine how well things are doing, such as sales figures, customer satisfaction, and employee productivity. It makes sure everything goes as smoothly as possible and helps identify areas where things may improve.

### 3.2 Statistical Data Tool and Techniques

Data science uses a variety of statistical analytic techniques<sup>11</sup> to glean insights from data. Let's examine some of the most important kinds and how they are used.

#### 3.2.1 Analysis of Descriptive Statistics:

Simpler, easier-to-understand summaries and descriptions of data are provided by descriptive statistical analysis. It entails gathering, analysing, and graphically displaying data using bar plots, pie charts, and graphs. The objective is to simplify difficult data so that analysis is made easier.

The following are essential elements of descriptive statistical analysis:

- **Frequency Measures**
  - **Count:** How frequently an observation occurs in the dataset.

<sup>11</sup> Statistical Data Analysis, <https://www.geeksforgeeks.org/data-science/what-is-statistical-analysis-in-data-science/>, (last visited October 16, 2025)

- The **frequency distribution** shows the appearance of each data point in a histogram or bar chart.
- The percentage of times an observation occurs relative to the total number of observations is known as the **relative frequency**.
- **Central Tendency Measures**
  - The **mean**, or average, is calculated by dividing the total number of observations by their sum.
  - When the data is arranged in ascending order, the **median** is the middle value.
  - **Mode**: The dataset's most frequent observation.
- **Dispersion Measures**
  - **Standard and Variance Deviation**: A measure of the data's degree of dispersion.
  - **Range**: The distinction between the highest and lowest numbers.

### 3.2.2 Analysis of Inferential Statistics

Using sample data, inferential statistical analysis enables us to draw conclusions about the population. This kind of analysis improves our comprehension of the data and enables us to test theories, examine connections, and draw broad conclusions.

#### Important Methods for Inferential Statistics:

- A statistical technique for testing population hypotheses based on sample data is called hypothesis testing.
- **t-tests**: Examine group means (independent or one-sample).
- **Chi-square test**: Analyse associations between categorical variables.
- **ANOVA**: Examine three or more independent groups' means.
- **Non-parametric tests**: Employed when data fails to satisfy the presumptions of other tests, such as Wilcoxon rank-sum, Kruskal-Wallis, etc.

Using sample data, inferential statistics offer a means of drawing conclusions or forecasts about a broader group.

### 3.2.3 Analysis of Predictive Statistics

Predictive analytics forecasts future trends or events based on historical data. This method aids companies in predicting shifts in consumer behaviour, market conditions, and new trends.

#### The Workings of Predictive Analytics:

- Preprocessing and data collection: Making sure the information is reliable and consistent.

- Model is the process of developing models that spot trends and forecast future events, such as consumer behaviour or sales forecasting.

### 3.2.4 Analysis of Prescriptive Statistics

In addition to forecasting future events, prescriptive statistical analysis recommends the best course of action to accomplish specified goals. To produce insights and make recommendations, it integrates historical data, predictive models, and optimization approaches.

#### The Operation of Prescriptive Analytics:

- Use optimization models to determine the best course of action for particular issues.
- Making decisions: Offers practical suggestions derived on analysis and forecasted results.

### 3.2.5 Analysis of causality

By demonstrating the cause-and-effect connections, causal analysis goes beyond simply determining the associations between variables. It assists companies in comprehending not just what happens but also why specific events take place.

#### Causal Analysis's Significance:

- It pinpoints the underlying reasons for issues or achievements.
- Instead, then only responding to symptoms, it assists companies in addressing problems at their root.
- Causal analysis is crucial for enhancing corporate procedures, resolving issues, and maximizing output.

## 3.3 Role of Statistical Tool in Evidence-based Research

Data is now a vital resource in every field, including the social sciences, business, economics, and healthcare. However, raw data isn't very useful on its own until it can be processed and examined to find trends, patterns, and connections. To convert unstructured data into insightful knowledge that can direct tactics, influence choices, and spur innovation, statistical analysis is essential. This part explores how statistical analysis forms the foundation for deciphering data and drawing conclusions that can be put into practice<sup>12</sup>.

**3.3.1 Converting Information into Useful Knowledge:** Fundamentally, statistical analysis is the process of converting data into insights that may be use. Although raw data points could seem like a collection of numbers, statistical approaches offer the means to effectively understand these numbers. Statistical analysis assists researchers and decision-makers in going beyond simple descriptions of data to a deeper

<sup>12</sup> Dr. Puneet Sethi Teerthanker, Dr. Rajiv Verma Teerthanker, Dr. Pankhuri Agarwal Teerthanker, Disha Rahal, "ROLE OF STATISTICAL TOOLS IN RESEARCH: A KEY TO DATA-DRIVEN INSIGHTS", Journal of Informatics Education and Research, ISSN: 1526-4726, Vol 5 Issue 2(2025), available <https://jier.org/index.php/journal/article/view/2462/2027> (last visited October 17, 2025)

understanding of underlying patterns and relationships, whether the goal is to predict market trends, understand customer preferences, or evaluate the effectiveness of a novel treatment.

**For instance**, businesses can create focused marketing campaigns by using statistical analysis of consumer behaviour to gain insights into purchase trends. In the medical field, patient data analysis can be used to pinpoint illness risk factors and recommend better treatment approaches.

**3.3.2 Finding Trends and Patterns:** Finding patterns and trends in data is one of statistical analysis's primary functions. When properly analysed, these patterns which may not be immediately visible to the unaided eye become evident. Hidden patterns, such as seasonal trends in sales, regional differences in health outcomes, or even changes in customer behaviour, can be found using statistical techniques like time series analysis or cluster analysis.

**For example:** In economics, statistical models may show the Phillips curve a link between unemployment and inflation rates which aids policymakers in comprehending and regulating economic stability. Retailers can improve their inventory and pricing strategies by identifying purchasing trends that happen throughout particular seasons of the year or in response to promotional activity.

**3.3.3 Verifying Assumptions and Testing Hypotheses:** Using actual data, statistical analysis enables researchers to test hypotheses, which are concepts or predictions about how things function in the real world. Usually, this procedure entails developing a null hypothesis, which implies no effect, and an alternative hypothesis, which suggests a possible effect. Tests such as t-tests, ANOVA, or chi-square tests are then applied.

**For instance:** A pharmaceutical business may speculate that a novel medication may reduce blood pressure more successfully than an already-approved course of treatment. Based on the significance of the findings, the business can decide whether to accept or reject this hypothesis using statistical tests on trial data. Researchers in the social sciences may postulate that income and educational attainment are correlated. Based on information from surveys or research, statistical analysis can confirm or deny this relationship.

**3.3.4 Lowering Risk and Uncertainty:** Decisions in the real world are frequently fraught with risk and ambiguity. By offering a framework for formulating predictions based on evidence, statistical tools aid in the reduction of uncertainty. Researchers and organizations can measure the degree of uncertainty surrounding their findings and make better judgments by using techniques like Bayesian analysis, probability distributions, and confidence intervals.

**For instance:** Investment managers in the financial industry forecast how stocks and portfolios will perform in the future under various market conditions using statistical models, such as Monte Carlo simulations. They can control risk and make more assured investing choices as a result. Statistical techniques such as risk ratios and survival analysis are used in clinical trials to evaluate the risks and prospects of novel treatments, allowing medical experts to decide whether to move forward with a given intervention.

**3.3.5 Forecasting Future Trends and Outcomes:** The capacity of statistical analysis to forecast future events is one of its main advantages. Researchers can create predictions based on historical data by using statistical models like machine learning algorithms, time series forecasting, and linear regression.

**For instance:** To forecast future weather events, meteorologists employ intricate statistical models that examine past weather trends. Business utilizes statistical tools to forecast future sales patterns, inventory requirements, and client demand. This enables companies to make plans and modify their tactics as necessary. Researcher and companies can foresee changes, get ready for possible obstacles, and seize opportunities by modelling future situations using statistical methods.

**3.3.6 Improving Decision-Making with Insights from Data:** An approach to decision-making that is more thorough and grounded in evidence is offered by statistical analysis. Using guessing or intuition can result in costly errors in a data-driven environment. Decision-makers can act with more confidence when they use statistical approaches to evaluate the validity and robustness of their conclusions.

**For instance,** statistical study of consumer behaviour in marketing can assist businesses in determining which markets to target, which items to promote, and which advertising channels to employ, resulting in more successful and economical campaigns. Governments and organizations use statistical data in public policy to decide how to allocate resources, plan for healthcare, and implement social initiatives. Governments use census data, for example, to plan infrastructure projects and direct funds to the most needed areas.

**3.3.7 Data Visualization:** Clear Communication of Insights even if statistical analysis yields profound insights, communicating these insights isn't always simple. The use of graphs, charts, and other visual aids in data visualization is essential for helping a wider audience comprehend statistical conclusions. Clear and understandable communication of intricate patterns, trends, and linkages is facilitated by effective data visualization.

**For instance:** Heat maps and survival curves are examples of visualizations that can be used in the healthcare industry to convey statistical findings about disease outbreaks or treatment effectiveness, which facilitates data interpretation for policymakers and healthcare professionals. Managers in the corporate world can monitor key performance indicators (KPIs) and make decisions in real time by using dashboards and interactive data visualizations.

**3.3.8 Promoting Innovation and Ongoing Enhancement:** Lastly, by highlighting fresh possibilities and regions for development, statistical analysis promotes creativity. Statistical techniques can stimulate ongoing innovation in research and business procedures by identifying patterns, confirming hypotheses, and pointing out inefficiencies.

**For instance,** businesses utilize statistical methods such as design of experiments (DOE) in product development to enhance production procedures, boost product quality, and create new features in response to consumer input. New findings, theories, or directions for additional research can result from data-driven

insights from statistical analysis. For instance, the discovery of illness biomarkers by statistical analysis may result in the creation of novel diagnostic instruments or therapeutic interventions.

## 4. Result and Discussion

The findings involve essential statistical findings of the data analysis in terms of measures of central tendencies, variability, and inferential statistics. This part explains the meaning of findings, relates them with the existing literature, and assesses the implications to the evidence-based decisions. The combined discussion critically evaluates the strong and weak points of the research findings.

**4.1 Combining the Literature with the Results:** The findings demonstrate that researchers use mixed, quantitative, or qualitative approaches to their investigations, each of which contributes differently to the production of evidence. While qualitative research provides contextual depth but frequently faces repeatability issues, quantitative research uses statistical rigor to ensure objectivity and replicability. Qualitative approaches employ matrices, charts, and tables to arrange subjective data, but they are challenging to replicate because of researcher bias and contextual unpredictability, particularly in domains like education where circumstances are ever-changing.

On the other hand, statistical data analysis offers quantifiable, verifiable insights that reinforce the body of evidence. Data management, hypothesis testing, and inferential analysis are supported by programs such as Excel, XLStat, SPSS, and SAS. Excel's Data Analysis Toolpak supports both descriptive and inferential statistics, as noted by Smeeton and Goda (2003), making it suitable for a range of study approaches. Analytical precision is increased by selecting the appropriate test, whether parametric or non-parametric, depending on the distribution of the data (e.g., using the Kolmogorov–Smirnov test for normality). These procedures show how statistics, the foundation of evidence-based research (EBR), transform unreliable data into reliable evidence.

Overall, the incorporation of statistical methods guarantees consistency, dependability, and better evidence, bringing research procedures into line with the EBR standards, even though qualitative investigations offer interpretive richness.

## 4.2 Implications

The study has wide variety of implications. To the researchers, it makes it clear why strict statistical procedures should be embraced to enhance the quality and validity of data in an empirical study. The interpretation of statistical analysis findings can help policymakers to develop data-driven policies to solve societal and economic problems in a more efficient way. The future direction of research involves development of statistical techniques, implementing machine learning in conjunction with conventional analysis, and using it to address complicated issues, thus, developing the boundary of evidence-based knowledge.

**4.2.1 For Researchers:** The study emphasizes the need of statistical training and data literacy. Researchers need to be able to choose the right statistical tests, comprehend how data is distributed, and appropriately interpret results. Reproducibility is increased and subjectivity is decreased when team-based qualitative

methods are combined with quantitative validation. Knowledge of programs such as SPSS or Excel improves analytical skills and increases the validity of results.

**4.2.2 For Policymakers:** Statistical data serves as the basis for judgments that are transparent, believable, and informed by facts. They can determine relationships, evaluate the effects of policies, and effectively manage resources thanks to regression and variance analysis. By guaranteeing that judgments are supported by quantifiable facts, data-supported decisions not only increase the efficacy of policies but also foster public trust.

**4.2.3 Prospective Research Paths:** Predictive modelling, big data, and AI-driven analytics should all be incorporated into future studies to improve accuracy and efficiency. Large datasets can be managed, intricate patterns can be found, and data cleansing can be automated with artificial intelligence. While hybrid approaches that mix qualitative and quantitative analysis can produce a more comprehensive body of evidence, big data analytics can aggregate data from several areas for wider insights. The quality and transparency of upcoming evidence-based research will be further enhanced by improving training in statistical reasoning and ethics.

## 5. Limitation of statistical Inference

The research paper recognizes the research weaknesses that were associated with sample size, quality of data, and possible biases in statistical modelling methods. The limitations of applying the results to the overall population and problems with considering all confounding factors are considered. The limitations<sup>13</sup> indicate methodological areas that need to be improved and demand results to be cautiously interpreted to provide direction on future research.

### 5.1 Problems with Data Quality:

- **Missing Data:** The validity of statistical analysis may be compromised by incomplete data. Data corruption, survey non-response, or mistakes in data collecting can all result in missing values.
- **Outliers and Data Errors:** Outliers or inaccurate data points have the potential to skew statistical test results and provide false conclusions. Maintaining the integrity of analysis depends on recognizing and resolving such problems.
- **Errors in measurement:** Biased results may arise from inaccurate data measurement. This is especially troublesome when data collecting is done by hand or using inaccurate tools.

### 5.2 Unsuitable Selection of Statistical Instruments:

- **Misapplication of Techniques:** Inaccurate results may result from using the inappropriate statistical method for the type of data or research issue. For instance, results may be deemed incorrect if a

<sup>13</sup> Dr. Puneet Sethi Teerthanker, Dr. Rajiv Verma Teerthanker, Dr. Pankhuri Agarwal Teerthanker, Disha Rahal, "ROLE OF STATISTICAL TOOLS IN RESEARCH: A KEY TO DATA-DRIVEN INSIGHTS", Journal of Informatics Education and Research, ISSN: 1526-4726, Vol 5 Issue 2(2025), available <https://jier.org/index.php/journal/article/view/2462/2027> (last visited October 17, 2025)

parametric test (such as the t-test) is applied on data that deviates from its presumptions (such as normality).

- **Models that are either overfit or underfit:** When a model is overly intricate, it overfits the data, fitting the noise instead of the actual underlying pattern. On the other hand, underfitting happens when the model is too basic to identify significant patterns. Both situations may lead to inaccurate generalizations and predictions.

**5.3 Assumption Violations:** A lot of statistical techniques rely on presumptions, such as the homogeneity of variance and the normality of the data. The outcomes may not be trustworthy if these presumptions are broken. For example, findings may be distorted if linear regression is used to non-linear relationships without any modifications. Non-independence of observations and an uneven or non-normal distribution of data are examples of common assumption breaches.

#### 5.4 Data Complexity:

- **Multidimensional Data:** In contemporary research, datasets frequently contain numerous variables, particularly when working with huge data. Such high-dimensional data analysis calls for more sophisticated methods, such as multivariate analysis or principal component analysis (PCA), which can be challenging to use and comprehend.
- **Unstructured Data:** It might be difficult to successfully apply typical statistical approaches to datasets like text, photos, or audio since they require specific tools for analysis (such as machine learning and natural language processing).

**5.5 Absence of Statistical Knowledge:** Complex statistical tools necessitate a thorough comprehension of the underlying theory as well as the proper use of the techniques. Researchers' or analysts' inexperience may result in incorrect data interpretation, improper technique utilization, or subpar model choices. Many researchers may use software tools without completely comprehending how they operate, which could cause them to blindly trust automated outcomes and possibly ignore model constraints.

**5.6 Interpreting Results Is Difficult:** The results of statistics can frequently be daunting, particularly when dealing with big datasets. It can be difficult for non-experts to interpret p-values, confidence intervals, and other statistical outputs in a meaningful and contextually relevant manner. Inaccurate conclusions regarding the research findings may result from a lack of knowledge of statistical significance (for example, conflating it with practical significance).

#### 5.7 Data Handling Ethical Concerns:

- **Data Manipulation:** There might be pressure to alter or selectively use data in order to support a particular theory or outcome. When statistical techniques are purposefully employed to mislead or skew results, ethical issues are raised.
- **Representativeness and Bias:** The statistical analysis may not sufficiently take sampling bias into account. This can produce results that are not typical of the larger population.

**5.8 Privacy Issues and Data Accessibility:** The sensitive nature of the data (such as patient records or personal information) makes it difficult to maintain privacy in domains like healthcare or social research while yet enabling the use of statistical analysis. Certain datasets cannot be used for study due to regulatory limitations like HIPAA (Health Insurance Portability and Accountability Act). Sharing of Data: Problems with data accessibility and sharing between organizations or nations might make using statistical approaches in collaborative or multi-centre research more difficult.

### 5.9 Limitations in Computation:

- **Resource Restrictions:** Some sophisticated statistical techniques demand a substantial amount of processing power, especially when they involve big datasets or intricate algorithms (like machine learning). The use of these techniques may be hampered by technology, software, or data storage constraints for researchers.
- **Software Restrictions:** Using the incorrect tool might restrict the scope of analysis, and not all statistical software programs are appropriate for all data or analysis types.

**5.10 Using statistical significance excessively:** The practical significance or real-world ramifications of the findings may be overlooked by many academics who use statistical significance (e.g., p-values less than 0.05) as the main indicator of a study's worth. When assessing statistical significance, it is crucial to take context, effect magnitude, and confidence intervals into account.

**5.11 Managing Non-Normal Information:** A normal distribution of data is assumed by many statistical techniques. Distributions in real-world data, however, could be heavy-tailed, bimodal, or skewed. Results may be erroneous or misleading if statistical procedures intended for normal data are applied to non-normal data. Researchers frequently have to use non-parametric approaches or transformation techniques (like log transformation), which might make the analysis process more difficult.

**5.12 Handling Correlation vs. Causality:** Although correlations between variables can be found using statistical approaches, causality cannot always be established. A high correlation between two variables, for example, does not necessarily mean that one causes the other. It's a crucial to distinguish between correlation and causation, because researchers risk making incorrect causal inferences if they don't use appropriate experimental designs (such as randomized controlled trials).

## 6. Conclusion

In summary, the foundation of evidence-based research is statistical data analysis, which bridges the gap between unprocessed data and well-informed decision-making. By converting observations into quantifiable, verifiable, and actionable facts, it guarantees that study conclusions are backed by empirical evidence rather than conjecture. Researchers can assess hypotheses, find significant associations, and accurately and transparently validate results by using statistical methods including descriptive and inferential analysis.

One of the main objectives of evidence-based research is to produce knowledge that is both socially and scientifically beneficial. By incorporating statistical tools into the research process, this approach improves credibility, repeatability, and ethical accountability. For policymakers, statistical evidence offers a solid basis for data-driven governance, facilitating more accurate and accountable program design and evaluation.

Even if issues like sampling bias, methodological constraints, and a lack of data literacy still exist, the expanding application of big data, artificial intelligence, and sophisticated analytics approaches presents encouraging avenues for further study. The analytical depth and dependability of evidence-based research would be further enhanced by these developments. In the end, statistical data analysis plays a transforming rather than merely technical role in evidence-based research. It promotes a culture of ongoing learning and well-informed advancement by guaranteeing that all decisions, whether they be academic, scientific, or policy-oriented, are based on objectivity, transparency, and quantifiable truth.

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