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# Mastering Probability and Non-Probability Methods for Accurate Research Insights

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**Abstract**

Sampling is a fundamental aspect of research methodology, crucial for obtaining valid and reliable results when working with large populations. This article explores the two primary types of sampling techniques: probability and non-probability sampling. Probability sampling methods—simple random, stratified, systematic, and cluster sampling—ensure that every individual in a population has a known chance of being selected, enhancing representativeness and allowing for the generalisation of findings. In contrast, non-probability sampling methods—including convenience, purposive, snowball, and quota sampling—do not provide equal selection chances for all individuals, making them more suitable for exploratory or qualitative research but potentially introducing biases. The article discusses key differences between these sampling approaches, including their suitability for different research goals and their impact on generalizability. It also addresses the challenges associated with each method, such as cost constraints, the rise of online surveys for probability sampling, and biases and limitations for non-probability sampling. Additionally, the article examines future directions in sampling, including the potential benefits and ethical considerations of integrating big data and artificial intelligence. This article aims to help researchers select appropriate sampling techniques to achieve valid, reliable, and ethical research outcomes by providing practical guidelines and emphasising the importance of methodological rigour.

Keywords: Sampling techniques, probability sampling, non-probability sampling, research methodology

## 1.0 Introduction

Sampling is a fundamental concept in research methodology, representing the process of selecting a subset of individuals or elements from a larger population to draw inferences about the entire group. It is particularly useful when studying an entire population is impractical, time-consuming, or costly. Using a sample, researchers can estimate population parameters with a reasonable degree of accuracy, making sampling an essential tool in fields such as social sciences, medicine, marketing, and public health. When done correctly, sampling allows researchers to gather data efficiently while ensuring the results are valid and representative.

The importance of sampling in data collection cannot be overstated, as the quality of research findings often depends on the sampling method chosen. Sampling enables researchers to focus their resources on a manageable group, ensuring more detailed and accurate data collection. By working with a sample, researchers can minimise costs, reduce time constraints, and enhance the precision of their analysis, particularly in large populations where surveying every member would be impractical. However, selecting an appropriate sampling technique is crucial to ensure that the data collected is reliable and generalisable. If the sample is not representative, the conclusions drawn from the study may be flawed or biased.

In research, two primary sampling methods are commonly employed: probability and non-probability sampling. The key distinction between these two methods is how individuals or elements are selected. Probability sampling involves random selection, giving each member of the population an equal and known chance of being chosen. This randomness ensures that the sample is more likely to be representative of the population, allowing researchers to make generalisable conclusions with a known level of accuracy (Etikan & Bala, 2017). In contrast, non-probability sampling does not involve random selection, meaning certain population members may be more likely to be included than others. While this approach is often easier and more cost-effective, it introduces the risk of selection bias, limiting the generalizability of the findings (Vehovar, Toepoel, & Steinmetz, 2016). Both methods have advantages and are appropriate depending on the research goals, resources, and time constraints.

## 2.0 Overview of Probability Sampling

### 2.1 Definition of Probability Sampling

Probability sampling refers to a sampling technique in which every individual or unit in the population has a known and non-zero probability of being selected for the sample. This method is grounded in randomness and ensures that each population element is given an equal or proportional chance of inclusion. Probability sampling is a cornerstone of quantitative research because it allows researchers to make generalisations from the sample to the population with high confidence. According to Etikan, Musa, and Alkassim (2016), the fundamental principle behind probability sampling is that randomisation reduces bias and increases the likelihood of achieving a representative sample, strengthening the research findings' external validity. By providing every individual with a known probability of selection, probability sampling enhances the objectivity and reliability of the study (Lepkowski & Bowles, 2020).

### 2.2 Types of Probability Sampling Techniques

Several types of probability sampling methods are designed to address different research needs and population structures. These include simple random, stratified, systematic, and cluster sampling. Each technique serves a specific purpose and has its strengths and limitations.

### 2.2.1 Simple Random Sampling

Simple random sampling is the most basic form of probability sampling. In this method, every member of the population has an equal and independent chance of being selected. This can be done by assigning numbers to each individual and using random number generators or drawing lots to select the sample. Bornstein, Jager, and Putnick (2013) explain that simple random sampling minimises bias. It ensures that the sample is a true representation of the population. However, it requires a complete and accurate population list, which may not always be feasible in large populations.

### 2.2.2 Stratified Sampling

Stratified sampling involves dividing the population into subgroups, or strata, based on a particular characteristic, such as age, gender, or socioeconomic status. After dividing the population, a random sample is taken from each subgroup proportionally or equally. This method is particularly useful when researchers want to ensure that specific subgroups are adequately represented in the sample. According to Singh and Masuku (2014), stratified sampling improves the precision of the research by ensuring that key population characteristics are accurately reflected in the sample. The method can enhance the comparability of different strata within the population, but it can also be more complex and time-consuming than simple random sampling.

### 2.2.3 Systematic Sampling

Systematic sampling involves selecting every 'nth' individual from a list of the population after determining a starting point at random. This technique is often used for its simplicity and efficiency, especially when dealing with large populations. Couper (2017) points out that systematic sampling can be quicker and easier to implement than simple random sampling, especially when the population list is long. However, it assumes that the population is evenly distributed, which may not always be the case, leading to potential bias if there is any hidden periodicity (Tillé, 2020).

### 2.2.4 Cluster Sampling

Cluster sampling divides the population into clusters, often geographically based or naturally occurring groups, such as schools, neighbourhoods, or companies. Instead of selecting individuals randomly, entire clusters are randomly selected, and all individuals within those clusters are studied. This method is particularly useful when studying large, dispersed populations, as it reduces costs and logistical challenges (Lavrakas, 2008). However, cluster sampling introduces a higher risk of sampling error, as clusters may not be as heterogeneous as individual random selections (Vehovar, Toepoel, & Steinmetz, 2016). Therefore, it is crucial to ensure that clusters are as diverse as possible to maintain representativeness (Singh & Masuku, 2014).

## 2.3 Advantages and Limitations of Probability Sampling

One of the primary advantages of probability sampling is its ability to reduce bias and provide a representative sample, allowing generalisations about the population. Because the method is based on randomisation, it enhances the reliability and validity of the research findings. For example, Flores et al. (2017) conducted a national health survey using probability sampling to ensure that the sample was representative of various racial and ethnic groups across the U.S. Additionally, probability sampling techniques enable researchers to calculate sampling error, providing a quantitative measure of the accuracy of the results (Lepkowski & Bowles, 2020).

Despite its many strengths, probability sampling also has limitations. One major drawback is the time and cost involved in implementing these techniques. It can be expensive and logistically challenging for large or geographically dispersed populations to create a complete population list and conduct random sampling. Furthermore, some methods, such as stratified or cluster sampling, require more complex planning and execution, which can increase the workload for researchers (Singh & Masuku, 2014). In some cases, a lack of available population data may also hinder the application of probability sampling techniques; nevertheless, when resources and time permit, probability sampling remains the preferred approach for studies aiming to achieve high levels of generalizability and precision.

## 3.0 Overview of Non-Probability Sampling

## 3.1 Definition of Non-Probability Sampling

Non-probability sampling is a technique in which not every individual in a population has an equal or known chance of being selected. This method chooses samples based on subjective judgment rather than random selection, which distinguishes it from probability sampling. Non-probability sampling is often employed when it is difficult or impossible to obtain a comprehensive population list or when the research focuses on specific, hard-to-reach populations. However, because the selection process is not random, it introduces the possibility of bias, reducing the extent to which the results can be generalised to the wider population (Etikan, Musa, & Alkassim, 2016). Researchers using non-probability sampling typically focus on specific characteristics, which can skew the sample and limit its representativeness (Palinkas et al., 2015).

## 3.2 Types of Non-Probability Sampling Techniques

Depending on the research context, there are several types of non-probability sampling techniques, each with distinct advantages and limitations. These techniques include convenience sampling, judgmental or purposive sampling, snowball sampling, and quota sampling.

### 3.2.1 Convenience Sampling

Convenience sampling involves selecting individuals who are easiest to reach or are readily available to the researcher. It is often used in exploratory research or pilot studies, where the objective is to gain quick insights rather than produce generalisable findings. This method is cost-effective and time-saving but can lead to significant biases as the sample does not necessarily represent the population (Bornstein, Jager, & Putnick, 2013). For example, using a convenience sample from a university setting may exclude individuals from other demographic groups, leading to skewed results (Emerson, 2015). While convenient, this sampling technique limits external validity and generalizability (Jager, Putnick, & Bornstein, 2017).

#### 3.2.2 Judgmental/Purposive Sampling

Judgmental or purposive sampling relies on the researcher's expertise to select individuals who meet certain predefined criteria. Qualitative research often uses this technique, focusing on in-depth understanding rather than broad generalisation. Researchers may choose participants based on their knowledge, experience, or specific characteristics relevant to the study. According to Etikan, Musa, and Alkassim (2016), purposive sampling is particularly useful when studying specialised populations or phenomena, as it allows for selecting information-rich cases. However, this method also increases the risk of bias since the selection process is subjective and may reflect the researcher's assumptions (Palinkas et al., 2015).

#### 3.2.3 Snowball Sampling

Snowball sampling is a method where existing participants recruit future participants from among their acquaintances or networks. It is commonly used in research involving hard-to-reach or hidden populations, such as individuals involved in illegal activities, marginalised communities, or rare disease groups (Noy, 2008). The process begins with a small group of participants who refer others to the study. While this method can effectively reach specific subpopulations, it may introduce selection bias, as the sample will likely consist of individuals with similar characteristics or from the same social circles (Handcock & Gile, 2011). As a result, snowball sampling can limit the sample's representativeness, thereby restricting the generalizability of the findings (Heckathorn, 2011).

#### 3.3.4 Quota Sampling

Quota sampling involves setting specific quotas for subgroups within the population, such as age, gender, or income level, and collecting data until these quotas are met. This method ensures that certain characteristics are represented in the sample, but the individuals within each subgroup are not selected randomly. According to Jager, Putnick, and Bornstein (2017), quota sampling can help address underrepresentation in convenience or purposive samples, making them more likely to reflect key demographic attributes. However, it still suffers from non-random selection, which can introduce bias and limit the statistical generalizability of the results (Vehovar, Toepoel, & Steinmetz, 2016).

### 3.4 Advantages and Limitations of Non-Probability Sampling

Non-probability sampling is often favoured in exploratory, qualitative, or pilot research due to its flexibility, ease of use, and cost-effectiveness. It is especially useful when the research focuses on specific populations or phenomena that are difficult to study through random sampling. In exploratory research, the goal is often to develop insights, theories, or understanding, making non-probability sampling a practical option. For example, researchers studying rare diseases or niche social groups may find it easier to collect data through purposive or snowball sampling, as these populations are not easily accessible using probability techniques (Emerson, 2015).

However, the primary limitation of non-probability sampling is its potential to introduce bias, which can skew the research findings. Since individuals are selected based on convenience or judgment, there is no guarantee that the sample is representative of the broader population, affecting the research's external validity. This limitation can be especially problematic in studies that generalise findings to larger populations (Bornstein, Jager, & Putnick, 2013). Additionally, the lack of randomisation makes it difficult to calculate sampling error or estimate how closely the sample reflects the population (Tille, 2020). For this reason, non-probability sampling is often less rigorous than probability sampling, particularly in quantitative research (Vehovar, Toepoel, & Steinmetz, 2016).

## 4.0 Key Differences Between Probability and Non-Probability Sampling

### 4.1 Randomness and Representation

A primary distinction between probability and non-probability sampling lies in the role of randomness. Probability sampling is based on random selection, which ensures that every individual in the population has a known, non-zero chance of being chosen. This randomness is crucial for achieving a representative sample, which minimises sampling bias and increases the likelihood that the results can be generalised to the entire population (Etikan, Musa, & Alkassim, 2016). By reducing the potential for human error or bias in sample selection, probability sampling provides a more objective foundation for research (Lepkowski & Bowles, 2020). In contrast, non-probability sampling relies heavily on the researcher's discretion in selecting participants. This lack of randomness introduces bias, as the sample may not accurately represent the population (Palinkas et al., 2015). For example, convenience sampling often results in an over-representation of easily accessible individuals, which can skew the results (Emerson, 2015).

Research by Jager, Putnick, and Bornstein (2017) indicates that while non-probability sampling can provide valuable insights, especially in exploratory or qualitative studies, it cannot claim the same representativeness as probability sampling. As such, the randomness inherent in probability sampling offers a significant advantage when the goal is to produce findings that can be generalised across a population (Lepkowski & Bowles, 2020).

### 4.2 Suitability for Different Research Goals

Probability and non-probability sampling techniques often depend on the research objectives. Probability sampling is generally preferred for confirmatory or quantitative research, where the goal is to test hypotheses and make inferences about a larger population. For example, survey-based studies that aim to generalise findings, such as national health surveys, typically employ probability sampling to ensure that the sample accurately reflects the diversity of the population (Flores et al., 2017). This approach is essential for producing statistically significant results and estimating population parameters with known margins of error (Vehovar, Toepoel, & Steinmetz, 2016).

On the other hand, non-probability sampling is often more suitable for exploratory research or studies focused on specific subgroups. In qualitative research, where the aim is to develop a deeper understanding of a particular phenomenon or group, non-probability techniques such as purposive or snowball sampling are commonly used (Etikan, Musa, & Alkassim, 2016). These techniques allow researchers to deliberately select participants who have relevant experience or characteristics, enabling in-depth exploration of the research topic (Palinkas et al., 2015). For example, studies on marginalised populations or rare diseases often use snowball sampling to reach individuals difficult to identify through random sampling (Heckathorn, 2011). While non-probability sampling can offer valuable insights, especially in specialised or hard-to-reach populations, it is less suitable for generalising results to the wider population (Emerson, 2015).

### 4.3 Generalizability

The ability to generalise findings to the broader population is another key difference between probability and non-probability sampling. Due to its reliance on random selection, probability sampling is more suited for making inferences about a population. It allows researchers to estimate sampling error and make claims about how the sample reflects the population (Tille, 2020). This generalisation ability is particularly important in studies that produce population-level insights, such as public health research or large-scale surveys (Lepkowski & Bowles, 2020). For instance, researchers conducting a nationwide health survey would use stratified random sampling to ensure that all relevant subgroups, such as age and income levels, are proportionally represented (Flores et al., 2017). They can confidently extend their findings to the general population by doing so.

In contrast, non-probability sampling methods are generally less suited for making broad inferences about a population. Because these methods do not rely on random selection, the sample may not be representative, and the findings may not accurately reflect the characteristics of the larger population (Bornstein, Jager, & Putnick, 2013). Instead, non-probability sampling is more useful for exploratory research, case studies, or targeted investigations where the goal is to gain insight into a specific group or phenomenon rather than generalising findings (Palinkas et al., 2015). For example, a researcher studying the experiences of homeless individuals might use purposive sampling to focus on individuals with particular characteristics, such as long-term homelessness, but the findings would not necessarily apply to the entire homeless population (Noy, 2008).

While non-probability sampling allows for flexibility and can provide rich, contextual data, the trade-off is a reduced ability to make statistically significant generalisations. Researchers must carefully weigh their research goals and the importance of generalizability when selecting a sampling method (Singh & Masuku, 2014).

## 5.0 Sampling Technique

Choosing the appropriate sampling technique depends on the research objectives, the nature of the population, and the available resources. Probability and non-probability sampling each have strengths and limitations, and the selection between them should be guided by the specific context and goals of the study (Etikan, Musa, & Alkassim, 2016)..

### 5.1 Guidelines for Selecting a Sampling Technique

Probability sampling is typically the method of choice when conducting quantitative research to produce generalisable results. This approach is most suitable for large-scale surveys that aim to make inferences about a population (Tille, 2020). For instance, national surveys, public health studies, and election polls rely on probability sampling methods such as simple random, stratified, or cluster sampling. These techniques allow researchers to control for sampling bias and estimate the margin of error, enhancing the findings' validity (Lepkowski & Bowles, 2020). Furthermore, when the goal is to make population-level estimates, the random selection process inherent in probability sampling ensures a more representative sample, which is critical for accurate generalisation (Singh & Masuku, 2014).

On the other hand, non-probability sampling is commonly used in exploratory or qualitative research, where the primary aim is not generalisation but rather a deep understanding of a specific phenomenon or population. For example, researchers studying marginalised or hard-to-reach populations often use purposive or snowball sampling to ensure that individuals with relevant experiences or characteristics are included (Palinkas et al., 2015). Non-probability sampling methods such as convenience or judgmental sampling are also useful in time-sensitive studies where quick data collection is a priority (Emerson, 2015). In exploratory research, the focus is often on developing theories or generating hypotheses, which can be achieved with a smaller, non-representative sample (Etikan, Musa, & Alkassim, 2016).

### 5.2 Linking Sampling Techniques to Research Scenarios

Probability sampling is indispensable in large-scale surveys like national health surveys or election polls. These studies often involve a diverse population with varying characteristics, and using probability sampling ensures that the sample accurately reflects this diversity (Bornstein, Jager, & Putnick, 2013). In this context, stratified sampling can be especially useful when researchers must ensure representation across specific subgroups, such as different age groups, income levels, or geographic regions (Flores et al., 2017). Similarly, cluster sampling is advantageous when studying large populations spread across vast geographic areas, as it allows researchers to divide the population into clusters and randomly select entire clusters for study, reducing logistical costs (Singh & Masuku, 2014).

For qualitative research, such as case studies or ethnographic research, non-probability sampling is often preferred. In these studies, the focus is on in-depth exploration rather than generalisation, and purposive sampling is frequently used to select participants who possess specific knowledge or experiences relevant to the research question (Palinkas et al., 2015). For example, a researcher studying the lived experiences of individuals with rare diseases might use purposive sampling to focus on participants who have undergone particular treatments or interventions (Noy, 2008). Snowball sampling is also valuable in this context, especially when the population of interest is difficult to identify or access, such as individuals engaged in illegal activities or members of marginalised communities (Heckathorn, 2011).

In time-sensitive studies, non-probability sampling methods like convenience or quota sampling may be employed to collect data quickly. For example, during a public health emergency, researchers might use convenience sampling to gather data from a nearby hospital or community centre to understand the immediate impact of the crisis (Vehovar, Toepoel, & Steinmetz, 2016). While this approach sacrifices some generalizability, it provides timely insights informing urgent policy decisions (Jager, Putnick, & Bornstein, 2017).

### 5.3 Ethical Considerations in Sampling

Ethical considerations are critical when selecting a sampling technique, particularly concerning fairness in participant selection. In probability sampling, ethical issues often relate to ensuring that all individuals in the population have an equal chance of being selected, which is essential for maintaining equity and avoiding discrimination (Vehovar, Toepoel, & Steinmetz, 2016). For instance, in stratified sampling, researchers must ensure that minority groups are appropriately represented and their voices are not excluded from the research findings (Flores et al., 2017). Failure to do so could result in biased outcomes that perpetuate inequalities.

In non-probability sampling, ethical concerns typically focus on the selection process and potential biases introduced by the researcher's discretion. Researchers must be transparent about the limitations of non-probability sampling and avoid overstating the generalizability of their findings (Palinkas et al., 2015). Additionally, researchers should ensure that vulnerable or marginalised populations are not exploited or unfairly targeted in convenience or snowball sampling studies (Etikan, Musa, & Alkassim, 2016). In snowball sampling, for example, recruiting participants through existing networks may inadvertently exclude individuals not part of those networks, raising ethical concerns about inclusivity and representation (Noy, 2008).

Informed consent is another key ethical consideration in both probability and non-probability sampling. Researchers must provide participants with clear information about the study's purpose, procedures, and potential risks, ensuring that participation is voluntary and that individuals can withdraw at any time (Heckathorn, 2011). This is particularly important in studies involving vulnerable populations, where there is a greater risk of coercion or exploitation (Emerson, 2015).

In summary, selecting the appropriate sampling technique requires careful consideration of the research goals, population characteristics, available resources, and ethical obligations. Probability sampling is typically favoured in studies aimed at generalisation. In contrast, non-probability sampling is more suited to exploratory or qualitative research. Regardless of the method chosen, researchers must ensure that their sampling practices are ethical and transparent, upholding fairness and respect for participants.

## 6.0 Examples

### 6.1 Probability Sampling Example

A relevant local example of probability sampling is the Malaysian Population and Housing Census conducted by the Department of Statistics Malaysia. This national census uses stratified random sampling to gather data on the Malaysian population's demographic, social, and economic characteristics. The process involves dividing the entire population into strata based on criteria such as geographical regions, ethnic groups, and urban versus rural settings. Within each stratum, a random selection of households is chosen to participate in the survey (Department of Statistics Malaysia, 2021).

This stratified random sampling approach ensures that the sample is representative of the diverse population of Malaysia, allowing for accurate estimates of population size, housing conditions, and socioeconomic indicators. The data collected through this method is crucial for informing government policies, resource allocation, and development programs (Lee & Lim, 2022). Probability sampling in this census is essential for producing reliable, generalisable data that reflects the characteristics of the entire population, which is vital for effective policy-making and planning at both national and local levels.

### 6.2 Non-Probability Sampling Example

A relevant local example of non-probability sampling in social science research can be found in a study conducted by Tan and Rahman (2021) on the experiences of migrant workers in Malaysia. In this research, the authors employed purposive sampling to select participants who were directly involved in the construction industry and had experience as migrant workers. This approach was chosen to ensure that the participants had specific and relevant insights into the challenges and experiences faced by this demographic group.

The purposive sampling technique allowed Tan and Rahman to gather in-depth qualitative data on issues such as working conditions, social integration, and the impact of migration policies. By focusing on individuals with direct knowledge and experience, the researchers explored aspects of the migrant workers' experiences that might not be captured through more general sampling methods (Tan & Rahman, 2021). This study highlights how non-probability sampling can effectively investigate complex, context-specific social issues and generate valuable insights for policy development and social support programs.

## 7.0 Challenges and Future Directions in Sampling

### 7.1 Challenges in Implementing Sampling Techniques

Both probability and non-probability sampling methods face significant challenges in today's research environment. For probability sampling, one major issue is the increasing difficulty of reaching representative samples due to the rise of online surveys and the decline in response rates. The challenge of achieving a representative sample has been exacerbated by the digital divide, where certain demographic groups are underrepresented in online survey samples (Bethlehem, 2020). Additionally, the cost and logistical complexity of implementing probability sampling techniques, such as stratified or cluster sampling, can be prohibitive, particularly for researchers with limited resources (Groves et al., 2016). These practical constraints may lead to increased reliance on alternative sampling methods or the adoption of less rigorous sampling techniques.

Non-probability sampling also encounters its own set of challenges. For example, convenience sampling often suffers from selection bias, as it relies on participants who are readily accessible rather than representative of the broader population (Etikan, Musa, & Alkassim, 2016). This can limit the generalizability of the findings and introduce significant bias. Snowball sampling, while useful for reaching hidden populations, can also lead to sampling bias as participants recruit others from their own social networks, which may not represent the entire target population (Heckathorn, 2011). Furthermore, non-probability sampling methods may struggle with issues of validity and reliability, making it challenging to produce findings that can be generalised or used for policy-making (Palinkas et al., 2015).

## 8.0 Future Directions in Sampling Methods

The advancement of big data and artificial intelligence (AI) is poised to impact sampling methods, offering opportunities and challenges significantly. Big data enables researchers to access vast amounts of information from various sources, enhancing the precision of sampling and improving the representativeness of samples (Kitchin, 2014). For instance, data from social media platforms and digital transactions can provide rich insights into population characteristics and behaviours, potentially reducing the need for traditional data collection methods (Hsu et al., 2020). AI-driven selection tools can also optimise sampling processes by using algorithms to identify and recruit participants more effectively, potentially addressing some of the biases and inefficiencies inherent in manual sampling methods (Mann & Wiggins, 2016).

However, these advancements come with their own set of challenges. Using big data and AI in sampling raises concerns about data privacy and ethical considerations, as researchers must navigate the complexities of handling large datasets and ensuring that personal information is protected (Zook et al., 2017). Additionally, the reliance on digital and algorithmic methods may inadvertently perpetuate existing biases or introduce new forms of bias, particularly if the data used to train A.I. systems does not represent the broader population (O'Neil, 2016). As researchers increasingly adopt these advanced techniques, they must remain vigilant about the potential for bias and work to develop methods that ensure fairness and accuracy in sampling.

The future of sampling methods will likely involve a combination of traditional and innovative approaches, leveraging the strengths of both to address the limitations of each. Integrating big data and AI with established sampling techniques could enhance the efficiency and accuracy of research while addressing some of the challenges associated with traditional methods (Hsu et al., 2020). Researchers must continue exploring and refining these approaches, balancing technological advancements with ethical considerations and methodological rigour.

## 9.0 Conclusion

In summary, the choice between probability and non-probability sampling techniques is critical for the validity and reliability of research outcomes. Probability sampling methods, such as simple random, stratified, systematic, and cluster sampling, provide each individual in the population with a known chance of being selected, which enhances the representativeness of the sample and allows for the generalisation of findings (Groves et al., 2016; Singh & Masuku, 2014). These methods are particularly valuable in large-scale surveys and studies where accurate population estimates are essential (Tille, 2020). However, high costs, logistical complexities, and declining response rates can impact their effectiveness (Bethlehem, 2020).

Conversely, exploratory or qualitative research often employs non-probability sampling methods, including convenience, purposive, snowball, and quota sampling. These methods are useful for gaining in-depth insights into specific phenomena or populations, particularly when time or resource constraints are present (Etikan, Musa, & Alkassim, 2016; Palinkas et al., 2015). Despite their utility, non-probability sampling techniques can introduce biases and limit the generalizability of findings, which researchers must carefully consider when interpreting results (Heckathorn, 2011; Noy, 2008).

The advent of big data and AI-driven tools presents opportunities and challenges for sampling methodologies. These advancements can enhance the precision of sampling and improve representativeness but also raise concerns regarding data privacy, ethical implications, and the potential for new biases (Hsu et al., 2020; Kitchin, 2014). As researchers navigate these developments, they must balance technological innovations with rigorous methodological practices to ensure ethical and accurate research outcomes (O'Neil, 2016; Zook et al., 2017).

Selecting the appropriate sampling technique is crucial for achieving valid, reliable, and ethical research results. Researchers are encouraged to carefully evaluate their sampling methods in the context of their research objectives and constraints. By doing so, they can ensure that their findings are robust and representative and contribute meaningfully to their fields of study.

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