Health Sciences International Journal (HSIJ)
Vol. 4, No. 1, Februari 2026, pp. 1 – 22
ISSN: 3026-5037 DOI: https://doi.org/10.71357/hsij.v4i1.87

Review

Research classification: Principles and applications for health research

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ARTICLE INFO

Article history:
Received 13 September 2025
Accepted 21 November 2025
Published 28 February 2026

Keywords:
Health research
Research design
Quantitative
Qualitative
Mixed methods

ABSTRACT

Background: Health research plays a crucial role in generating evidence that supports clinical practice, policy development, and public health interventions. The diversity of research types—ranging from descriptive to experimental studies—reflects the complexity of health problems and the need for appropriate methodological approaches.
Objective: This review aims to provide a comprehensive overview of the classifications of health research, emphasizing their characteristics, purposes, strengths, and limitations, as well as factors that determine the choice of research design.
Discussion: Health research can be classified based on purpose, design, approach, time, and population. Basic research contributes to fundamental scientific knowledge, while applied, evaluative, and developmental studies bridge theory with practical solutions. Quantitative approaches allow generalization of findings, qualitative approaches capture cultural and social meanings, and mixed methods integrate both dimensions to offer a holistic perspective. By design, studies can be descriptive, analytic observational, experimental, quasi-experimental, case studies, or action research, each serving specific contexts and questions. The choice of design is influenced by research questions, available resources, validity requirements, ethical considerations, and socio-cultural characteristics of the population.
Conclusion: A careful selection of methods ensures that research not only contributes to scientific knowledge but also provides practical implications for improving health outcomes and informing policy decisions.

1. Research as a basis for public health

Global health has faced increasingly complex and multidimensional public health challenges over the past decade. Phenomena such as stunting, non-communicable diseases (NCDs), and food security threatened by climate change have become central concerns in national health policies (Guell et al., 2024; Kurebwa & Kurebwa, 2024; Sutanto, 2024; Wheatley, 2024). According to the Survei Status Gizi Indonesia (SSGI), the prevalence of stunting declined from 24.4% in 2021 to 19.8% in 2024. However, the government's ambitious target of reducing stunting to below 14.2% by 2029 requires more systematic and evidence-based approaches (Ministry of Health - Republic of Indonesia, 2023; UNICEF, 2025).

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Meanwhile, the prevalence of diabetes and cardiovascular diseases continues to rise, reflecting an epidemiological transition that demands an integration of promotive, preventive, and curative approaches (Priya et al., 2023). Health research is not only an academic tool but also a strategic instrument to design, evaluate, and revise health interventions relevant to local needs. Well-designed research can bridge the gap between policy and practice, while also strengthening community capacity to address dynamic health challenges (Malagón de Salazar, 2018; Miranda et al., 2024; Wadsworth et al., 2024).

The transformation of health systems in the post-pandemic era underscores the urgency of strengthening scientific foundations in policymaking. However, the effectiveness of policies largely depends on the quality of data and analysis underpinning them. Evaluative research, for instance, plays a critical role in assessing the impact of policies on vulnerable populations such as low-income groups and those living in remote areas. Participatory and transdisciplinary approaches have become increasingly relevant, as they integrate local perspectives with rigorous scientific frameworks (Dias et al., 2015; Meessen et al., 2012; Yiu et al., 2021). Research is no longer viewed as the exclusive domain of academia but rather as a collaborative process involving governments, health workers, community cadres, and the general public. Consequently, health research serves as a foundation for building adaptive, inclusive, and sustainable systems (Azizan et al., 2023; Françoise et al., 2022).

The double burden of malnutrition (DBM)—where populations simultaneously face undernutrition and overnutrition—represents a growing challenge requiring more flexible and contextualized research approaches (Hoffman et al., 2023; Kiosia et al., 2024). Shifts in dietary patterns, influenced by extreme diet trends such as keto and intermittent fasting, risk reducing dietary diversity, particularly among urban populations exposed to health information that is not always evidence-based. Meanwhile, rural communities are struggling with food insecurity due to climate change affecting staple food production (Agudelo Ibáñez, 2023; Charles, 2024). Community-based research, including longitudinal studies and action research, is essential to capture these dynamics in depth. By engaging communities as both subjects and partners, such approaches generate recommendations that are more contextual and applicable. Research thus extends beyond numerical measurements to capture lived experiences and the social meanings of health and nutrition challenges (Quinteros-Reyes et al., 2024).

The rising prevalence of NCDs such as hypertension, cancer, and metabolic disorders necessitates research designs capable of accurately identifying risk factors. Cohort studies and

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case-control studies are particularly relevant in this context, as they enable the analysis of associations between exposures and health outcomes over time (Muñoz & Nieto, 2021; Zhang, 2024). For example, a cohort study among industrial workers can reveal the relationship between pollutant exposure and chronic respiratory diseases. Retrospective research also plays an important role in analyzing medical records to identify disease patterns and treatment effectiveness. In practice, a combination of quantitative and qualitative approaches is often required to understand not only what is happening but also why and how communities respond to health conditions. Hence, the appropriate research design is key to producing reliable evidence that informs both clinical and policy decision-making (Bai & Yang, 2024; Gail et al., 2019).

Research serves as an essential navigational tool to ensure that innovations and interventions genuinely address community needs in the era of digital transformation and decentralized healthcare services (Abdillah, 2024; Rakuasa, 2023; Tira et al., 2024). The purpose of this review is to provide a comprehensive understanding of the types of health research, examine their strengths and limitations, and highlight the relevance of each research type for public health practice.

2. Classification of Research

Health research encompasses a wide range of classifications that assist researchers in selecting approaches aligned with objectives, resources, and community contexts. Understanding these classifications is crucial to ensure that research does not merely end with data collection but is able to generate practical recommendations relevant to public health services. The following are several common classifications of health research.

Objective-oriented approach

Basic research

Basic research refers to scientific studies aimed at understanding the principles, mechanisms, and fundamental processes of life without direct consideration of practical applications. It provides the theoretical foundation for the development of translational medicine, therapies, and future health technologies. Long-term investment in this area often leads to significant breakthroughs in disease diagnosis and treatment (Beyer et al., 2023; Campos & Pfister, 2023; Sequeira, 2024). Example, basic research on cellular communication systems, such as the Wnt signaling pathway in embryonic development, has laid the theoretical groundwork for innovative therapies for osteoporosis or cancer (Houschyar et al.,

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2019; Tejeda-Muñoz & Mei, 2024; Yu et al., 2024).

Applied research

Applied research is a systematic investigation designed to understand and determine ways to address specific needs or problems. Its primary aim is to translate scientific knowledge into tangible solutions for particular health issues. This type of research focuses on pragmatic outcomes that can be immediately applied in practice, such as improving health policies, designing interventions, or enhancing public services (Marotti de Mello & Wood Jr, 2019; Song, 2021; Vilcahuamán & Rivas, 2017). A common example includes evaluating nutrition interventions for toddlers in rural areas—assessing whether locally based supplementary feeding significantly improves nutritional status.

Evaluative research

Evaluative research assesses the effectiveness, efficiency, and relevance of health programs or policies using scientific methods. Its purposes include strategic, formative, summative, and implementation analyses of health interventions. The utility of this research lies in its ability to evaluate the impact of health policies, identify barriers and facilitators, and formulate strategies for program improvement. Through evaluative research, policymakers can ensure that interventions are aligned with community needs and provide optimal benefits (Baratieri et al., 2019; Raine et al., 2016). For instance, evaluating a measles immunization program in a given region—measuring its effectiveness in reducing incidence rates, required costs, and implementation barriers—represents a concrete example of evaluative research.

Research and development

Research and Development (R&D) is a structured approach that guides the creation of new medical products and services, ensuring their alignment with public health needs and regulatory requirements. The goal of R&D is to create, refine, or adapt new products, models, or technologies in healthcare. This type of research is not only concerned with testing theories but also with generating innovations that can be practically implemented (Gad et al., 2024; Huang & Gábor, 2024; Lee et al., 2023). Positioned between basic and applied research, R&D often utilizes fundamental findings to develop practical solutions for real-world application. Moreover, R&D usually involves limited trials to ensure feasibility, effectiveness, and user acceptance prior to broader implementation. Thus, R&D is highly relevant to addressing the demand for health innovations that are adaptive to technological advancements and societal dynamics (Sabali et al., 2022). Examples include the development of educational modules for

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mothers with low literacy levels to facilitate comprehension of health information, or the creation of mobile applications for monitoring hypertension among older adults.

Methodological approach

Quantitative research

Quantitative research is a scientific approach that involves the collection and analysis of numerical data to understand patterns, relationships, or trends within a specific field, with the aim of testing hypotheses and generalizing findings to a broader population. Its primary objectives include establishing generalizable facts, testing hypotheses, and predicting future outcomes through statistical analysis (Hering, 2021; Sciberras & Dingli, 2023a; Varbanova & Beutels, 2020). Utilizing designs such as surveys, controlled experiments, or cohort studies that rely on statistical techniques and numerical measurement tools, this approach enables researchers to systematically and reproducibly investigate prevalence, distribution, and health risk factors (Watson, 2015). Its strengths lie in high internal validity and the ability to generalize findings, although it is often limited in exploring the social or cultural contexts underlying the data. For instance, a prevalence survey on childhood stunting or a quantitative analysis of the relationship between dietary patterns and cholesterol levels represents common applications of quantitative research in public health.

Qualitative research

Qualitative research is defined as a set of methodological approaches designed to generate in-depth understanding of the social world by exploring the experiences, perspectives, and histories of individuals or communities. The primary aim of qualitative research is to develop concepts that clarify phenomena by emphasizing participants' meanings, experiences, and viewpoints. In health research, qualitative methods are employed to explore complex phenomena, such as the beliefs underlying illness-related behaviors and the aspects of healthcare services most valued by different groups of users (Kemparaj & Chavan, 2013; Leepile, 2019; Murray, 2003; Renjith et al., 2021; Verhoef & Casebeer, 1997). Approaches such as ethnography, phenomenology, narrative analysis, and discourse analysis each provide unique insights into phenomena by uncovering the social, cultural, and subjective factors influencing health behaviors. The strength of this approach lies in its ability to provide contextualized and nuanced insights that quantitative methods may overlook, although its findings are not always broadly generalizable (Chasokela, 2024; Muurlink & Thomsen, 2024). Example, an ethnographic study examining rural community beliefs about

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exclusive breastfeeding practices illustrates how cultural norms and local knowledge shape maternal behaviors—an issue of critical importance but difficult to quantify numerically.

Mixed methods research

Mixed Methods Research (MMR) is a methodological approach that integrates both qualitative and quantitative research techniques within a single study or a series of studies. This approach is particularly valuable in health research, as it enables a comprehensive understanding of complex phenomena by combining numerical data with experiential insights. The primary objectives of MMR are to enhance the depth and breadth of understanding, address complex research questions, and provide a more holistic view of the research subject (Ginossar, 2022; Pérez Peña et al., 2023; Tariq & Woodman, 2013). MMR seeks to integrate clinical data with patient experiences to better inform health policies and practices. Its advantages include rich insights and validation of findings through data triangulation, though it requires complex designs and dual analytical expertise (Elsherif, 2024; Sciberras & Dingli, 2023b). For instance, a study on handwashing behavior in schools may employ quantitative measures (e.g., the number of children washing their hands correctly) alongside qualitative interviews (e.g., reasons why some children avoid handwashing), thereby providing a more holistic understanding of the phenomenon.

Framework-oriented

Descriptive studies

Descriptive research refers to studies aimed at portraying the characteristics of a population or phenomenon under investigation. Such studies do not answer questions of how, when, or why characteristics occur, which are instead addressed in analytical research. Their primary purpose is to describe the distribution of diseases or health behaviors—for example, the prevalence of obesity or the level of knowledge among pregnant women regarding danger signs of pregnancy—using data from cross-sectional studies, surveillance, or case reports/series. Descriptive studies rely on systematic observation and data collection methods, such as surveys, interviews, and questionnaires, to gather information about the population of interest (Deckert & Wilson, 2023; Mao & Huo, 2023). A concrete example would be a survey assessing the percentage of pregnant women who understand pregnancy danger signs without exploring the underlying determinants of such understanding.

Analytical observational studies

Analytical observational research investigates the natural course of events without

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active intervention by the researcher. This design includes cohort, case-control, and cross-sectional studies, all of which are employed to evaluate the relationship between exposures and outcomes. The main objective is to identify and analyze associations between variables, understand the prevalence of conditions, and assess the impact of different exposures on health outcomes. Such designs are valuable in revealing real-world determinants of health (Santa María, 2024). For instance, a case-control study examining the relationship between smoking habits and the incidence of lung cancer enables a valid exploration of risk factors within an epidemiological context.

Experimental and quasi-experimental studies

Experimental designs—particularly randomized controlled trials (RCTs)—involve randomized interventions to assess the effectiveness of health measures, whereas quasi-experimental designs are applied when randomization is not feasible. Their goal is to provide robust evidence on intervention effectiveness, such as testing the effects of probiotics in reducing the duration of acute diarrhea in children through an RCT. RCTs are highly valued for their ability to establish causality between interventions and outcomes. By randomly assigning participants to intervention or control groups, RCTs minimize selection bias and confounding variables, thereby allowing clearer outcome comparisons. In contrast, quasi-experimental designs may be used in real-world contexts—for example, comparing pre- and post-intervention groups without randomization—when full control is not possible. Their strength lies in their relatively higher causal validity, though they remain more limited than pure RCTs (Andrade, 2021; Fahmy et al., 2023; Voleti, 2024b; Zurita-Cruz et al., 2018).

Case studies

Case study research focuses on in-depth analyses of a single individual, group, or community without aiming for broad generalization. Its primary goal is to explore, describe, and explain complex issues, often to provide insights that inform decision-making or policy development (Duff, 2019; Green et al., 2022; Shishkov, 2020). For example, a case study on the empowerment practices of community health volunteers in a remote village may offer detailed insights into local strategies and challenges, thereby serving as a useful reference for designing interventions that are sensitive to specific sociocultural contexts.

Action research

Action research is a participatory and democratic approach to inquiry that emphasizes solving real-world problems through cyclical processes of planning, action, observation, and

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reflection. It is frequently applied in fields such as education and healthcare, where it addresses context-specific challenges. The main aim of action research is not necessarily to contribute to generalizable knowledge, but to inform local practices, facilitate professional learning, and empower participants to generate self-knowledge and solutions to their immediate problems. For instance, action research has been used to improve self-care practices and occupational safety among women weavers. This involves community participation and the co-development of action plans addressing both health and environmental concerns, ultimately leading to sustainable changes at the community level (Johnson, 2020; Miksza et al., 2023; Nilvarangkul et al., 2013).

Time frame and direction of observation approach

Retrospective

A retrospective design utilizes secondary data previously collected to evaluate the relationship between risk exposures and disease outcomes in the past. Its primary purpose is to quickly and cost-effectively identify epidemiological associations, making it particularly suitable for studying rare conditions or long-term effects, although it is vulnerable to selection and information biases. Its utility lies in offering an initial exploration of exposure–outcome relationships without requiring new data collection, thereby serving as a pragmatic option in retrospective clinical or public health research (De Sanctis et al., 2022; Gundler et al., 2024; Panageas et al., 2018). For instance, analyzing the medical records of patients with diabetes mellitus to assess correlations between previous lifestyle factors and the development of latent complications is a typical application of this design.

Prospective studies

A prospective design involves planning and conducting research by following a group of individuals from a defined starting point into the future, prior to the occurrence of the outcomes of interest, in order to evaluate the relationship between exposure and health events. Its objective is to generate robust causal evidence, predict future health trends, and assess the effectiveness of interventions (Hammoudeh et al., 2018; Love et al., 2023; Seidler et al., 2019). This design is particularly valuable in epidemiology and disease risk assessment, such as in a cohort study of pregnant women monitored until delivery to observe the incidence of preeclampsia, which provides high-quality data despite greater demands on time and resources.

Longitudinal studies

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A longitudinal design, a subtype of cohort studies, involves repeated measurements on the same individuals over an extended period, enabling the analysis of changes in variables and transitions in health conditions. Its primary aim is to monitor long-term developments or dynamics—going beyond single snapshots—making it useful for understanding growth trajectories, chronic exposure effects, or shifts in health status over time. Although strong in capturing individual and temporal trends, longitudinal designs face significant challenges, including participant attrition, missing data, and the high resource demands of extended follow-up (Donovan, 2023; Lamphere & Holler, 2013; M. Wang & Huang, 2013). An example is a study that tracks child development from early childhood into adulthood to detail patterns of physical and cognitive growth.

Cross-sectional studies

A cross-sectional design involves simultaneous measurement of exposure and outcome variables in a defined population at a single point in time, without following individuals over time. Its purpose is to provide an overview of prevalence and distribution of conditions or behaviors, as well as to identify preliminary associations between variables. The advantages include cost-effectiveness and efficiency, making it ideal for population surveys, surveillance studies, and initial intervention planning. However, its limitations include the inability to establish causality and potential vulnerability to selection or information biases (Kesmodel, 2018; Puspa Zuleika & Legiran, 2022; Voleti, 2024a). A concrete example is a survey of smoking behaviors among high school students in a city, measuring prevalence along with demographic correlates without capturing temporal dynamics.

Subjects and Populations Approach

Cohort studies

A cohort study design represents a prospective or longitudinal, analytical observational approach that follows groups of individuals based on exposure status (e.g., exposed vs. non-exposed) to assess the incidence of future health outcomes. This design enables the evaluation of causal relationships with clear temporality between exposure and outcome and allows for the simultaneous assessment of multiple outcomes. Its utility in epidemiology is substantial, providing risk estimates, insights into disease etiology, and understanding of the natural history of diseases. However, cohort studies often require extended timeframes, substantial resources, and are prone to attrition bias resulting from loss to follow-up (Capili & Anastasi, 2021; Ghaith & Kirollos, 2024; Liu, 2023; X. Wang & Kattan, 2020). For instance, a

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cohort study monitoring groups of miners over several years to evaluate risks of chronic pulmonary disease demonstrates a realistic application in occupational epidemiology..

Case-control studies

Case-control studies are retrospective observational designs that compare individuals with a disease or condition (cases) to those without it (controls) to assess prior exposures. The purpose is to evaluate associations between risk factors and disease occurrence. This design is highly efficient for studying rare diseases or conditions with short latency periods. While cost- and time-efficient, it is susceptible to recall bias, where affected individuals may more readily remember exposures than controls, potentially leading to spurious associations (Haley & Huber, 2023; Krivicich et al., 2023; Tenny et al., 2025). Example, comparing mothers of children with diarrhea to mothers of healthy children to explore associations with household sanitation illustrates a classic implementation of the case-control design.

Randomized Controlled Trial

Randomized Controlled Trials (RCTs) are prospective experimental designs in which participants are randomly assigned to intervention or control groups, thereby enabling rigorous evaluation of intervention effectiveness with high internal validity (Zabor, 2020; Hariton & Locascio, 2018). Randomization minimizes selection bias and ensures balance of confounding factors across groups (Spieth et al., 2016). RCTs are widely regarded as the gold standard for establishing causal relationships in health interventions, though they often require considerable resources and careful ethical considerations (Hariton & Locascio, 2018; Siepmann et al., 2016; Voleti, 2024c; Zabor et al., 2020). A concrete example includes clinical trials of iron supplementation among pregnant women to prevent anemia, where the RCT design allows direct and reliable evaluation of intervention effectiveness.

3. Selecting the Appropriate Research Design

Strengths and limitations of each approach

Each type of research in the health field has its own methodological strengths and limitations that must be understood to ensure accurate interpretation of results. Descriptive research, for instance, is advantageous in providing a general overview of the health status of a population at a given point in time. However, its limitation lies in the inability to establish causal relationships (Mao & Huo, 2023). Conversely, analytical observational studies, such as case-control or cohort designs, are stronger in assessing the association between exposure and outcomes, though they remain vulnerable to selection or recall bias (Indu & Vidhukumar,

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2021; Krivicich et al., 2023). xperimental studies or randomized controlled trials (RCTs) are considered the gold standard for testing the effectiveness of interventions, yet they are often constrained by cost, time, and ethical considerations (Troxel & Hade, 2024; Voleti, 2024b). Qualitative research, on the other hand, can capture sociocultural dimensions that quantitative data may overlook, but its generalizability is limited (Taherdoost, 2022). Therefore, the choice of research design must balance internal validity, generalizability, and the surrounding social context.

Determinants of research design selection

The choice of research design is intrinsically linked to the context of the problem under investigation, as it determines the methodological approach and influences the outcomes. This context encompasses the nature of the research question, the underlying assumptions, and the practicalities of data collection and analysis. Such alignment ensures that the research design is not only appropriate but also effective in addressing specific problems (Breakwell, 2023). For example, in maternal and child health programs in remote villages, challenges often include high rates of stunting, low immunization coverage, and limited maternal knowledge of balanced nutrition. In such cases, researchers must consider the primary purpose of the study. If the aim is to describe the general health conditions of mothers and children, a descriptive design using surveys may be appropriate. However, if the objective is to examine the relationship between parenting practices and stunting, an analytical observational design is more suitable, as it can explore causal associations without requiring direct intervention.

The selection of research design must also account for available resources, including research personnel, funding, time, and access to communities. Such alignment ensures that studies are feasible and can be effectively conducted within given constraints (Ragni et al., 2023). For instance, prospective studies following pregnant women from early pregnancy through childbirth may be ideal for identifying risk factors of complications, yet they require significant time and resources. When conditions are limiting, researchers may opt for a retrospective design using medical records or community health reports, which still provides valid insights despite inherent limitations. The key point is that research designs must remain realistic, feasible, and aligned with community capacities to ensure that findings can be rapidly translated into practice.

Beyond technical considerations, cultural and social factors also play a critical role in selecting research designs. Cultural and social contexts shape how research is conducted,

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interpreted, and applied (Ashdown & Maitner, 2024; Emon, 2024). For example, in breastfeeding studies, quantitative approaches may effectively capture exclusive breastfeeding rates but may not explain why some mothers resist breastfeeding. In such cases, qualitative approaches are indispensable. Through in-depth interviews or focus group discussions (FGDs), researchers can uncover cultural norms, traditional beliefs, or family pressures that influence maternal decision-making. Thus, mixed-methods designs often provide the most comprehensive understanding of public health problems by integrating quantitative breadth with qualitative depth.

Community participation is crucial to the success of health research. Participatory approaches, such as action research, enable communities to actively engage as partners rather than passive subjects. This approach respects the lived realities of communities and aims to foster sustainable social change (Ambuehl et al., 2024). For example, in maternal health improvement programs, community health volunteers and local leaders may be involved from the planning stage through data collection and intervention development. In this way, research outputs extend beyond academic reports, producing tangible impacts such as behavior change, enhanced community health worker capacity, and strengthened local health institutions. This illustrates that selecting an appropriate research design requires attention not only to academic rigor but also to program sustainability and community empowerment.

4. Conclusion

Health research encompasses a diversity of designs, objectives, and approaches that complement one another in addressing public health challenges. Basic research contributes to the expansion of fundamental knowledge, whereas applied, evaluative, and developmental studies bridge scientific inquiry with practical implementation. Methodologically, quantitative research enables generalization, qualitative research uncovers sociocultural meanings, and mixed methods provide a comprehensive perspective. Meanwhile, classifications based on design, time frame, and population—ranging from descriptive studies, cohort and case-control designs, to randomized controlled trials—offer methodological options tailored to context. The selection of research design is influenced by research questions, available resources, validity, ethical considerations, and sociocultural characteristics. Thus, a deep understanding of both strengths and limitations is essential for generating relevant and applicable evidence. Looking forward, the integration of digital health, big data, and precision

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ISSN: 3026-5037 DOI: https://doi.org/10.71357/hsij.v4i1.87

public health will further enrich research methodologies, yet such advances must remain grounded in robust research designs to enhance the quality of scientific evidence, policymaking, and health practice.

5. Conflict of interest

Author's declare no conflict of interest.

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Health Sciences International Journal (HSIJ)
Vol. 4, No. 1, Februari 2026, pp. 1 – 22
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