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Epidemiological Insights into Diabetes, Hypertension, and Cardiovascular Diseases: Implications for Public Health Nutrition

Mayaki Lucky David [a], Esther Oluwakanyinsola Olapade [b], Deborah Chinenye Uzor [c], Feyi Oshinyemi [d], Ebelechukwu Chinwe Metuh [e] and Ridwan Abiodun Alimi [f*]

[a] School of Health Studies, Northern Illinois University, Illinois, USA.
[b] Department of Medicine, Lagos State University, Lagos, Nigeria.
[c] Department of Public Health, University of Illinois Springfield, Illinois, USA.
[d] Department of Communication and Journalism, Eastern Illinois University, Illinois, USA.
[e] Department of Applied Microbiology and Brewing, Nnamdi Azikwe University, Awka, Nigeria.
[f] Department of Statistics, University of Ilorin, Ilorin, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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**Corresponding author: E-mail: alimiridwann@gmail.com;*

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ABSTRACT

This review examines the epidemiological understanding of diabetes, hypertension, and cardiovascular diseases as interconnected nutritional disorders. These conditions, sharing common dietary and lifestyle risk factors, collectively represent significant global public health challenges that require integrated investigation and intervention approaches. Epidemiological approaches, including descriptive, analytical, and interventional designs, emphasizing their strengths and limitations in investigating disease prevalence, risk factors, and potential interventions. It scrutinizes the utilisation of routine population data and surveillance systems in estimating disease burden and assessing intervention effectiveness, focusing on large-scale population-based studies and national surveys. Advanced statistical analyses enhance data interpretation while accounting for demographic variables, ensuring precise comparative analyses across populations. The application of standardization techniques and robust statistical methods strengthens epidemiological findings and minimizes potential biases. A coordinated, multidisciplinary approach is essential for translating epidemiological evidence into effective public health interventions, emphasizing collaboration between epidemiologists, healthcare practitioners, and policymakers. This analysis provides insights for researchers, public health professionals, and policymakers engaged in addressing nutrition-related chronic diseases through epidemiological approaches, highlighting the field's potential to mitigate the escalating burden of these conditions while acknowledging its limitations.

Keywords: Nutritional epidemiology; chronic diseases; population databases; disease surveillance; risk factor analysis; intervention effectiveness; public health nutrition.

1. INTRODUCTION

The field of public health nutrition relies heavily on epidemiological approaches to comprehend and tackle prevalent nutritional disorders, particularly diabetes, hypertension, and cardiovascular diseases. These conditions have emerged as critical public health issues, given their widespread occurrence and substantial contribution to global morbidity and mortality rates. The elevated glucose levels characteristic of diabetes can result in severe complications, including neuropathy and various cardiovascular ailments [1]. Hypertension, manifesting as abnormally high blood pressure, significantly increases the risk of cerebrovascular incidents and cardiac disorders, with dietary factors often exacerbating its progression [2]. Cardiovascular diseases, encompassing conditions such as coronary artery disease and heart failure, represent the foremost cause of mortality worldwide, with a strong correlation to nutritional practices and lifestyle choices [3]

Addressing the rising prevalence of chronic illnesses, that is; diabetes, hypertension, and cardiovascular diseases (CVDs), requires a strong focus on public health nutrition. These conditions' increasing frequency and substantial impact to morbidity and mortality have made them serious worldwide public health problems. In 2019, 463 million people worldwide were predicted to have diabetes, and by 2045, that number is expected to rise to 700 million, according to the [4]. More than two-thirds of the 1.13 billion individuals who suffer from hypertension live in low- and middle-income nations [5]. An estimated 17.9 million fatalities a year, or 31% of all deaths globally, are attributed to cardiovascular disorders, which include coronary artery disease and stroke. These conditions continue to be the leading cause of mortality worldwide [6].

The interplay between these conditions is deep, as they share common risk factors such as poor dietary habits, physical inactivity, obesity, and tobacco use. These risk factors not only aid in the development of the diseases but also accelerate their course, which, if unchecked, can result in serious consequences. For example, owing to the fact that diabetes damages blood arteries over time, poorly controlled diabetes also raises the risk of cardiovascular events, such as heart attacks and strokes [3,7]. On the other hand, hypertension is a known risk factor for both diabetes and cardiovascular diseases (CVDs), with a markedly increased chance of heart failure, renal disease, and stroke [5].

Epidemiological studies have been instrumental in unraveling the relationships between these conditions and their shared risk factors. Large-scale population studies, including the INTERHEART research and the Nurses' Health research, have shed important light on the ways

that lifestyle choices like food and exercise affect the onset of many chronic diseases [8,9]. These findings highlight the necessity of public health initiatives that aim to mitigate these risk factors by promoting greater amounts of physical exercise and better eating habits.

Despite the abundance of epidemiological data, there are still difficulties in precisely estimating the worldwide prevalence of these diseases since different regions have varied diagnostic standards and data gathering techniques. Due to major infrastructural hurdles in the healthcare system, underreporting and inadequate disease management are common in low and middle-income countries, where the frequency of chronic diseases are rising at a geometric pace [10]. Also, the shift to Westernised diets in many emerging nations has led to an increase in obesity, which in turn has fuelled the prevalence of CVDs, diabetes, and hypertension [11].

This research thereby aims to unriddle the pivotal role of epidemiology in elucidating and addressing these three major nutritional disorders: diabetes, hypertension, and cardiovascular diseases. Given their substantial impact on public health, these conditions necessitate the application of comprehensive epidemiological methodologies to formulate efficacious interventions. The interplay between dietary habits, lifestyle factors, and the development of these diseases highlights the importance of epidemiological research in informing public health strategies and nutritional recommendations.

2. MATERIALS AND METHODS

This review was conducted using a systematic approach to identify relevant studies on diabetes, hypertension, and cardiovascular diseases from various databases, including PubMed, Scopus, and Web of Science. Studies were selected based on their relevance to the topic, and data were synthesized to provide a deep understanding of the shared risk factors and epidemiological trends across the diseases.

2.1 Overview of Study Designs in Epidemiology

In nutritional epidemiology, significant advancements have been made in explicating the prevalence, risk factors, and potential interventions for non-communicable diseases such as diabetes, hypertension, and cardiovascular disorders. The application of various epidemiological methodologies, encompassing descriptive, analytical, and interventional approaches, has facilitated a comprehensive understanding of these conditions [12].

Descriptive epidemiological studies serve as the cornerstone for establishing disease distribution patterns within populations. Cross-sectional investigations, in particular, have proven instrumental in quantifying the prevalence of hypertension across diverse demographic subgroups [13]. A prime exemplar of such research is the National Health and Nutrition Examination Survey (NHANES) conducted in the United States, which has yielded extensive data on hypertension prevalence and associated risk factors across age and ethnic strata [14].

The identification and assessment of risk variables and disease relationships has been greatly aided by analytical epidemiological techniques, particularly cohort and case-control studies. The long-term impact of dietary and lifestyle variables on the development of diabetes and cardiovascular illnesses has been particularly well-explained by longitudinal cohort studies [15]. With its extensive long-term follow-up of a sizable female cohort, the Nurses' Health Study, a groundbreaking cohort study, has significantly contributed to the identification of risk factors for type 2 diabetes and cardiovascular illnesses [16]. Among case-control studies, the INTERHEART study, with participants from 52 countries, demonstrated the importance of modifiable risk factors in the development of myocardial infarction, such as dietary practices, physical activity levels, and tobacco use. This investigation provided a global perspective on cardiovascular disease prevention strategies [8].

It is important to recognize the inherent methodological limitations of cohort and case-control studies, even though they have unquestionably improved our understanding of risk variables and disease relationships. Strict data collection procedures, suitable statistical adjustments for confounding variables, and rigorous study designs are necessary to minimize potential biases and guarantee the validity and reliability of research findings. Therefore, placing epidemiological findings in the context of population-specific characteristics is essential. The Nurses' Health Study results, for example, may not be as generalizable to other

ethnic and socioeconomic groups because the study's participants were primarily Caucasian females. Likewise, the global view on cardiovascular disease risk factors offered by the INTERHEART study does not adequately convey the different aspects of regional food habits and cultural factors that influence illness risk in specific populations.

2.2 Utilization of Epidemiological Data in Public Health Nutrition (PHN)

Epidemiological data is fundamental to understanding the prevalence and risk factors of non-communicable diseases, including diabetes, hypertension, and cardiovascular ailments, in the context of public health nutrition. This knowledge is crucial in creating successful ways to address these health risks (Akindahunsi et al. [17], Health Survey for England, Canadian Community Health Survey). Numerous data points from extensive population-based studies and nationwide surveys allow scholars and decision-makers to identify trends and factors influencing these circumstances in a range of demographic contexts.

Initiatives like the National Health and Diet Examination Survey (NHANES) in the US, which provides a thorough overview of disorders related to diet, are prominent among these data sources. Similarly, both the Canadian Community Health Survey (CCHS) and the Health Survey for England (HSE) provide insightful data on the prevalence of chronic illness in their respective populations (Health Survey for England, Canadian Community Health Survey). These surveys facilitate the exploration of intricate relationships between dietary habits, physical activity levels, and the onset of various health conditions, thus informing evidence-based public health policies and educational initiatives.

2.3 How Disease Burden is Estimated Using Routine Population Data

The utilisation of routine population data has proven indispensable in quantifying the burden of these non-communicable diseases, thereby guiding resource allocation and intervention strategies. A seminal effort in this domain is the Global Burden of Disease Study (GBD), which has provided extensive quantification of disease impact on a global scale (GBD [18], Roth et al. [19]). The GBD's findings for 2019 revealed that diabetes alone accounted for 1.37 million deaths worldwide, with a disproportionate impact on low- and middle-income nations [18]. Furthermore, the study highlighted the substantial mortality associated with ischemic heart disease and stroke, which collectively resulted in over 15 million fatalities globally in the same year [3,19]. At the national level, disease registries and surveillance systems play a crucial role in estimating disease burden. In the United States, the National Diabetes Surveillance System has been instrumental in tracking diabetes prevalence and incidence, revealing concerning trends, particularly among younger demographics [20]. Concurrently, the National Cardiovascular Data Registry (NCDR) has emerged as a vital resource for monitoring cardiovascular disease burden and evaluating the quality of healthcare delivery in this domain [21].

These epidemiological tools and data sources collectively contribute to an intensive understanding of the relationship between nutrition, lifestyle factors, and the development of chronic diseases. Leveraging this wealth of information will assist public health professionals in devising targeted interventions, allocating resources efficiently, and formulating policies that address the evolving landscape of non-communicable diseases in diverse populations.

2.4 Standardization for Age, Gender, and Other Demographic Factors

Standardization is an essential methodological strategy in the epidemiological research on diabetes, hypertension, and heart disease. This method allows for more accurate comparisons between populations and periods by accounting for differences in age, gender, and other demographic parameters [22]. Age-standardized prevalence rates are a commonly used method to evaluate the burden of disease in various age groups and populations. Menke et al. [23] used this method to explain why there are notable differences in diabetes prevalence in the US between socioeconomic and racial/ethnic groups.

Gender-specific analyses have been carried out to clarify the distinct risk profiles and patterns of disease that exist in populations of men and women. Furthermore, whether comparing disease burden or assessing the effectiveness of initiatives, researchers have used sophisticated standardization approaches to take into account a wider range of demographic characteristics, such as socioeconomic level, educational attainment, and differences between urban and rural areas [24]. More accurate and insightful

comparison analyses are made possible by these methodological techniques, which guarantee that detected differences are not confused by underlying population structures.

2.5 Population Databases

In public health research and policy formulation, population-based datasets such as NHANES and the Health Survey for England serve as critical resources. These comprehensive databases offer extensive information on prevalent health conditions including diabetes, hypertension, and cardiovascular ailments. Public health researchers utilize these datasets to investigate disease prevalence, associated risk factors, and temporal trends, which in turn inform the development of public health strategies. Complementing these broad-based datasets are disease-specific registries, exemplified by the UK's National Diabetes Audit and the American Heart Association's Get with The Guidelines registries. These specialized databases provide granular, patient-level information that is instrumental in evaluating clinical practices and shaping medical guidelines.

Nonetheless, the methodologies employed in amassing population-level data are not without their limitations. A significant proportion of this data is derived from self-reported information, which is susceptible to inaccuracies stemming from recall bias or deliberate underreporting. Furthermore, the heterogeneity in data collection protocols, sample sizes, and demographic representation across different studies can compromise data consistency and reliability. It is noteworthy that even ostensibly standardized data can be afflicted by these issues, potentially leading to distortions in reported disease prevalence rates and putative risk factor associations. Therefore, a critical appraisal of these methodological constraints is paramount for accurate data interpretation and the formulation of efficacious public health interventions.

3. RESULTS

Epidemiological research relies heavily on quantitative measures of disease occurrence within populations, particularly incidence and prevalence, to illustrate the magnitude and distribution of health conditions [25]. Incidence, defined as the number of new cases arising within a specified timeframe, contrasts with prevalence, which encompasses the total existing cases at a given point. These metrics serve as crucial indicators for assessing population health status and informing public health strategies. The global diabetes landscape exemplifies the application of these measures. In 2017, an estimated 22.9 million new diabetes cases emerged, while the prevalence reached 463 million in 2019. Projections suggest a substantial increase to 700 million cases by 2045 [25]. However, these figures may underrepresent the true extent of the condition due to factors such as undiagnosed cases and incomplete data collection in certain demographic groups.

Hypertension, on the other hand, presents another significant health challenge, affecting approximately 1.13 billion individuals worldwide. The annual incidence rate among adults is estimated at 10% [26]. Nevertheless, the accuracy of these statistics may be compromised by variations in diagnostic criteria, blood pressure measurement techniques, and population-specific risk factors, potentially leading to disparities in reported incidence and prevalence across different regions and demographic cohorts.

Globally, cardiovascular diseases (CVDs) are the leading cause of death, with 422.7 million cases reported in 2016. 17.9 million deaths worldwide that year were due to CVDs, or 31% of all deaths [10]. However, several confounding variables, such as differences in healthcare accessibility, diagnostic proficiency, and the existence of comorbidities, could affect these results. These factors may lead to underreporting or incorrect case classification, especially in settings with limited resources. These non-communicable illnesses represent significant problems to public health, as the epidemiological data presented demonstrates. It underlines the vital necessity for ongoing surveillance efforts and focused actions to properly control and mitigate their effects on population health. Furthermore, these statistics highlight the importance of considering potential limitations and biases in data collection and interpretation when formulating health policies and allocating resources for disease prevention and management.

Epidemiological data has played a pivotal role in identifying and quantifying the multifaceted relationships between various risk factors and the development of diabetes, hypertension, and cardiovascular diseases. This body of evidence has significantly informed the formulation of public health nutrition strategies aimed at

mitigating the burden of these non-communicable diseases.

Various research has consistently demonstrated strong associations between specific dietary patterns and an elevated risk of developing these conditions. Notably, the consumption of processed foods, sugar-sweetened beverages, and saturated fats has been implicated as a significant contributor to disease risk [27,28]. When it comes to determining links between dietary practices and the prevalence of diabetes and hypertension, the National Health and Nutrition Examination Survey (NHANES) has shown to be an excellent tool [29,30]. Furthermore, sedentary behaviour and physical inactivity are significant risk factors for these disorders in epidemiological investigations [31]. The implementation of public health efforts encouraging active lives and balanced nutritional practices as preventive measures has been accelerated by these findings. Significant differences in the incidence and prevalence of these disorders among other demographic groups, including those based on location, socioeconomic position, and ethnicity, have also been revealed by epidemiological data [32]. These findings highlight the necessity of focused interventions and appropriate resource distribution to overcome systemic health disparities.

4. DISCUSSION

4.1 Critical Examination of Research Design and Measure

Epidemiological investigations into diabetes, hypertension, and cardiovascular diseases employ diverse research methodologies, each with its unique strengths and limitations in assessing disease frequency and etiology. While these methodological approaches have advanced the understanding significantly, each presents distinct challenges that warrant careful consideration in interpreting their findings. The selection of an appropriate study design is crucial for obtaining valid and reliable results, as each approach offers distinct advantages and faces specific challenges [33].

Cross-sectional studies, while widely employed, present particular methodological concerns when investigating chronic conditions such as diabetes, hypertension, and cardiovascular diseases. Their inherent temporal limitations significantly constrain our ability to establish causality, potentially leading to incomplete understanding of disease progression and risk factor relationships. A notable example is the research conducted by Kim et al [34], which explored the relationship between abdominal obesity and cardiovascular risk factors. However, this study design's inability to capture disease development over time potentially obscures crucial temporal relationships between risk factors and disease outcomes. This constraint significantly impedes researchers' capacity to determine the chronological order of exposure and outcome Kim et al [34].

Case-control studies offer an efficient means of investigating the associations between exposures and chronic diseases. Wang et al. [35] exemplified this approach in their examination of dietary patterns and hypertension risk. Yet, these studies frequently encounter challenges related to recall bias and selection bias, particularly problematic when investigating dietary and lifestyle factors that may have changed over time. The retrospective nature of data collection in such studies raises questions about the reliability of exposure assessments, especially in conditions with long latency periods. However, the validity of case-control studies may be compromised by recall and selection biases, arising from participants' imperfect recollection of past exposures and the potential non-representativeness of the selected sample as emphasised by Tenny et al. [36]. Cohort studies provide a more robust framework for establishing causality by longitudinally tracking participants. The Nurses' Health Study stands as a prominent example, having yielded valuable insights into the impact of dietary and lifestyle factors on diabetes and cardiovascular diseases [9]. Despite their strengths, cohort studies are resource-intensive and time-consuming. Moreover, they are susceptible to attrition bias due to participant loss during follow-up, which can potentially skew results and diminish the representativeness of the sample, thereby affecting the validity of the findings [37].

In epidemiological research, randomized controlled trials (RCTs) are considered the gold standard for determining causal links and assessing interventions. One of the first RCTs to show how lifestyle treatments can lower the incidence of type 2 diabetes in high-risk adults was the Diabetes Prevention Program [38]. RCTs' randomization procedure reduces confounding variables by guaranteeing that variations in outcomes are attributable to the

intervention rather than unrelated causes. This methodological strength improves the results' validity and dependability. However, RCTs have drawbacks as well; they can be expensive, logistically challenging, and, in some situations, ethically questionable [39].

4.2 The Importance of Surveillance in Public Health

Public health surveillance systems represent a critical infrastructure for monitoring these chronic conditions, yet their effectiveness is often constrained by methodological and practical limitations. These surveillance methods use systematic approaches to gather, examine, and share information regarding the incidence, prevalence, risk factors, and consequences of diseases, creating a complete epidemiological landscape. The implementation of these systems, while comprehensive in design, frequently encounters challenges in data quality, consistency, and timeliness of reporting.

To keep an eye on these disorders, the Centers for Disease Control and Prevention (CDC) in the US have implemented several surveillance programs. To evaluate the prevalence, incidence, and risk factors linked with diabetes, the National Diabetes Surveillance System compiles data from several sources. However, these programs often struggle with issues of representativeness and completeness, particularly in underserved populations. The systematic underrepresentation of certain demographic groups poses significant challenges to the generalizability of surveillance findings. Notwithstanding these drawbacks, the data from this method have been crucial in clarifying differences in diabetes prevalence among different socioeconomic and racial/ethnic groups, thus informing targeted initiatives and management strategies [40].

Similarly, the Behavioural Risk Factor Surveillance System (BRFSS) and the National Health and Nutrition Examination Survey (NHANES) of the CDC are significant sources of surveillance data for cardiovascular illnesses and hypertension. These surveys have greatly helped in the discovery of modifiable risk factors such as obesity, physical inactivity, and eating patterns, hence boosting our understanding and approach to addressing these disorders. It is crucial to recognize that these surveys might still have difficulties collecting some aspects of the illness burden, especially differences among underserved populations, which could affect the precision and thoroughness of prevalence estimates [41].

The Global Monitoring Framework for Non-Communicable Diseases (NCDs) was created by the World Health Organization (WHO) and includes global targets for reducing the prevalence of cardiovascular, hypertensive, and diabetic disorders [42]. This framework makes it easier to gather and analyze surveillance data from participating nations, allowing for cross-national comparisons and the discovery of worldwide trends and patterns.

4.3 Assessment of Intervention Performance via Surveillance

The evaluation of intervention effectiveness through surveillance data presents unique methodological challenges that merit careful consideration. An important factor in assessing the success of public health initiatives meant to lessen the burden of these chronic illnesses is surveillance data. However, the interpretation of such data requires careful consideration of potential confounding factors and implementation variables that may influence outcomes.

Surveillance systems track disease patterns, risk factors, and outcomes across time to evaluate the effectiveness of interventions and direct required revisions. One example of how surveillance data can be used effectively for intervention assessment is the Diabetes Prevention Program (DPP) [43]. While the program demonstrated significant success in reducing diabetes incidence, the generalizability of these findings to diverse populations and different healthcare settings remains a critical consideration. The varying results observed across different implementation contexts highlight the complexity of translating controlled trial findings into real-world outcomes. The DPP was the first scientific trial that showed how lifestyle treatments, with a focus on dietary changes and increased physical activity, could considerably lower the incidence of type 2 diabetes in high-risk adults. The National Diabetes Prevention Program (NDPP) and the DPP Outcomes Study (DPPOS) later data supported the participants' sustained decreases in cardiovascular risk variables and diabetes incidence [42]. The results of surveillance-based assessments of salt reduction programs have been inconsistent, underscoring the significance of comprehending their influence. Some countries see slight drops in blood pressure and

intake of sodium after implementation, while others see little to no change [44]. These differences underline the need for continuous monitoring and customized interventions to get over obstacles and difficulties that are unique to each nation to accomplish the intended results.

Another example of the importance of surveillance in determining the effectiveness of an intervention is the Finnish North Karelia Project, which aims to lower the risk of cardiovascular disease [45]. The experiment showed significant decreases in blood pressure, cholesterol, and cardiovascular death rates within the targeted population by using intensive surveillance and monitoring to measure outcomes. This strategy provided important insights into the dietary and lifestyle modifications promoting better health outcomes in addition to validating the intervention's effectiveness. While the project achieved notable success in reducing cardiovascular disease risk factors, the specific contextual factors contributing to this success may not be readily transferable to other settings. This raises important questions about the scalability and adaptability of successful interventions across different populations and healthcare systems.

Surveillance data however plays a critical role in resolving health inequalities in chronic disease therapies by facilitating focused methods that are tailored to the particular requirements and difficulties encountered by minority communities. This strategy is demonstrated by US initiatives such as REACH, which targets cardiovascular, diabetes, and obesity. The assessment of intervention efficacy and impact enhancement is facilitated by surveillance; however, obstacles continue because of data quality, consistency, and timely reporting, which are fundamental components of efficient disease surveillance [46]. These difficulties may make it more difficult to measure the effects of therapies and evaluate their efficacy in treating conditions including diabetes, hypertension, and cardiovascular disorders [47]. However, disease surveillance continues to be a crucial part of the ongoing efforts to treat these persistent illnesses [48,49].

5. EMERGING TRENDS AND FUTURE DIRECTION

Emerging trends in epidemiological research for diabetes, hypertension, and cardiovascular diseases are reshaping our understanding of these conditions and paving the way for more targeted interventions. The integration of big data analytics and artificial intelligence is revolutionizing disease surveillance and risk prediction, enabling researchers to identify subtle patterns and risk factors that were previously undetectable. Concurrently, the advent of wearable technologies and mobile health applications is facilitating real-time data collection, offering unprecedented insights into the day-to-day fluctuations of physiological parameters and lifestyle behaviors.

Looking ahead, the field is poised for significant advancements in precision epidemiology. This approach promises to refine our understanding of disease etiology by incorporating genomic, proteomic, and metabolomic data alongside traditional epidemiological measures. Furthermore, the growing emphasis on social determinants of health is likely to yield more comprehensive models of disease risk and progression, accounting for the complex interplay between biological, environmental, and societal factors. As these trends converge, future epidemiological research will likely adopt a more holistic, systems-based approach, potentially leading to more effective, personalized strategies for prevention and management of these chronic conditions.

6. CONCLUSION

Epidemiological research plays a significant role in the understanding and management of chronic conditions such as diabetes, hypertension, and cardiovascular diseases. However, it is imperative to recognize the inherent limitations of this field. While descriptive studies provide valuable insights, they fall short of establishing causal relationships. Analytical approaches, including case-control and cohort designs, are susceptible to various biases, such as selection, recall, and attrition. Even randomized controlled trials, despite their methodological rigour, face challenges in terms of generalizability and ethical considerations.

The quality of epidemiological data is often compromised by factors such as self-reporting inaccuracies, evolving diagnostic criteria, and inconsistent data collection methodologies across diverse populations. These issues significantly impact the reliability of routine surveillance systems and population databases. To address these shortcomings, there is a growing emphasis on the application of advanced statistical techniques to enhance the

robustness and minimize bias in epidemiological findings. Translating epidemiological evidence into effective public health interventions necessitates a multidisciplinary approach. Collaboration between epidemiologists, healthcare practitioners, and policymakers is essential for developing contextualized interventions that account for the unique characteristics of specific populations. The impact of epidemiology on chronic disease management is contingent upon continuous methodological refinement, improvements in data quality, and cross-sectoral cooperation to overcome its inherent limitations. To fully leverage epidemiology's potential in mitigating the escalating burden of chronic diseases, it is important to develop evidence-based nutrition policies and programs. This can only be achieved through a concerted effort to address the field's limitations while capitalizing on its strengths. By doing so, epidemiology can continue to provide valuable insights and guide effective interventions in the realm of public health.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have not been used during writing or editing of this manuscript.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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