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Assessing Health Professionals' Awareness of the Social and Health Impacts of Energy Inefficiency: An Empirical Study

Gazment Koduzi^{1*}, Rustem Celami², Elida Mataj³, Denada Selfo⁴

¹Faculty of Technical Medical Sciences, University "Aleksandër Xhuvani", Elbasan, Albania

²Gynecological Obstetric University Hospital "Koço Gliozheni", Tiranë, Albania

³Institute of Public Health of Albania, Tiranë, Albania

⁴Faculty of Health, University "Ismael Qemali", Vlora, Albania

*gazment.koduzi@uniel.edu.al

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Abstract

Introduction: Healthcare personnel play a critical role in identifying and addressing health risks associated with energy deprivation; however, their level of knowledge and perceptions in the Albanian context remain insufficiently explored. This study aims to assess healthcare professionals' awareness of the health impacts of household energy inefficiency and to examine differences according to gender and age. **Methods:** A cross-sectional survey was conducted among healthcare professionals employed in healthcare services and academia. Data were collected using a structured questionnaire assessing awareness of energy inefficiency and its health implications. Descriptive statistics and chi-square tests were applied, with a significance level set at $p < 0.05$. **Results:** Statistically significant differences were identified across gender and age groups. Female respondents demonstrated higher awareness of psychosocial consequences (88 vs. 19, $p < 0.001$), sleep disturbances (32 vs. 0, $p < 0.001$), and heat-related health risks (105 cases reported, $p < 0.001$). Male participants showed greater recognition of socioeconomic dimensions, including poverty-related impacts (45 vs. 53 among females, $p < 0.001$). Age-related differences were also observed, with participants aged 18–34 showing higher awareness of household energy inadequacy (32 cases, $p < 0.001$), while those aged 50–64 more frequently reported worsening of chronic conditions (35 cases, $p < 0.001$). **Conclusion:** Gender and age are significant determinants of healthcare personnel's awareness of the health impacts of energy inefficiency. These findings highlight the need for targeted educational and training interventions to strengthen health professionals' capacity in recognizing and addressing

energy-related health risks, emphasizing the integration of energy poverty considerations into public health strategies.

Keywords: energy inefficiency, healthcare personnel, awareness, public health, education

Introduction

Energy is a fundamental determinant of health and well-being, directly influencing the capacity of individuals and households to maintain safe, comfortable, and healthy living environments. Access to adequate energy for heating, cooling, lighting, and other essential needs is not only a technical or economic issue but also a matter of public health and social justice. Inadequate household energy, commonly referred to as energy poverty or energy inefficiency, has been associated with a wide range of adverse health outcomes.

Evidence from a large longitudinal study in Australia demonstrates that energy poverty significantly worsens mental health and increases the likelihood of hypertension and depression/anxiety among adults (Bentley et al., 2023). In addition, global analyses indicate that energy poverty has a negative impact on public health by limiting access to essential energy services, thereby reducing life expectancy and overall well-being (Pan et al., 2021). Furthermore, data from New York City show that multiple indicators of energy insecurity are associated with higher odds of respiratory illness, mental health disorders, and cardiovascular conditions, highlighting the importance of framing energy poverty as a critical public health issue (Siegel et al., 2024).

Although existing research has established the health implications of energy poverty at the household level, less attention has been given to how healthcare personnel perceive and understand these issues in clinical practice. Health workers play an essential role in identifying, reporting, and managing environmental and climate-related health problems in both clinical and community settings; however, studies suggest important gaps in their knowledge and preparedness. A systematic review found that healthcare professionals generally recognize climate change and its associated health risks, but often lack contextualized training and clarity regarding their role in response and mitigation efforts (Tesfaye et al., 2025; Kotcher et al., 2021).

Cross-sectional research among healthcare professionals in Greece reported high awareness of the health impacts of climate change, alongside notable gender differences in levels of concern (Kravvari et al., 2025). Similarly, a large nationwide survey of healthcare workers identified limited knowledge of climate-related health hazards, suggesting a widespread knowledge gap (Otoh et al., 2025). Other studies conducted in diverse settings have shown that healthcare personnel demonstrate moderate and variable perceptions of environmental health risks, including the direct

effects of climate and environmental change on patient health and workplace sustainability (Kotcher et al., 2021).

Research among medical students and future healthcare professionals indicates strong awareness of climate-related health threats and a clear demand for further education, emphasizing the need for targeted training interventions (Zubair et al., 2025; Flock et al., 2025). In addition, qualitative evidence suggests that climate-related stressors negatively affect both patient outcomes and the mental well-being of healthcare workers (Turzáková et al., 2024; Tesfaye et al., 2025).

Despite this growing body of literature, no prior study has specifically examined healthcare workers' awareness of the health impacts of household energy inefficiency, nor assessed how this awareness varies by gender and age, particularly in low-resource settings such as Albania. Addressing this gap, the present study assesses the level of knowledge among healthcare personnel in the Vlora region regarding the health impacts of energy inefficiency and explores demographic differences in these perceptions.

This study represents one of the first comprehensive assessments of healthcare personnel's knowledge and perceptions regarding the health impacts of household energy inefficiency in Albania. Previous research on energy poverty has largely focused on technical, economic, or general population-level health outcomes, often overlooking the perspectives of healthcare professionals as key actors in identifying and addressing health risks. Moreover, limited attention has been given to gender and age-related differences in awareness, as well as to the intersection of psychosocial, physical, and socioeconomic consequences of energy inefficiency within the healthcare workforce. By addressing these gaps, this study provides novel insights into how demographic factors influence recognition of energy-related health risks and identifies key areas for targeted training and awareness-raising interventions.

Methodology

This study employed a quantitative cross-sectional design to examine associations between demographic characteristics (gender and age), household energy deprivation, and healthcare professionals' awareness of the health impacts of energy inefficiency, particularly under extreme seasonal conditions. The primary objective was to identify patterns of awareness and lived experience related to energy deprivation and its potential physical and mental health consequences among healthcare professionals.

A cross-sectional design was considered appropriate as it allows the simultaneous assessment of exposures and outcomes within a defined population, providing a contextual snapshot of the phenomenon during a specific time period.

Study setting and population

The study was conducted in the Vlora region of Albania. This region was selected due to its role as a major regional healthcare hub serving both urban and rural populations, as well as its specific challenges related to healthcare service delivery, energy infrastructure, and seasonal population variability.

The target population included healthcare professionals employed in public healthcare institutions, public health specialists, and academic staff from the Technical Medical Department at “Ismail Qemali” University of Vlora. The inclusion of academic personnel alongside clinical and public health practitioners allowed for the integration of both practical and theoretical perspectives, strengthening the analytical scope of the study.

Additionally, the Vlora region was part of the implementation area of the project “EmpowerMED – Empowering Women to Take Action Against Energy Poverty in the Mediterranean”, which provided logistical support and facilitated access to healthcare facilities engaged in energy and public health-related initiatives.

Sampling and data collection

A purposive (goal-directed) sampling strategy was applied to ensure inclusion of participants with relevant professional experience and knowledge related to health and energy issues. Efforts were made to achieve variation across gender and three age groups (24–34, 35–49, and 50–64 years).

Data were collected through an online self-administered questionnaire distributed via institutional email addresses between June and August 2024. This period was selected to capture perceptions during the summer season, when heat-related energy needs are particularly relevant, while also including items addressing winter and year-round energy deprivation.

Participation was voluntary, and informed consent was obtained electronically prior to questionnaire access. Respondents were informed of their right to withdraw at any stage before submission. Eligibility criteria required participants to be medical doctors and currently employed in the healthcare sector within the Vlora region.

The average completion time of the questionnaire was 10–12 minutes.

Study instrument

The questionnaire was specifically developed for this study based on existing literature on energy poverty, energy insecurity, and health impacts. It consisted of closed-ended items organized into three sections:

Sociodemographic characteristics: gender, age group, and employment category.

Household energy deprivation: inability to meet energy needs, frequency of inadequate heating or cooling, and self-reported energy insufficiency.

Health-related awareness and perceived impacts: physical and psychological outcomes including sleep disturbances, stress, respiratory problems, headaches, irritability, concentration difficulties, and exacerbation of chronic conditions.

All responses were recorded in binary format (Yes/No), enabling categorical comparisons across groups.

Content validity was ensured through expert review by three specialists in public health, environmental health, and energy policy. Their feedback was used to refine item clarity and contextual relevance.

A pilot test involving 10 healthcare professionals from the same region (not included in the final sample) was conducted to assess clarity, relevance, and completion time. Minor modifications were made based on feedback.

Internal consistency reliability was assessed using Cronbach's alpha, which ranged between 0.78 and 0.91 across sections, indicating good reliability.

Ethical considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Participation was voluntary, and informed consent was obtained from all respondents. No personal identifiers were collected, ensuring anonymity and confidentiality. As the study did not involve clinical intervention or patient-level medical data, formal ethical committee approval was not required according to institutional regulations.

The authors declare no conflict of interest.

Data analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 25. Descriptive statistics were used to summarize participant characteristics and response distributions.

Inferential analysis was conducted using the Chi-square (χ^2) test of independence to examine associations between categorical variables, including gender, age group, and household energy deprivation versus awareness of health impacts.

Statistical significance was set at $p < 0.05$, with highly significant associations reported at $p < 0.001$. Results were presented using χ^2 values and corresponding p-values. Findings were organized in tables and figures to facilitate interpretation and comparison across groups.

Results

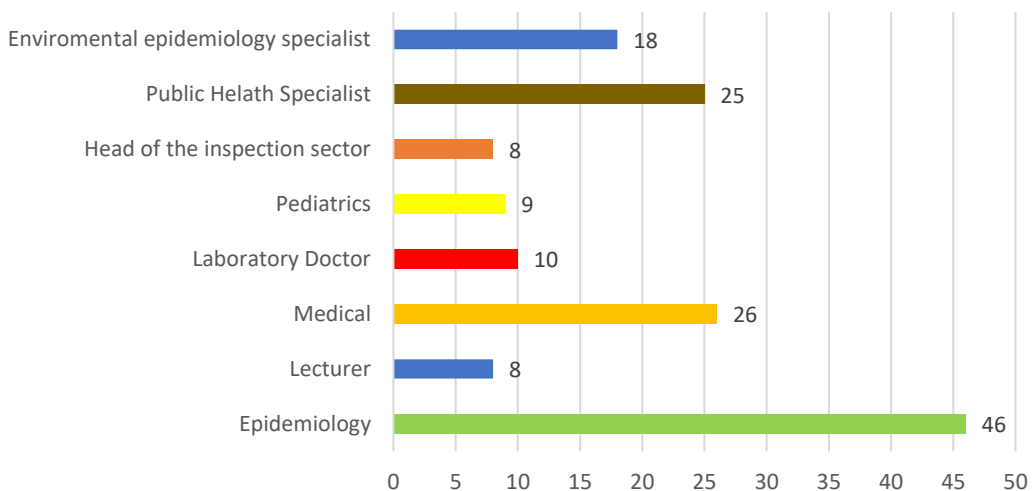
Participant characteristics

The professional distribution of study participants is presented in Figure 1. The sample was predominantly composed of epidemiology specialists ($n = 46$), followed

by medical doctors (n = 26) and public health specialists (n = 25). Environmental epidemiology specialists accounted for 18 participants.

Smaller proportions of respondents included laboratory physicians (n = 10), pediatricians (n = 9), university lecturers (n = 8), and heads of inspection services (n = 8). Overall, the distribution reflects a heterogeneous professional composition, with a predominance of participants working directly in epidemiological and clinical practice, thereby ensuring that responses reflect both population health and healthcare delivery perspectives.

Figure 1. Distribution of participants by professional role



Gender differences in perceived health and socioeconomic impacts of energy inefficiency

Table 1 presents the association between gender and perceived impacts of energy inefficiency across multiple health and socioeconomic indicators. The results demonstrate statistically significant differences between female and male healthcare personnel for all examined variables ($p < 0.001$), indicating a consistent gender-based variation in awareness and perception.

Female participants more frequently reported being affected by psychosocial and health-related outcomes, including psychosocial problems, stress, mental health problems, sleep disturbances, headaches, and heat-related health risks. In particular, heat stroke and psychosocial problems showed the strongest reported impact among female respondents. In addition, females more commonly identified respiratory and cardiac insufficiency as consequences of energy inefficiency.

In contrast, male participants more often reported socioeconomic dimensions of energy deprivation, particularly poverty and related economic constraints. However, for several health-related indicators, male respondents reported lower levels of

perceived impact compared to females, with some outcomes showing no reported effect in certain categories.

Overall, the findings indicate a clear and statistically significant gender disparity in perceived consequences of energy inefficiency. Female healthcare personnel tend to emphasize direct health and psychosocial effects, whereas male participants show relatively greater sensitivity to socioeconomic aspects. These patterns suggest that gender may influence the perception and framing of energy-related health risks within healthcare professionals.

Table 1. Gender differences in awareness of the health impacts of energy inefficiency

Indicator	Gender	Not affected (n)	Affected (n)	χ^2	p-value
Feeling cold	Female	88	17	56.133	< 0.001
	Male	9	36		
Diseases of skeletal system	Female	52	53	35.125	< 0.001
	Male	45	0		
Poverty	Female	52	53	34.111	< 0.001
	Male	0	45		
Hot days without cooling	Female	70	35	56.25	< 0.001
	Male	0	45		
Low level of economy	Female	70	35	56.25	< 0.001
	Male	0	45		
Minimum living conditions	Female	70	35	56.25	< 0.001
	Male	0	45		
Sustainability perception	Female	97	8	20.629	< 0.001
	Male	28	17		
Insufficient energy supply	Female	97	8	20.629	< 0.001
	Male	28	17		

Gender-related indicators	Female	87	18	30.106	< 0.001
	Male	17	28		
Respiratory & cardiac insufficiency	Female	35	70	56.25	< 0.001
	Male	45	0		
Psychosocial problems	Female	17	88	26.642	< 0.001
	Male	26	19		
Headache	Female	36	69	26.374	< 0.001
	Male	36	9		
Heat stroke	Female	0	105	76.829	< 0.001
	Male	27	18		
Mental health problems	Female	18	87	25.092	< 0.001
	Male	26	19		
Stress	Female	18	87	25.092	< 0.001
	Male	26	19		

Age and energy insecurity as determinants of perceived health and psychosocial outcomes

Table 2 presents the association between age, inability to meet household energy needs, and a range of perceived health and psychosocial outcomes among healthcare personnel. The results indicate statistically significant associations across all examined variables ($p < 0.001$), demonstrating that both age and energy insecurity are important determinants of perceived health impacts.

Regarding age-related differences, participants aged 18–34 years reported higher levels of inability to meet household energy needs compared to older age groups, particularly in relation to energy access during extreme conditions. This younger group also demonstrated higher reported associations with sleep disorders and selected psychosocial outcomes. Participants aged 50–64 years, in contrast, more frequently reported sleep disturbances, stress, depression, and irritability, suggesting a stronger perceived vulnerability to mental health-related outcomes in this age group. Middle-aged participants (35–49 years) showed a more balanced distribution of responses but still exhibited significant associations across most indicators.

In terms of physical health outcomes, respiratory tract infections and gastrointestinal disorders were significantly associated with both age and energy insecurity, with higher reported prevalence observed among middle-aged and older participants. Additionally, exposure to cold days without adequate heating was more frequently reported among participants aged 35–49 and 50–64 years, indicating increased vulnerability to seasonal energy deprivation in these groups.

When examining the role of inability to meet family energy needs, clear and statistically significant associations were observed with all health-related outcomes. Participants reporting energy insecurity were more likely to experience sleep disorders, psychosocial problems, headaches, reduced concentration, decreased effectiveness, worsening of chronic diseases, stress, and irritability. In contrast, participants without reported energy insecurity consistently showed lower frequencies across all adverse outcomes.

Overall, the findings indicate that both age and household energy insecurity significantly influence perceived health and psychosocial outcomes. Energy deprivation appears strongly associated with both physical and mental health challenges, while age modifies the pattern of these associations, with different age groups exhibiting distinct vulnerability profiles.

Table 2. Association of age and household energy insecurity with perceived health and psychosocial outcomes

Variable	Category	Not affected (n)	Affected (n)	χ^2	p-value
Inability to meet family energy needs	18–34	0	32	49.257	< 0.001
	35–49	37	18		
	50–64	45	18		
Sleep disorders	18–34	0	32	111.039	< 0.001
	35–49	45	10		
	50–64	0	63		
Stress / depression	18–34	32	0	63.32	< 0.001
	35–49	26	29		
	50–64	9	54		
Irritability	18–34	32	0	63.32	< 0.001
	35–49	26	29		

	50-64	9	54		
Respiratory tract infections	18-34	8	24	64.791	< 0.001
	35-49	9	46		
	50-64	54	9		
Gastrointestinal disorders	18-34	8	24	64.791	< 0.001
	35-49	9	46		
	50-64	54	9		
Cold days without heating	18-34	24	8	67.777	< 0.001
	35-49	0	55		
	50-64	10	53		
Sleep disorders vs energy insecurity	Not affected	35	47	19.687	< 0.001
	Affected	8	60		
Psychosocial problems	Not affected	35	47	17.378	< 0.001
	Affected	8	60		
Headache	Not affected	55	27	26.363	< 0.001
	Affected	17	51		
Lack of concentration	Not affected	9	73	26.005	< 0.001
	Affected	33	35		
Reduced effectiveness	Not affected	9	73	26.005	< 0.001
	Affected	33	35		
Worsening of chronic diseases	Not affected	9	73	26.005	< 0.001
	Affected	33	35		
Stress / depression (energy insecurity)	Not affected	18	64	37.763	< 0.001
	Affected	49	19		

Irritability (energy insecurity)	Not affected	18	64	37.763	< 0.001
	Affected	49	19		

Discussion

The findings of this study highlight the complex interplay between demographic characteristics, household energy insecurity, and awareness of the health impacts of energy inefficiency among healthcare personnel. Gender emerged as a significant factor influencing perceived health risks, with female participants demonstrating consistently higher awareness of psychosocial and physical health consequences, including stress, mental health problems, headaches, heat-related illness, and respiratory conditions. In contrast, male participants were more likely to recognize structural and socioeconomic determinants such as poverty, minimum living conditions, and low economic status. These patterns, evident in Tables 1 and 2, are consistent with evidence suggesting that women experience a disproportionate burden of energy poverty due to caregiving responsibilities and household management roles (Walters 2025; Shrestha et al., 2025). The statistical associations observed across all variables were highly significant ($p < 0.001$), confirming strong relationships between gender, age, and energy insecurity indicators.

Age-related differences were also evident. Younger healthcare workers (18–34 years) reported more acute manifestations of energy deprivation, particularly sleep disturbances and difficulties in meeting household energy needs. Middle-aged participants (35–49 years) showed higher associations with respiratory and gastrointestinal conditions, while older participants (50–64 years) reported more pronounced chronic outcomes, including stress, depression, and irritability. These findings are consistent with previous research indicating that prolonged exposure to energy insecurity contributes to cumulative health effects over time (Wang et al., 2024; Pan et al., 2021).

Household energy insecurity was strongly associated with a wide range of health outcomes, including sleep disorders, psychosocial problems, headaches, reduced concentration, and worsening of chronic diseases, as shown in Table 2. These findings reinforce the understanding of energy deprivation as a multidimensional social determinant of health (Hernandez and Siegel 2019; Graff and Aung 2025).

From a broader public health perspective, the results underscore the importance of ensuring equitable access to affordable and reliable energy services. Investments in energy efficiency, housing improvements, and targeted interventions for vulnerable populations—particularly women and older adults—may reduce both physical and psychological health burdens. In addition, strengthening awareness and training among healthcare professionals is essential to improve recognition of energy-related

health risks and to support preventive public health strategies (European Public Health Alliance 2024; Tang and Kim 2023).

The findings align with international policy frameworks emphasizing the relationship between energy access and health. The World Health Organization (WHO) highlights that access to clean, affordable, and reliable energy is fundamental to health protection and to achieving the Sustainable Development Goals. Initiatives such as the Clean Household Energy Policy Repository and the Health and Energy Platform of Action promote cross-sectoral collaboration between health and energy systems to mitigate the adverse health effects of energy inefficiency (World Health Organization, Household Energy Policy Repository 2021; World Health Organization, Health and Energy Platform of Action 2019).

At the European level, the European Union has adopted the principle of “energy efficiency first” through the revised Energy Efficiency Directive, which sets binding targets for energy reduction and emphasizes addressing energy poverty and improving building performance (European Commission, Energy Efficiency Directive 2021; European Commission, Energy Efficiency Targets 2025; European Commission, Energy Efficiency Directive (revised) 2023). These frameworks provide an important reference point for integrating health-sector responses to energy-related risks across similar socio-economic contexts.

Beyond demographic associations, the findings suggest that energy insecurity operates through interconnected behavioral, environmental, and occupational pathways. Healthcare personnel may be exposed to compounded risks due to simultaneous household and workplace energy constraints, which can exacerbate physiological stress and contribute to both acute and chronic health conditions. This highlights the need to consider healthcare workers not only as service providers but also as a potentially vulnerable population within energy poverty research.

In addition, the observed associations between energy insecurity, sleep disturbances, and reduced concentration have important implications for healthcare delivery. Fatigue and impaired cognitive performance among healthcare personnel may negatively affect productivity and patient safety, particularly in high-demand clinical environments. This underscores the importance of integrating occupational health considerations into energy and public health policies.

The results also highlight the role of broader structural determinants, including housing quality, infrastructure, and access to energy-efficient technologies. Improvements in these areas, such as building insulation and heating/cooling efficiency, may generate co-benefits in terms of health outcomes, reduced healthcare demand, and improved well-being.

Healthcare professionals may also play an important role in mitigating the effects of energy poverty at the community level. As trusted actors, they are well positioned to raise awareness among patients regarding the health impacts of inadequate energy

access and to promote preventive behaviors. Strengthening this role through targeted training and capacity-building programs could enhance public health responses to energy insecurity.

Finally, a multi-sectoral approach is essential for addressing the complex challenges identified in this study. Collaboration between the health sector, energy authorities, social services, and policymakers is required to develop integrated strategies that address energy efficiency, health equity, and social protection simultaneously. Such coordinated approaches are particularly relevant in settings where socioeconomic and environmental vulnerabilities intersect.

Limitations

This study has several limitations that should be acknowledged. First, its focus on the Vlora region limits the generalizability of the findings to other settings in Albania or beyond. Second, the cross-sectional design does not allow for causal inference between energy insecurity and health outcomes. Third, reliance on self-reported data may introduce reporting bias, particularly in relation to health status and household energy conditions.

Future research should expand to a national level and employ longitudinal designs to better understand temporal relationships between energy insecurity and health outcomes. Additionally, intervention-based studies integrating household energy security with public health strategies are recommended. Further exploration of the role of healthcare professionals in educating patients about energy poverty may contribute to improved health equity and policy development.

Conclusions

This study provides evidence that household energy inefficiency has a significant impact on both physical and mental health, with distinct patterns influenced by gender, age, and the inability to meet household energy needs. Female and older healthcare workers demonstrated higher awareness of psychosocial and chronic health consequences, whereas male participants were more oriented toward structural and economic dimensions of energy deprivation. Younger healthcare workers showed greater sensitivity to acute manifestations, particularly sleep disturbances, while middle-aged and older participants reported a higher prevalence of chronic and stress-related conditions.

Based on these findings, several practical implications can be outlined. First, healthcare institutions should implement targeted training programs as part of continuous education in order to strengthen healthcare personnel's understanding of the health impacts of energy poverty, with emphasis on both acute and chronic outcomes as well as psychosocial dimensions. Second, healthcare professionals should be provided with appropriate tools and guidelines to identify individuals at risk of energy insecurity and to facilitate timely counselling, referral, or support. Third, interventions should take into account demographic differences, particularly

gender and age, and incorporate awareness of socioeconomic determinants into clinical practice and community health activities.

At the policy level, the findings support the integration of energy efficiency strategies with public health interventions at both local and national levels. Improving access to affordable and reliable energy, enhancing housing energy efficiency, and strengthening social protection mechanisms may contribute to reducing stress, sleep disturbances, and the burden of chronic conditions, particularly among vulnerable populations.

Overall, this study highlights energy security as an important determinant of health equity. Strengthening the capacity of healthcare professionals to recognize and respond to energy-related health risks is essential for improving population health and building more resilient healthcare systems. Further research at the national level is recommended to validate these findings and support the development of evidence-based policy interventions applicable across Albania.

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Conflict of interest

The authors declare no conflict of interest. This study did not receive external funding.

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