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The Moldovan Association for Biosafety and Biosecurity (MDBBA) is a scientific and practical, instructive and educational, non-governmental, apolitical and non-profit professional organization, founded in 2017.

The main objective of the association is the development of good practices and culture in the field of biosafety and biosecurity and the promotion of knowledge within professional and research-innovation groups.

BIOSAFETY includes security principles, technologies and rules to be followed to prevent unintended exposure to pathogens and toxins or their accidental release/ leakage.

"Protection of personnel, population from unintended exposure to pathogens/ biohazardous material".

BIOSECURITY includes a wide spectrum of measures (biosecurity policies, regulatory regime, scientific and technical measures) applied in an organized framework, necessary to minimize risks (prevention of actions, terrorist attacks by the intentional release of pathogens or toxins as well as loss, their theft or misuse).

"Protection and prevention of theft, intentional misuse of pathologies/biohazardous material".

RISK MANAGEMENT is a decision-making process in which the results of risk assessment (the process of estimating workplace hazards) are integrated with economic, technical, social and political principles to generate strategies for risk reduction.

One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems.

It recognizes that the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent.

While health, food, water, energy and environment are all wider topics with sector-specific concerns, the collaboration across sectors and disciplines contributes to protect health, address health challenges such as the emergence of infectious diseases, antimicrobial resistance, and food safety and promote the health and integrity of our ecosystems.

By linking humans, animals and the environment, One Health can help to address the full spectrum of disease control – from prevention to detection, preparedness, response and management – and contribute to global health security.

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One Health: A Strategic Imperative for the Future of Public Health

Prof. Dr. **Simona VILLANI**
Full Professor of Medical Statistics, PhD, University of Pavia
Deputy Head of the Department of Public Health,
Experimental and Forensic Medicine Director of the Specialization School
of Health Statistics and Biometrics Chair of the Degree Program in Health
and Midwifery Professions Programme Director,
BSc in Environmental and Workplace Prevention Techniques

According to the World Health Organization "One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. (...) By linking humans, animals and the environment, One Health can help to address the full spectrum of disease control – from prevention to detection, preparedness, response and management – and contribute to global health security (WHO-One Health)".

It is therefore evident that advancing an integrated and forward-looking vision of health is no longer, but imperative. The One Health approach provides a powerful and necessary framework for addressing the multifaceted nature of today's public health challenges, from emerging and re-emerging infectious diseases to the far-reaching consequences of environmental change.

In this context, One Health & Risk Management stands out as a timely and essential academic platform, committed to fostering interdisciplinary research and meaningful scientific exchange. By bridging disciplines and uniting expertise, this journal plays a critical role in generating robust, evidence-based solutions and in strengthening the connection between research, practice, and policy.

From the standpoint of biostatistics and epidemiology, such initiatives are strategically crucial. Rigorous research methodologies grounded in good epidemiological practice, high-quality data, and robust analytical methods constitute the pillars for translating evidence into resilient, responsive, and sustainable health systems. Platforms such as this journal are instrumental in advancing these objectives and in shaping the future of public health.

I warmly commend the editorial team for their vision, leadership, and commitment to scientific excellence. I am confident that One Health & Risk Management will establish itself as a leading voice in the global public health community, driving innovation, fostering collaboration, and contributing meaningfully to a healthier and more secure world.

Prof. Dr. Simona Villani

REVIEW ARTICLES

MEDICAL SCIENCES

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STRATEGIES FOR RISK ASSESSMENT IN MEDICATION MANAGEMENT: A SYSTEMATIC REVIEW OF THEIR IMPACT ON PATIENT SAFETY AND OPERATIONAL EFFICIENCY

Tosi RAHMADDIAN[1], Sevilla Ukhtil HUVAID[2], Hilda HIDAYAT[2], Yulianita YULIANITA[2], Sri OKTARINA[2]

[1] Hospital Administration, Faculty of Health Sciences, Baiturrahmah University, Jl. By Pass, Aie Pacah, Koto Tangah District, Padang City, West Sumatra

[2] Public Health, Faculty of Health Sciences, Baiturrahmah University, Jl. By Pass, Aie Pacah, Koto Tangah District, Padang City, West Sumatra

Corresponding author: Tosi Rahmaddian, e-mail: tosi_rahmaddian@fkm.unbrah.ac.id

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ABSTRACT

Introduction Medication management is a complex, high-risk component of healthcare and remains vulnerable to errors that might affect patient safety and operational efficiency. This systematic review aimed to evaluate risk assessment strategies used in medication management and to synthesize evidence regarding their impact on patient safety and operational performance.

Materials and methods A systematic review was conducted following PRISMA 2020 guidelines. Comprehensive searches of the Scopus and PubMed databases identified peer-reviewed studies published between 2020 and 2025. Using the PICOS framework, eligible studies evaluated risk assessment strategies within medication-use processes and reported patient-related safety and/or efficiency outcomes. Data were analysed through thematic synthesis.

Results Sixteen studies met the inclusion criteria. Proactive risk assessment strategies—notably Failure Mode and Effects Analysis and its variants—were widely implemented across medication-use processes, particularly in high-risk settings. Their use improved the identification and prioritization of medication-related risks, reduced error rates or risk scores, bolstered compliance with safety protocols, and optimized workflow organization and resource allocation. Technology-driven tools further enhanced effectiveness by enabling standardization and continuous monitoring.

Conclusions Structured risk assessment strategies measurably improve patient safety and operational efficiency in medication management. Further longitudinal and comparative research is required to evaluate long-term clinical and economic outcomes.

Keywords Pharmaceutical Oversight, Patient Welfare, Hazard Evaluation, Operational Effectiveness, Risk assessment.

STRATEGII DE EVALUARE A RISCURILOR ÎN MANAGEMENTUL MEDICAȚIEI: O REVIZUIRE SISTEMATICĂ A IMPACTULUI ACESTORA ASUPRA SIGURANȚEI PACIENTULUI ȘI EFICIENȚEI OPERAȚIONALE

Introducere Managementul medicației reprezintă o componentă complexă și cu risc ridicat a sistemului de sănătate, caracterizată prin vulnerabilități persistente, care afectează siguranța pacientului și eficiența operațională. Această revizuire sistematică a examinat strategiile de evaluare a riscurilor utilizate în managementul medicației și a sintetizat dovezile, privind impactul acestora asupra siguranței pacientului și eficienței operaționale.

Materiale și metode A fost realizată o revizuire sistematică conform ghidului PRISMA 2020. Căutările efectuate în bazele de date Scopus și PubMed au identificat studii evaluate de colegi (peer-reviewed), publicate în perioada 2020–2025. Utilizând cadrul PICOS, au fost incluse studiile care au evaluat strategii de evaluare a riscurilor în cadrul proceselor de utilizare a medicamentelor și au raportat rezultate privind siguranța și/sau eficiența. Datele au fost analizate prin sinteză tematică.

Rezultate Șaisprezece studii au îndeplinit criteriile de includere. Strategiile proactive de evaluare a riscurilor, în special analiza modurilor de defectare și a efectelor acestora (Failure Mode and Effects Analysis – FMEA) și variantele sale, au fost frecvent aplicate în procesele de utilizare a medicamentelor, în special în contexte cu risc înalt. Aplicarea acestora a îmbunătățit identificarea și prioritizarea riscurilor asociate medicației, a redus ratele erorilor sau scorurile de risc, a consolidat conformitatea cu practicile de siguranță și a optimizat organizarea fluxurilor de lucru și utilizarea resurselor. Instrumentele susținute de tehnologie au crescut eficiența prin facilitarea standardizării și monitorizării continue.

Concluzii Strategiile structurate de evaluare a riscurilor contribuie la îmbunătățirea siguranței pacientului și a eficienței operaționale în managementul medicației. Sunt necesare cercetări longitudinale și comparative suplimentare pentru a evalua rezultatele clinice și economice pe termen lung.

Cuvinte-cheie Supraveghere farmaceutică, siguranța pacientului, evaluarea riscurilor, eficiență operațională, managementul riscurilor.

INTRODUCTION

Drug medication management is a fundamental component of healthcare delivery, encompassing a series of interrelated processes including prescribing, dispensing, administration, and monitoring of medicines. The effectiveness of medication management systems is critical in ensuring patient safety, improving clinical outcomes, and optimizing the use of healthcare resources. Inadequate medication management has consistently been associated with medication errors and adverse drug events, which represent a major source of preventable patient harm across healthcare settings. The World Health Organization has emphasized medication safety as a strategic priority within its Global Patient Safety Action Plan 2021–2030, highlighting that systematic improvements in medication management processes are essential to reducing avoidable harm and strengthening patient safety across healthcare systems worldwide (1-3).

Despite ongoing global initiatives to enhance medication safety, medication-related errors and system inefficiencies continue to occur across healthcare settings. Recent evidence suggests that limitations in prescribing accuracy, medication dispensing processes, and interprofessional communication continue to be major contributors to preventable patient harm, adverse drug events, and avoidable healthcare costs. These challenges reinforce the need for systematic improvements in medication management to enhance patient safety and optimize clinical outcomes (4–6). Traditionally, medication safety initiatives have relied on reactive approaches, focusing primarily on incident reporting and retrospective analysis after errors occur. Although these methods are valuable for learning from past events, they do not reliably prevent harm before it arises and are limited in their ability to address underlying systemic risks. Growing evidence indicates that proactive strategies—such as systematic risk assessment, structured medication reconciliation, and multidisciplinary interventions designed to anticipate and mitigate potential errors—are more effective in preventing unintended medication discrepancies and improving patient safety outcomes (7). These approaches prioritize the early identification of vulnerabilities within the medication-use process and the implementation of preventive measures, rather than relying solely on retrospective analyses once errors have occurred.

Risk assessment has emerged as a key proactive approach within medication management. By systematically identifying, analysing, and prioritising potential risks, these approaches enable early intervention and informed decision-making across medication-related processes (8, 9). Methodologies such as Failure Mode and Effects Analysis, Hazard Vulnerability Assessment, and technology-supported risk assessment tools have been applied to identify vulnerabilities in prescribing, dispensing, and administration systems (10, 11). Beyond improving patient safety, these approaches have also been associated with improved workflow organisation and more efficient use of healthcare resources (12).

Although numerous studies have explored the use of risk assessment tools in specific areas of medication management—such as high-alert medications, pharmacy operations, and clinical trial drug handling—the available evidence remains fragmented. Most studies focus on individual interventions or local implementations, with limited synthesis of their broader implications for patient safety and operational efficiency (10-12). As a result, decision-makers lack a comprehensive evidence base to support the systematic integration of risk assessment into medication management systems.

To address this gap, the present study conducted a systematic literature review to identify and synthesise evidence on risk assessment strategies applied in

medication management across healthcare settings. This review was aimed to examine how these strategies are implemented and to assess their reported impact on patient safety and operational efficiency, thereby providing an evidence-informed foundation for future research and practice.

MATERIALS AND METHODS

Study design

This study was conducted as a systematic literature review (SLR) aimed at synthesizing empirical evidence on risk assessment strategies applied in medication management and their reported impact on patient safety and operational efficiency in healthcare settings. A systematic review design was employed to ensure a transparent, structured, and reproducible approach to identifying, selecting, and synthesizing relevant studies. The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, which provide internationally recognized standards for the conduct and reporting of systematic reviews (13).

Review question

The review was guided by the following research question:

What risk assessment strategies are used in medication management in healthcare settings, and how do they impact patient safety and operational efficiency?

This research question was designed to capture both the implementation of risk assessment approaches within medication management systems and their reported impact on patient safety and operational performance.

Eligibility criteria

Eligibility criteria were predefined using the Population, Intervention, Comparison, Outcomes, and Study Design (PICOS) framework to ensure methodological consistency throughout the study selection and data extraction processes (14).

1. Population: Healthcare facilities, including hospitals and other clinical care settings where medication management processes are implemented.
2. Intervention: Risk assessment strategies applied within medication management, including structured analytical methods (such as Failure Mode and Effects Analysis and Hazard Vulnerability Assessment), risk-prioritisation tools, and technology-assisted risk assessment approaches.
3. Comparison: Conventional or non-risk-based medication management approaches, where applicable.
4. Outcomes: Outcomes related to patient safety (e.g. medication errors, adverse drug events, safety compliance) and/or operational efficiency (e.g. workflow optimization, resource utilization, process efficiency).
5. Study design: Empirical studies employing qualitative, quantitative, or mixed-methods designs.

Studies were excluded if they focused exclusively on pharmaceutical manufacturing processes, chemical impurity analysis, or non-clinical contexts unrelated to medication management within healthcare settings.

Search strategy:

A comprehensive literature search was conducted in the Scopus and PubMed databases to identify relevant peer-reviewed studies published between January 2020 and December 2025. These databases were selected to ensure broad coverage of biomedical, pharmaceutical, and healthcare management literature.

The search strategy combined controlled vocabulary terms and free-text keywords related to medication management, risk assessment, and healthcare outcomes. Boolean operators were applied to refine the search and enhance sensitivity. The core search string used was:

("medication management" OR "pharmacy management")

AND ("risk assessment" OR "risk management" OR "failure mode and effects analysis" OR "hazard vulnerability assessment")

AND ("patient safety" OR "medication error" OR "operational efficiency")

To minimise the risk of missing relevant studies, the reference lists of all included articles were also manually screened.

Study selection

All records retrieved from the database searches were exported and screened in two sequential stages. In the first stage, titles and abstracts were reviewed to exclude studies clearly irrelevant to the research question. In the second stage, full-text articles were assessed for eligibility according to predefined inclusion and exclusion criteria.

The study selection process followed the PRISMA flow structure, including identification, screening, eligibility assessment, and final inclusion (13). Any uncertainties encountered during the selection process were resolved through discussion to reach consensus.

Data extraction

Data were extracted from the included studies using a structured data extraction form developed specifically for this review. Extracted information included author(s), year of publication, study setting, study design, type of risk assessment strategy, outcomes related to patient safety and operational efficiency, and key findings.

The use of a standardized data extraction approach was intended to enhance consistency across studies and reduce the risk of selective reporting.

Quality appraisal and risk of bias assessment

The methodological quality of the included studies was assessed using appropriate critical appraisal tools according to study design. The appraisal focused on key methodological aspects, including clarity of study objectives, appropriateness of research design, robustness of data collection methods, and validity of outcome reporting.

Rather than serving as exclusion criteria, the results of the quality appraisal were used to support the interpretation of findings and to contextualize the strength and limitations of the available evidence.

Data synthesis

A thematic synthesis approach was employed to analyse and integrate findings from the included studies, allowing systematic comparison across heteroge-

neous study designs and contexts (15). Extracted data were initially coded to identify recurring concepts related to risk assessment strategies and their reported impacts. These codes were subsequently grouped into broader analytical themes reflecting patient safety outcomes and operational efficiency implications.

This approach enabled the identification of patterns, similarities, and differences across studies while accommodating variations in healthcare settings and methodological designs.

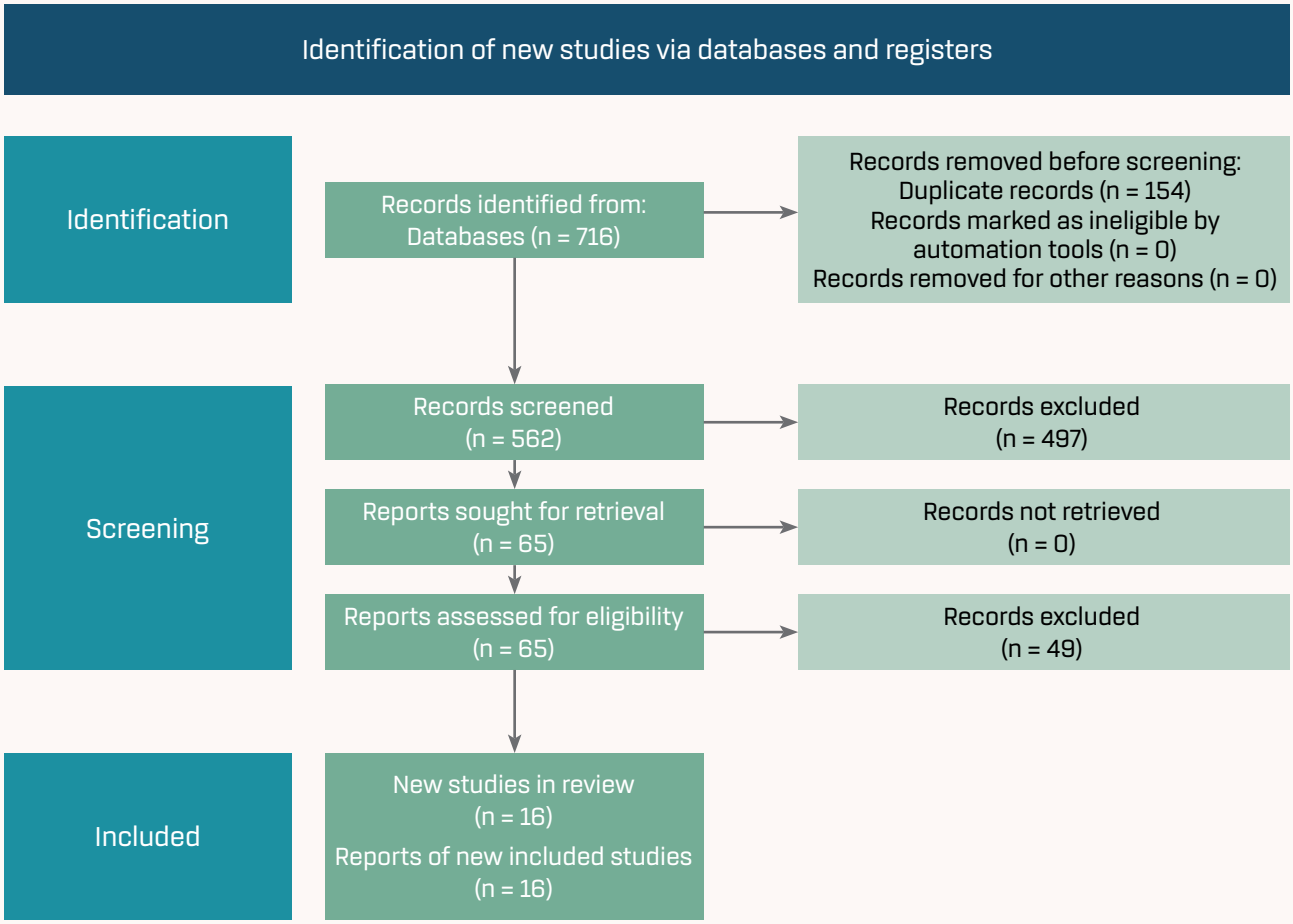

Figure 1. PRISMA approach.

The database search yielded a total of 716 records from Scopus and PubMed, with an additional 18 records identified through reference list screening. After removing 154 duplicates, 562 records remained for title and abstract screening. In accordance with PRISMA 2020 terminology, 'records' refer to database search results, while 'reports' refer to full-text articles assessed for eligibility. Of these, 497 records were excluded due to lack of relevance to medication management, risk assessment, or the outcomes of interest. Full-text review was conducted for 65 articles, of which 49 were excluded for reasons including non-clinical focus, absence of risk assessment strategies, or irrelevant outcomes. Ultimately, 16 studies were included in the qualitative synthesis.

RESULTS

Study selection

The study selection process is illustrated in the PRISMA 2020 flow diagram (Figure 1). Following database searches in Scopus and PubMed and additional screening of reference lists, a total of records was identified. After duplicate removal and title abstract screening, full-text articles were retrieved and assessed for eligibility. Studies were excluded at the full-text stage if they did not address risk assessment strategies in medication management or failed to report outcomes related to patient safety or operational efficiency. Ultimately, 16 studies met all inclusion criteria and were included in the qualitative synthesis. The study outcomes are summarized in the table below.

Characteristics of included studies

The characteristics of the included studies are described in Table 1. The studies were published between 2021 and 2025 and were conducted across a wide range of healthcare settings, predominantly hospital-based pharmacy services, including inpatient wards, outpatient pharmacies, oncology units, perioperative services, and centralized intravenous admixture units.

Table 1. Characteristics of the included studies (n = 16).

No	Research Name	Setting & focus	Risk assessment method
1	Anjalee JAL, Rutter V, Samaranayake NR. **Application of failure mode and effects analysis (FMEA) to improve medication safety**. *BMC Public Health*. 2021.	Outpatient hospital pharmacy; dispensing process	FMEA + failure mode prioritization → planning mitigation
2	Abbassi A, Ben Cheikh Brahim A, Ouahchi Z. **FMEA applied to improve medication management process in a teaching hospital pharmacy**. *Eur J Hosp Pharm*. 2023.	Teaching hospital pharmacy (Tunisia); medication management process	FMEA + simplified rating system proposal
3	Pueyo-López C, Sánchez-Cuervo M, Vélez-Díaz-Pallarés M, et al. **HFMEA in chemotherapy preparation process**. *J Oncol Pharm Pract*. 2021.	Centralized chemotherapy preparation	HFMEA (hazard scoring) → action plan
4	Caballero-Romero Á, Fernández S, Morillo AB, et al. **HFMEA & cost-minimization of three medication delivery services**. *Farm Hosp*. 2021.	Outpatient medication delivery (pickup vs community pharmacy vs home delivery)	HFMEA + cost analysis
5	ElLithy MH, et al. **FMEA analysis of challenges during pharmacy automation/robotics implementation**. *Saudi Pharm J*. 2023.	Implementation of hospital pharmacy automation/ robotics	FMEA for identification of implementation risks and barriers
6	Meknassi Salime G, Bhirich N, Chefchaouni AC, et al. **Assessment of Automation Models in Hospital Pharmacy**. *Hospital Pharmacy*. 2025.	Hospital pharmacy automation model (technology review and impact)	Systematic review of automation technologies (for the context of error prevention strategies)
7	Engström M, et al. **Impact of transition to a digital hospital on medication incidents**. *npj Digital Medicine*. 2023.	"digital hospital" transition; medication incidents	Before–after evaluation of drug incidents related to digitalization
8	Yu K, et al. **Technology implementation impacts on dispensing errors: validation through error reporting system**. *JMIR Med Inform*. 2025.	Drug technology and error reporting	Analysis of the impact of technology on dispensing errors

No	Research Name	Setting & focus	Risk assessment method
9	Zhang L, He X, Wang Y, et al. **FMEA for anesthetic & class I psychotropic drugs management (pilot)**. *Scientific Reports*. 2025.	High-risk medication management (anesthetics/ psychotropics)	FMEA + RPN for risk prioritization
10	Cai J, Li M-X, Lu S, et al. **FMEA to improve monoclonal antibody drugs management in PIVAS**. *Scientific Reports*. 2025.	PIVAS (IV admixture); mAb drugs	Multi-round FMEA → RPN decrease
11	Chen S, Zhang H, Zhi H, Wang J. **HFMEA to enhance patient-controlled analgesia management after anesthesia**. *Frontiers in Medicine*. 2025.	PCA management (post-anesthesia)	HFMEA + risk scoring → flow improvement
12	Ghoushchi SJ, Dorosti S, Ab Rahman MN, et al. **Theory-Based FMEA for Medication Errors**. *J Healthcare Engineering*. 2021.	Medication errors (theoretical model/ approach)	Theory-based FMEA (causal factor modeling)
13	Despott RA, Vella Bonanno P, Gauci C. **Risk management of medication errors: improving pharmacotherapeutic practice**. *Pharmacol Res Perspect*. 2025.	Pharmacotherapy practice; medication errors	Quality risk management approach
14	Ford EH, Michalek C. **Medication Safety Officers: a pillar of patient safety in hospital pharmacy**. *Farmacia Hospitalaria*. 2025.	The role of MUSO and drug safety strategies	Practice/policy articles: systems approach and safety programs
15	Sakly H, Chakroun I, Ben Jeddou K. **FMECA for temperature-sensitive drugs medication-use process**. *Can J Hosp Pharm*. 2022.	Cold chain / temperature-sensitive drugs	FMECA (5Ws & How + Ishikawa) → improvement priority
16	Joly-Mischlich T, Maltais S, Tétu A, et al. **FMEA before implementing CPOE in oncology clinic**. *J Oncol Pharm Pract*. 2023.	CPOE pre-implementation (oncology)	FMEA for vulnerability identification & redesign

Methodologically, the review encompasses quantitative observational designs, qualitative case studies, mixed-methods evaluations, and implementation-focused research. Most studies examined proactive risk assessment approaches, particularly Failure Mode and Effects Analysis (FMEA), Healthcare Failure Mode and Effects Analysis (HFMEA), or Failure Mode, Effects, and Criticality Analysis (FMECA). Several studies also examined technology-supported strategies, such as pharmacy automation, digital medication systems, and electronic prescribing, either as standalone interventions or in combination with structured risk assessment frameworks.

Across the included studies, outcomes were commonly reported in terms of patient safety indicators (e.g. medication errors, risk prioritisation, safety compliance) and operational efficiency measures (e.g. workflow optimisation, resource allocation, process standardisation).

Synthesis of findings

Thematic synthesis of the included studies identified three overarching themes:

1. Proactive risk assessment strategies in medication management,
2. Impact of risk assessment on patient safety, and
3. Impact of risk assessment on operational efficiency.

Most studies reported the implementation of structured, proactive risk assessment methodologies to identify vulnerabilities within medication management processes before adverse events occurred. FMEA-based approaches were the most commonly used strategies and were applied across multiple stages of the medication-use process, including prescribing, dispensing, preparation, storage, and administration.

Several studies described the use of FMEA, HFMEA, or FMECA to systematically map medication-use workflows, identify potential failure modes, and prioritize risks using scoring systems based on severity, occurrence, and detectability. These approaches were particularly prominent in high-risk settings, including chemotherapy preparation, management of high-alert medications, anaesthetic and psychotropic drug handling, and temperature-sensitive drug storage.

In addition to conventional FMEA-based methods, a subset of studies incorporated technology-driven risk assessment strategies, such as pharmacy automation, digital medication incident reporting systems, and electronic prescribing platforms. In these contexts, risk assessment was commonly integrated into broader system redesign initiatives, enabling continuous monitoring and iterative refinement of medication-use processes.

Impact of risk assessment strategies on patient safety

Across the included studies, implementation of risk assessment strategies was consistently associated with improvements in patient safety outcomes. Many studies reported more effective identification of latent risks within medication management systems, particularly those arising from complex workflows, high-risk medications, and transitions of care.

Several studies revealed reductions in medication error rates or risk priority numbers following the application of FMEA or HFMEA, indicating better control of high-risk failure modes. Other studies highlighted qualitative improvements, including increased staff awareness of medication-related risks, stronger adherence to safety protocols, and more structured documentation of medication processes.

Technology-driven interventions further enhanced patient safety by enabling real-time error detection, standardizing medication workflows, and facilitating more effective communication among healthcare professionals. Overall, the findings suggest that proactive risk assessment serves as an effective mechanism for strengthening medication safety by shifting the organisational efforts from reactive error correction toward anticipatory risk mitigation.

Impact of risk assessment strategies on operational efficiency

In addition to patient safety benefits, many included studies reported positive effects on operational efficiency. Risk assessment strategies enabled healthcare organisations to prioritise resources toward high-risk processes, thereby reducing unnecessary workload and improving workflow efficiency.

FMEA-based interventions were commonly associated with more streamlined medication preparation and dispensing processes, reduced process variability, and clearer role definition among pharmacy staff. Studies assessing pharmacy automation and digital medication systems reported further efficiency gains, including reduced manual handling, shorter turnaround times, and improved traceability of medication-related activities.

Importantly, several studies highlighted that improvements in operational efficiency did not compromise patient safety. Instead, efficiency gains were often described as complementary outcomes of more effectively designed, risk-informed medication management systems.

Summary of results

Overall, the findings of this systematic review indicate that risk assessment strategies are widely implemented across medication management processes and healthcare settings, with consistent evidence of benefits for both patient safety and operational efficiency. Although specific methods and outcomes varied among studies, the overall body of evidence supports structured and proactive risk assessment as a fundamental component of effective medication management systems.

DISCUSSIONS

This systematic literature review synthesized evidence from 16 international studies to examine how risk assessment strategies are implemented in medication management and how they influence patient safety and operational efficiency. The findings extend the existing medication safety literature by demonstrating that proactive, structured risk assessment functions not only as a patient safety intervention but also as a managerial tool that contributes to operational performance within healthcare systems.

Integration of risk assessment within medication management systems

The findings of this review indicate that risk assessment strategies are increasingly embedded across multiple stages of the medication-use process, including prescribing, preparation, dispensing, storage, and administration. This system-wide implementation reflects a transition from isolated safety measures toward more comprehensive risk management approaches. Previous literature has commonly examined medication errors as discrete events or focused on single interventions (1–3). In contrast, the studies included in this review highlight the role of risk assessment as an ongoing process that facilitates organizational learning and system redesign (15–17).

The predominance of FMEA-, HFMEA-, and FMECA-based approaches across diverse settings indicates that these methodologies remain central to proactive medication safety initiatives. Their adaptability in high-risk contexts, such as oncology services, perioperative care, and the management of high-alert or temperature-sensitive medications, highlights their relevance within complex medication systems (18–20). This finding supports earlier calls for system-based approaches to medication safety rather than reliance on individual vigilance alone (3, 21).

Implications for patient safety outcomes

Consistent with prior research, the findings of this review indicate that risk assessment strategies are associated with improved patient safety outcomes, particularly through more effective identification of latent risks and prioritization of high-risk failure modes (7, 10). Several included studies reported reductions in medication error rates or risk priority numbers following the implementation of structured risk assessment approaches (22). Others described qualitative improvements, including increased staff awareness, stronger adherence to safety protocols, and more consistent documentation practices (23, 24).

Importantly, the value of risk assessment extends beyond measurable reductions in error rates to its broader influence on safety practices. By rendering risks visible and actionable, risk assessment facilitates proactive decision-making and fosters a stronger culture of safety. This finding aligns with broader patient safety frameworks that emphasize anticipation and prevention rather than retrospective incident analysis (13, 25).

Operational efficiency as a complementary outcome

A key contribution of this review is the synthesis of evidence demonstrating that operational efficiency and patient safety are not competing priorities. Many of the included studies showed that risk assessment strategies supported more efficient resource allocation, reduced workflow variability, and improved process standardization (26, 27). These efficiency gains were commonly achieved through the prioritization of high-risk processes, allowing organizations to focus on improvement efforts to areas of greatest need.

Technology-enabled interventions further strengthened these outcomes. Studies assessing pharmacy automation, digital medication systems, and electronic prescribing platforms reported improvements in turnaround times, traceability, and coordination among professional groups (28, 29). Crucially, these efficiency improvements were achieved without compromising safety, suggesting that risk-informed system design can simultaneously advance quality and productivity within healthcare organizations.

Integration of risk assessment and digital health technologies

The review further highlights the synergistic relationship between risk assessment and digital health technologies. While structured methodologies such as FMEA provide a systematic framework for identifying and prioritizing risks, digital tools facilitate continuous monitoring, data integration, and feedback. Several studies demonstrated that integrating risk assessment with automation or electronic systems led to more sustainable and scalable improvements in medication management (29).

However, the findings caution against considering technology a standalone solution. Without an underlying risk assessment framework, technological interventions may fail to address deeper system vulnerabilities or may introduce new risks. This reinforces the importance of integrating digital solutions within a comprehensive risk management strategy rather than adopting them as isolated interventions.

Novelty and contribution of this review

The novelty of this systematic review lies in its integrated evaluation of both patient safety and operational efficiency outcomes within the context of medication management. Whereas previous reviews have primarily focused on medication errors or safety outcomes alone (30), the present review synthesizes evidence on how risk assessment strategies affect both safety and operational performance. It thereby integrates clinical safety research with healthcare management and operational practice.

Furthermore, this review extends existing knowledge by incorporating recent international studies (2021–2025) that reflect contemporary challenges, including digitalisation and automation of medication systems. The synthesis highlights emerging trends in the integration of risk assessment with digital health technologies, offering insights that are particularly relevant for healthcare systems undergoing technological transformation.

Implications for practice and policy

From a practical perspective, the findings suggest that healthcare organizations should incorporate structured risk assessment as a routine element of medication management, particularly in high-risk settings. Multidisciplinary collaboration is essential to ensure thorough risk identification and the development of effective mitigation planning. At the policy level, the evidence supports integrating proactive risk assessment into medication safety standards and quality improvement frameworks at both institutional and national levels.

Research gaps and future directions

Despite the positive findings, several gaps remain. Many included studies were context-specific and employed heterogeneous outcome measures, limiting comparability across settings. Quantitative evidence linking risk assessment strategies to long-term clinical outcomes and cost-effectiveness remains scarce. In addition, few studies have assessed the sustainability of risk assessment interventions over extended follow-up periods.

Future research should focus on longitudinal and comparative study designs to better quantify the impact of risk assessment strategies on both patient safety and operational efficiency. Further research is also needed to explore how risk assessment approaches can be optimally integrated with emerging digital technologies across diverse healthcare environments.

Summary of discussion

In summary, this systematic literature review demonstrates that structured risk assessment strategies play a critical role in enhancing medication management systems. By supporting proactive risk identification and informed decision-making, these strategies improve patient safety while enhancing the efficiency of healthcare operations. The findings highlight the value of risk-informed approaches as a foundation for high-quality, sustainable medication management.

LIMITATIONS

This systematic literature review has several limitations that should be considered when interpreting the findings. First, the review was limited to studies published in English and indexed in the Scopus and PubMed databases, which may have resulted in the exclusion of relevant studies published in other languages or indexed in additional databases. Second, substantial heterogeneity was observed across the included studies in terms of design, healthcare settings, and outcome measures, limiting the feasibility of quantitative synthesis and direct comparison.

Third, most studies were context-specific and conducted within single institutions or specialized clinical settings, which may limit the generalizability of the findings to other healthcare environments. In addition, variations in how patient safety and operational efficiency outcomes were defined and measured across studies may have influenced the interpretation of results. Finally, as with all systematic reviews, the findings depend on the quality and reporting of the included studies, and unreported biases within the primary literature may have affected the overall conclusions.

CONCLUSIONS

1. This systematic literature review synthesized evidence from 16 international studies to examine risk assessment strategies in medication management and their effects on patient safety and operational efficiency. The findings indicate that structured and proactive approaches particularly those based on Failure Mode and Effects Analysis and related methodologies are widely applied and associated with improvements in both safety outcomes and operational performance.
2. The review demonstrates that patient safety and operational efficiency are complementary rather than competing objectives. Risk-informed medication management systems support safer care delivery while simultaneously enhancing the efficient use of healthcare resources. The integration of risk assessment with digital health technologies further strengthens these outcomes through continuous monitoring, process standardization, and data-driven decision-making.
3. Overall, the evidence underscores the importance of embedding structured risk assessment into routine medication management practices, especially in high-risk clinical settings. Future research should prioritize robust longitudinal and comparative studies to better quantify the long-term clinical and economic impacts of risk assessment strategies across diverse healthcare environments.

ETHICAL APPROVAL

This study was a systematic literature review and did not involve the collection of primary data from human participants or animals. All studies included in this review had received ethical approval from the respective institutional ethics committees, as reported in the original publications, and were conducted in accordance with applicable ethical standards and informed consent requirements. Therefore, additional ethical approval was not required for the present review.

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Tosi Rahmaddian, WoS Researcher ID: GLS-2496-2022, SCOPUS ID: 58757175500

Sevilla Ukhtil Huvaid, WoS Researcher ID: NNG-7856-2025, SCOPUS ID: 59179438200

MEDICAL SCIENCES

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GLOBAL SEROPREVALENCE OF ANTI-HEV IgG AND IgM ANTIBODIES AMONG PREGNANT WOMEN: A SYSTEMATIC REVIEW AND META-ANALYSIS

Octavian SAJIN[1], Adela TURCANU[2], Veaceslav GUTU[1], Nina IZIUMOV[1], Valentina BLAJ[1]

[1] National Agency for Public Health, Chisinau, Republic of Moldova
[2] State University of Medicine and Pharmacy "Nicolae Testemițanu", Chisinau, Republic of Moldova

Corresponding author: Octavian Sajin, e-mail: octavian.sajin@ansp.gov.md

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ABSTRACT

Introduction Hepatitis E virus (HEV) represents a significant public health concern during pregnancy, being associated with severe maternal and fetal complications. This meta-analysis aimed to estimate the global seroprevalence of anti-HEV IgG and IgM antibodies among pregnant women.

Materials and methods A systematic review and meta-analysis were conducted in accordance with PRISMA guidelines. Observational studies were identified in PubMed, Scopus, and Web of Science. Pooled seroprevalence estimates were calculated using a random-effects model. Heterogeneity was assessed using Cochran's Q and the I^2 statistic, while publication bias was evaluated by funnel plots and Egger's regression test.

Results Thirty studies from diverse geographic regions were included. The pooled global seroprevalence of anti-HEV IgG was 11.76% (95% CI: 9.45–14.54), indicating widespread prior exposure. Anti-HEV IgM seroprevalence, reflecting recent infection, was 1.07% (95% CI: 0.61–1.86). Substantial heterogeneity was observed for both markers (I^2 > 95%), reflecting marked regional variability. No statistically significant small-study effects were detected by Egger's regression (p > 0.05).

Conclusions HEV exposure among pregnant women is common globally, with pronounced regional differences, whereas recent infection appears relatively rare at the global level. These findings highlight the need for region-specific surveillance, improved diagnostic standardization, and targeted preventive strategies to reduce HEV-related risks during pregnancy.

Keywords HEV, IgG, IgM, seroprevalence, pregnancy.

SEROPREVALENȚA GLOBALĂ A ANTICORPILOR IGG ȘI IGM ANTI-HEV LA FEMEILE ÎNSĂRCINATE: O ANALIZĂ SISTEMATICĂ ȘI O META-ANALIZĂ

Introducere Virusul hepatitei E (HEV) reprezintă o problemă importantă de sănătate publică în timpul sarcinii, fiind asociat cu complicații materne și fetale severe. Scopul acestei meta-analize a fost estimarea seroprevalenței globale a anticorpilor anti-HEV IgG și IgM la femeile însărcinate.

Materiale și metode A fost realizată o revizuire sistematică și o meta-analiză conform ghidului PRISMA. Studiile observaționale au fost identificate în PubMed, Scopus și Web of Science. Seroprevalențele combinate au fost calculate utilizând un model cu efecte aleatorii. Heterogenitatea a fost evaluată prin testul Q al lui Cochran și indicele I^2, iar biasul de publicare prin funnel plots și testul Egger.

Rezultate Au fost incluse 30 de studii din regiuni geografice diverse. Seroprevalența globală combinată anti-HEV IgG a fost de 11,76% (IC 95%: 9,45–14,54), indicând o expunere larg răspândită. Seroprevalența anti-HEV IgM a fost de 1,07% (IC 95%: 0,61–1,86). Heterogenitatea a fost foarte ridicată pentru ambii markeri (I^2 > 95%). Nu a fost identificat un bias de publicare semnificativ.

Concluzii Expunerea la VHE în rândul femeilor însărcinate este frecventă la nivel global, cu variații regionale importante, în timp ce infecția recentă este relativ rară. Rezultatele subliniază necesitatea unor strategii de supraveghere și prevenție adaptate contextului regional.

Cuvinte-cheie HEV, IgG, IgM, seroprevalență, sarcină.

INTRODUCTION

Hepatitis E virus (HEV) represents a growing public health concern, particularly in the context of pregnancy, where its clinical consequences can be disproportionately severe. HEV is primarily transmitted through the fecal–oral route and is endemic in many low- and middle-income countries, with outbreaks frequently associated with inadequate sanitation and contaminated water sources (1). Globally, HEV is estimated to cause approximately 20 million infections each year, resulting in about 3.3 million symptomatic cases and more than 50,000 deaths annually (1).

Pregnant women, especially during the third trimester, are at significantly increased risk of severe HEV-related complications, including fulminant hepatic failure, preterm labor, stillbirth, and elevated maternal mortality (2, 3). Despite these well-documented clinical risks, the global burden of HEV infection among pregnant women remains incompletely characterized, with substantial regional variation in seroprevalence and inconsistent reporting across studies.

This meta-analysis aims to address these gaps by systematically evaluating the global seroprevalence of anti-HEV IgG and IgM antibodies among pregnant women. By synthesizing data from diverse geographic regions, this study provides a comprehensive overview of HEV exposure and recent infection patterns during pregnancy, thereby contributing evidence to support improved surveillance strategies and public health prioritization in this vulnerable population.

MATERIALS AND METHODS

Study Design and Reporting Framework

This study was conducted as a systematic review and meta-analysis of observational studies reporting the seroprevalence of HEV antibodies among pregnant women. The methodology and reporting followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Data Sources and Search Strategy

A systematic literature search was conducted in PubMed, Scopus, and Web of Science to identify relevant studies reporting HEV seroprevalence among pregnant women. The search covered all articles published up to January 10, 2025 and was conducted and reported in accordance with the PRISMA guidelines. The search strategy combined Medical Subject Headings (MeSH) and free-text terms related to HEV infection and pregnancy, including “hepatitis E”, “HEV”, “seroprevalence”, “pregnant women”, “anti-HEV IgG”, and “anti-HEV IgM”.

The PubMed search strategy was as follows:

((“Hepatitis E”[Mesh] OR “hepatitis E virus” OR HEV) AND (“Pregnancy”[Mesh] OR pregnant OR pregnancy OR pregnant women) AND (seroprevalence OR prevalence OR “anti-HEV IgG” OR “anti-HEV IgM”)).

Search strategies were adapted for Scopus and Web of Science using database-specific syntax. The search was restricted to observational studies (cross-sectional, cohort, or case–control designs) published in the English language. Additional records were identified through manual screening of reference lists from relevant articles and review papers to ensure comprehensive coverage of the available literature.

Subsequently, titles and abstracts were screened for relevance, followed by full-text assessment of potentially eligible studies. All full-text articles retrieved after screening met the predefined inclusion criteria and were therefore included in the final meta-analysis. The study selection process and reasons for exclusion are summarized in the PRISMA flow diagram (fig. 1).

The review protocol was not prospectively registered in PROSPERO, as this meta-analysis was conducted as part of an institutional research project with a predefined scope and timeline. The absence of protocol registration is acknowledged, and all methodological decisions were defined a priori and applied consistently across included studies.

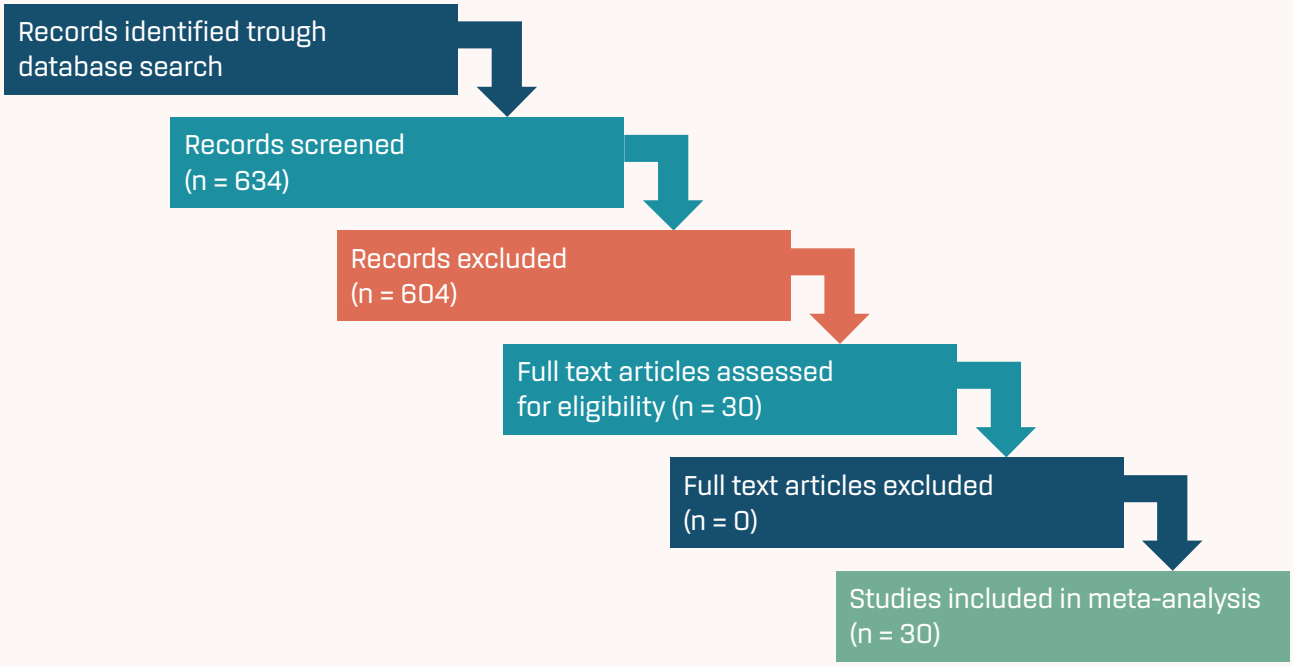

Figure 1. PRISMA flow diagram of study selection. Records were identified through database searching (PubMed, Scopus, and Web of Science). Titles and abstracts were screened for eligibility, followed by full-text assessment. All full-text articles retrieved after screening met the predefined eligibility criteria and were included in the final meta-analysis.

Eligibility Criteria

Studies were included if they met the following criteria:

- Reported the seroprevalence of anti-HEV IgG and/or anti-HEV IgM antibodies among pregnant women;
- Used ELISA or other validated serological assays for HEV antibody detection;
- Provided sufficient data to allow calculation of prevalence estimates (number of positive cases and total sample size, or equivalent information);
- Were original observational studies (cross-sectional, cohort, or case–control);
- Were published in English.

Studies were excluded if they:

- Focused on non-pregnant populations;
- Lacked extractable seroprevalence data;
- Were case reports, reviews, editorials, or conference abstracts.

Study Selection

All identified records were screened independently by two reviewers. Titles and abstracts were first assessed for relevance, followed by full-text evaluation of potentially eligible articles. Any discrepancies between reviewers were resolved through discussion and consensus. The study selection process is summarized using a PRISMA flow diagram.

Data Extraction

From each included study, the following data were extracted using a standardized form:

- Country and study setting;
- Year of publication;
- Sample size (number of pregnant women tested);
- Number or proportion of anti-HEV IgG–positive cases;
- Number or proportion of anti-HEV IgM–positive cases;
- Type of serological assay used.

When overall HEV seroprevalence among pregnant women was not explicitly reported, prevalence estimates were extracted from the largest available subgroup that best reflected the general pregnant population included in the study. This approach was predefined before data extraction and applied consistently across studies. Priority was given to population-based samples or subgroups including all tested pregnant women, whereas clinically selected or high-risk subgroups (e.g., symptomatic cases or women with acute hepatitis) were excluded to reduce selection bias and improve comparability.

Quality Assessment

The methodological quality of included studies was assessed using a domain-based evaluation framework adapted from the Newcastle–Ottawa Scale (NOS) for observational studies (4). Rather than generating a cumulative numeric score, this approach focused on key methodological domains directly relevant to prevalence estimation, including sample representativeness, diagnostic accuracy of the serological assays, and data completeness.

Although the Joanna Briggs Institute (JBI) critical appraisal tools are commonly recommended for prevalence studies, we chose a domain-based framework adapted from the Newcastle–Ottawa Scale (NOS). This decision was made to maintain consistency with previous HEV seroprevalence meta-analyses and to place greater emphasis on diagnostic validity and population representativeness.

Based on the overall methodological rigor across these domains, studies were classified qualitatively as high, moderate, or low quality. This qualitative categorization was applied to facilitate comparison across studies and to support sensitivity analyses, rather than to derive a cumulative numeric score. Any discrepancies in quality assessment were resolved through discussion and consensus between reviewers.

The detailed results of the quality assessment for each included study are presented below (tab. 1).

Table 1. Domain-based quality assessment framework adapted from the Newcastle–Ottawa Scale (NOS).

Country/Study	Sample Representativeness	Diagnostic Accuracy	Data Completeness	Overall Quality
Argentina (5)	Moderate	Moderate (ELISA Diapro)	Moderate	Moderate
China (6)	High (Large sample)	High (ELISA Wantai)	High	High
Nigeria (7)	Low (Small sample)	Moderate (ELISA Canoga Park)	Moderate	Low to Moderate
Cambodia (8)	High	High (Validated methods)	High	High
South Africa (9)	Moderate	High	High	High
Germany (10)	Low (Small sample)	High	Moderate	Moderate
Senegal (11)	High	High	High	High
Iran (12)	Moderate	Moderate (ELISA Diapro)	High	Moderate to High
China (13)	High (Very large sample)	High	High	High
Pakistan (14)	Low (Very small sample)	Moderate (MicroLISA)	Moderate	Low to Moderate
China* (15)	Moderate	High	Moderate	Moderate
Nigeria (16)	Low (Small sample)	Moderate (ELISA Diapro)	High	Moderate
China (17)	Moderate	High	High	High
Haiti (18)	High	High	High	High
Benin (19)	Moderate	Moderate (ELISA Diapro)	High	Moderate to High
Ghana (20)	Moderate	High	High	High
Ethiopia (21)	Moderate	High	High	High
Ethiopia (22)	High	High	High	High
China (23)	Moderate	High	High	High
China (24)	High	High	High	High
Iran (25)	High	Moderate (ELISA Diapro)	High	High
Turkey (26)	Moderate	Moderate (MicroELISA)	Moderate	Moderate
Spain (27)	High	Moderate (ELISA Diapro)	High	High
Tunisia (28)	Moderate	Moderate (ELISA Globe Diagnostic SRL)	Moderate	Moderate
Kyrgyzstan (29)	High	High	High	High
France (30)	Moderate	High	High	High
Croatia (31)	Low (Very small sample)	High	Moderate	Moderate
China (32)	Moderate	High	High	High
Thailand (33)	Low (Very small sample)	High	Moderate	Low to Moderate
Vietnam (34)	Moderate	High	High	High

**Note:* For the study conducted in Qinhuangdao, China, overall HEV seroprevalence among pregnant women was not explicitly reported. Therefore, prevalence estimates were derived from the largest available subgroup representing the general pregnant population included in the study. Clinically selected subgroups were not used for prevalence extraction, in accordance with the predefined data extraction criteria described in the Methods section.

Statistical analysis

For each included study, seroprevalence was calculated as the proportion of positive cases among the total number of tested pregnant women. Study-level 95% confidence intervals (CIs) were computed using the Wilson method, which provides stable estimates for proportions, including studies with small sample sizes. For studies reporting zero seropositive events, confidence intervals were not displayed in descriptive tables to avoid misinterpretation and visual clutter, as such intervals are typically extremely wide and uninformative. Nevertheless, zero-event studies were retained in the meta-analysis and incorporated into the pooled estimates using variance-stabilizing transformations.

Pooled seroprevalence estimates for anti-HEV IgG and anti-HEV IgM were calculated using random-effects meta-analysis to account for substantial between-study heterogeneity related to geographic region, population characteristics, and diagnostic methods. Proportions were stabilized using the Freeman–Tukey double arcsine transformation prior to pooling. Between-study variance (τ^2) was estimated using the DerSimonian–Laird method, and pooled confidence intervals were calculated using the standard random-effects model.

Statistical heterogeneity was assessed using Cochran's Q test and quantified with the I^2 statistic, which represents the proportion of total variability attributable to true between-study heterogeneity rather than sampling error. For anti-HEV IgM, studies reporting zero events were included in the pooled prevalence estimation but were excluded from heterogeneity testing and other standard error–based diagnostics to ensure statistical stability; this distinction is reflected in the reported degrees of freedom for heterogeneity analyses.

To explore potential sources of heterogeneity a priori, exploratory subgroup analyses were planned based on geographic region and serological assay type, as these variables were available for most included studies (Tab. 2). Subgroup analyses were conducted descriptively due to substantial residual heterogeneity and unequal numbers of studies across subgroups. Formal meta-regression was not performed because of incomplete reporting of relevant covariates and limited statistical power within individual subgroups.

Sensitivity and Bias Assessment

Sensitivity analyses were performed to evaluate the influence of studies with extreme prevalence values or very small sample sizes on the pooled estimates. Publication bias was explored through visual inspection of funnel plots and formally assessed using Egger's regression test, with the acknowledgment that such methods have limited power and interpretability in meta-analyses of prevalence, particularly in the presence of substantial heterogeneity.

All statistical analyses were performed using R software (version 4.2.2), employing the meta and metafor packages.

RESULTS

The characteristics of the studies included, which evaluated the seroprevalence of anti-HEV IgG and IgM antibodies among pregnant women across different countries, along with the corresponding references [4–33], are summarized (tab. 2). The included studies provide insights into the epidemiology of HEV infection, diagnostic methodologies used, and regional disparities in seroprevalence.

Table 2. Global Seroprevalence of Anti-HEV IgG and IgM in Pregnant Women

Country/Study	Number of tested pregnant women (samples)	Seroprevalence of Anti-HEV IgG	Seroprevalence of Anti-HEV IgM	Testing method
Argentina (5)	202	8.4% (95% CI: 5.3%–13.1%)	1.0% (95% CI: 0.3%–3.5%)	ELISA Diapro
China (6)	4244	10.5% (95% CI: 9.6%–11.4%)	0.4% (95% CI: 0.2%–0.6%)	ELISA Wantai
Nigeria (7)	200	22.0% (95% CI: 16.8%–28.2%)	15.0% (95% CI: 10.7%–20.6%)	ELISA Canoga Park
Siem Reap, Cambodia (8)	1565	11.6% (95% CI: 10.1%–13.2%)	2.6% (95% CI: 1.9%–3.5%)	ELISA, RecomLine LIA, from Mikrogen
Pretoria, South Africa (9)	384	3.1% (95% CI: 1.8%–5.4%)	0	ELISA Wantai
Germany (10)	62	9.7% (95% CI: 4.5%–19.5%)	0	ELISA Wantai
Senegal (11)	1227	7.4% (95% CI: 6.1%–9.0%)	0.5% (95% CI: 0.2%–1.1%)	ELISA Wantai
Ilam, West of Iran (12)	420	4.3% (95% CI: 2.7%–6.7%)	0.5% (95% CI: 0.1%–1.7%)	ELISA Diapro
China (13)	19,762	11.4% (95% CI: 10.9%–11.8%)	0.1% (95% CI: 0.1%–0.2%)	ELISA Wantai
Pakistan, capital (14)	90	60.0% (95% CI: 49.7%–69.5%)	13.3% (95% CI: 7.8%–21.9%)	MicroLISA
Qinhuangdao, China (15)	365	20.3% (95% CI: 16.6%–24.7%)	4.1% (95% CI: 2.5%–6.7%)	ELISA Wantai
Ibadan, Nigeria (16)	230	17.0% (95% CI: 12.7%–22.3%)	4.8% (95% CI: 2.7%–8.4%)	ELISA Diapro
Qingdao and Weihai, China (17)	990	16.2% (95% CI: 13.9%–18.5%)	2.6% (95% CI: 1.8%–3.8%)	ELISA Wantai
Haiti (18)	1279	10.3% (95% CI: 8.4%–12.3%)	0.3% (95% CI: 0.2%–0.3%)	ELISA Wantai
Benin (19)	278	16.2% (95% CI: 12.3%–21.0%)	1.4% (95% CI: 0.6%–3.6%)	ELISA Diapro
Ghana, Cape Coast Metropolis (20)	393	12.2% (95% CI: 9.3%–15.8%)	0.2% (95% CI: 0.0%–1.4%)	ELISA INNOVITA
Addis Ababa, Ethiopia (21)	386	31.6% (95% CI: 27.2%–36.4%)	0.5% (95% CI: 0.1%–1.9%)	ELISA Wantai
Tigray, Northern Ethiopia (22)	846	42.4% (95% CI: 39.1%–45.8%)	0.9% (95% CI: 0.5%–1.9%)	ELISA Wantai
Jiangsu, China (23)	497	11.1% (95% CI: 8.6%–14.1%)	0.6% (95% CI: 0.2%–1.8%)	ELISA Wantai
Inner Mongolia, China (24)	3278	6.0% (95% CI: 5.2%–6.9%)	0.3% (95% CI: 0.2%–0.6%)	ELISA Wantai
Iran (25)	1331	6.2% (95% CI: 5.1%–7.7%)	0.8% (95% CI: 0.5%–1.5%)	ELISA Diapro
Turkey (26)	245	12.6% (95% CI: 9.1%–17.4%)	0	microELISA Virotech GmbH, Germany

Country/Study	Number of tested pregnant women (samples)	Seroprevalence of Anti-HEV IgG	Seroprevalence of Anti-HEV IgM	Testing method
Madrid, Spain (27)	1,040	3.6% (95% CI: 2.7%–5.0%)	0.7% (95% CI: 0.3%–1.4%)	ELISA Diapro
Tunisia (28)	404	12.1% (95% CI: 9.3%–15.7%)	0	ELISA (Globe Diagnostic SRL
Kyrgyzstan (29)	1472	5.9% (95% CI: 4.8%–7.2%)	4.8% (95% CI: 3.4%–5.5%)	ELISA NPO "Diagnostic Systems"
France (30)	315	7.7% (95% CI: 4.7%–10.8%)	0	ELISA Wantai
Croatia (31)	118	1.7% (95% CI: 0.2%–5.9%)	0	ELISA; Euroimmun
Yunnan, China (32)	293	10.2% (95% CI: 7.3%–14.2%)	1.4% (95% CI: 0.5%–3.5%)	ELISA Wantai
Thailand (33)	17	41.2% (95% CI: 21.6%–64.0%)	11.8% (95% CI: 3.3%–34.3%)	ELISA; Euroimmun
Vietnam (34)	183	7.6% (95% CI: 4.6%–12.4%)	2.1% (95% CI: 0.9%–5.5%)	ELISA Wantai

Note: Confidence intervals were not reported for zero-event studies.

Study Selection and Characteristics

A total of 30 observational studies reporting seroprevalence of HEV antibodies among pregnant women were included in the final meta-analysis. The publication years of the included studies ranged from 2004 to 2024. The studies were conducted across multiple geographic regions, including Africa, Asia, and Europe, and encompassed a wide range of sample sizes, from small cohorts ($n < 100$) to large population-based studies ($n > 10,000$).

Overall, data from 42,116 pregnant women were available for the analysis of anti-HEV IgG seroprevalence, while 42,022 pregnant women contributed data to the analysis of anti-HEV IgM seroprevalence. All included studies employed validated serological assays, predominantly ELISA-based methods, although the specific commercial kits varied across studies.

Analysis of the Data

The seroprevalence of anti-HEV IgG among pregnant women demonstrated pronounced geographic variability, ranging from 1.7% in Croatia to 60.0% in Pakistan, indicating substantial differences in cumulative exposure across settings. Using a random-effects model, the pooled global seroprevalence of anti-HEV IgG was 11.76% (95% CI: 9.45–14.54). Substantial heterogeneity was observed (Cochran's $Q = 1281.4$, $df = 29$, $p < 0.001$; $I^2 = 97.74\%$), suggesting that most variability reflects true between-study differences rather than sampling error.

Exploratory subgroup assessment suggested marked variability in anti-HEV IgG seroprevalence across geographic regions. Higher prevalence estimates were predominantly observed in studies from South Asia and sub-Saharan Africa, whereas lower estimates were more common in European populations. Differences were also noted according to the serological assay used, with studies employing Wantai-based ELISA tests frequently reporting higher seroprevalence than those using other commercial platforms. However,

substantial heterogeneity persisted within subgroups, indicating that no single factor fully accounted for the observed variability.

A forest plot summarizing individual study estimates and the pooled IgG seroprevalence is presented in Figure 2.

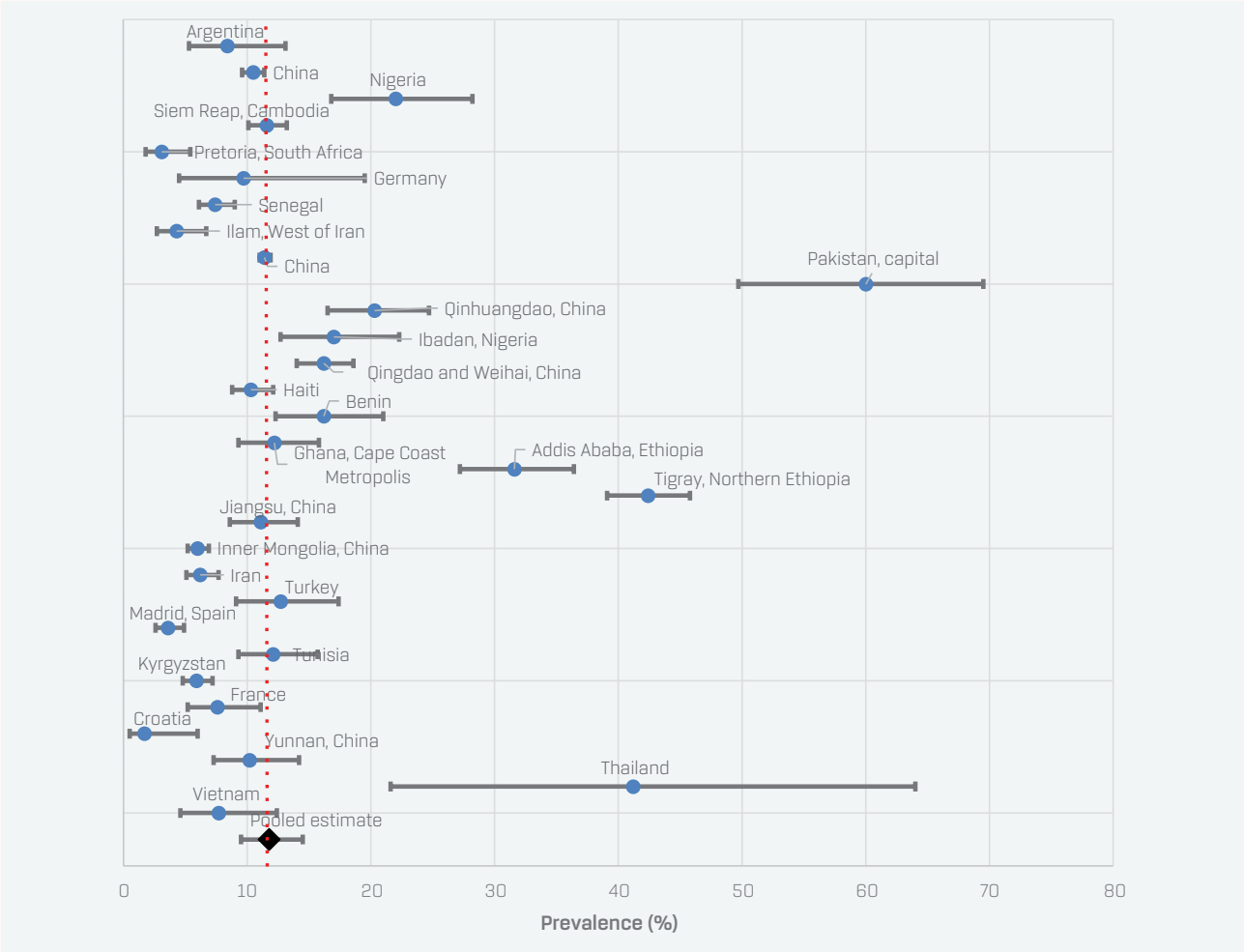

Figure 2. Forest plot of anti-HEV IgG seroprevalence among pregnant women across included studies.

Sensitivity analyses excluding studies with extremely high prevalence values and/or very small sample sizes resulted in only minor changes to the pooled estimate, while heterogeneity remained high. Specifically, the pooled anti-HEV IgG estimate varied by less than 1.0 percentage point after exclusion of these studies, indicating that the observed variability is driven by genuine epidemiological differences rather than by single influential studies.

In contrast, anti-HEV IgM seroprevalence, a marker of recent or acute HEV infection, was low in most included studies, frequently below 1%. Nevertheless, several countries reported markedly higher IgM prevalence, including Nigeria (15.0%), Pakistan (13.3%), and Thailand (11.8%), indicating ongoing transmission or recent outbreaks in these settings. Using a random-effects model, the pooled global seroprevalence of anti-HEV IgM was estimated at 1.07% (95% CI: 0.61–1.86). Heterogeneity remained considerable (Cochran's Q = 570.9, df = 23, $p < 0.001$; $I^2 = 95.97\%$), reflecting substantial variability in recent HEV exposure across study populations.

Exploratory subgroup assessment for anti-HEV IgM suggested higher prevalence estimates in studies from South Asia and sub-Saharan Africa compared with other regions; however, interpretation was limited by the low overall prevalence, frequent zero-event studies, and the small number of studies within individual subgroups. Accordingly, no robust subgroup-specific pooled estimates were derived for IgM.

Anti-HEV IgM data were available in 24 studies. Heterogeneity statistics for IgM were therefore calculated based on studies reporting non-zero prevalence values, as the inclusion of zero-event studies may lead to instability in standard error–based estimates. Studies reporting zero anti-HEV IgM events were retained in the pooled prevalence analysis and displayed in the forest plot (fig. 3); however, they were excluded from heterogeneity testing and funnel plot–based publication bias assessment, including Egger's regression, to ensure the stability of standard error–based diagnostics. This analytical distinction is explicitly reflected in the reported degrees of freedom for heterogeneity analyses and does not affect the pooled prevalence estimates. Confidence intervals for zero-event studies were not displayed in descriptive tables because they are typically extremely wide and uninformative; nevertheless, these studies were appropriately incorporated into the pooled estimates through the applied variance-stabilizing transformation.

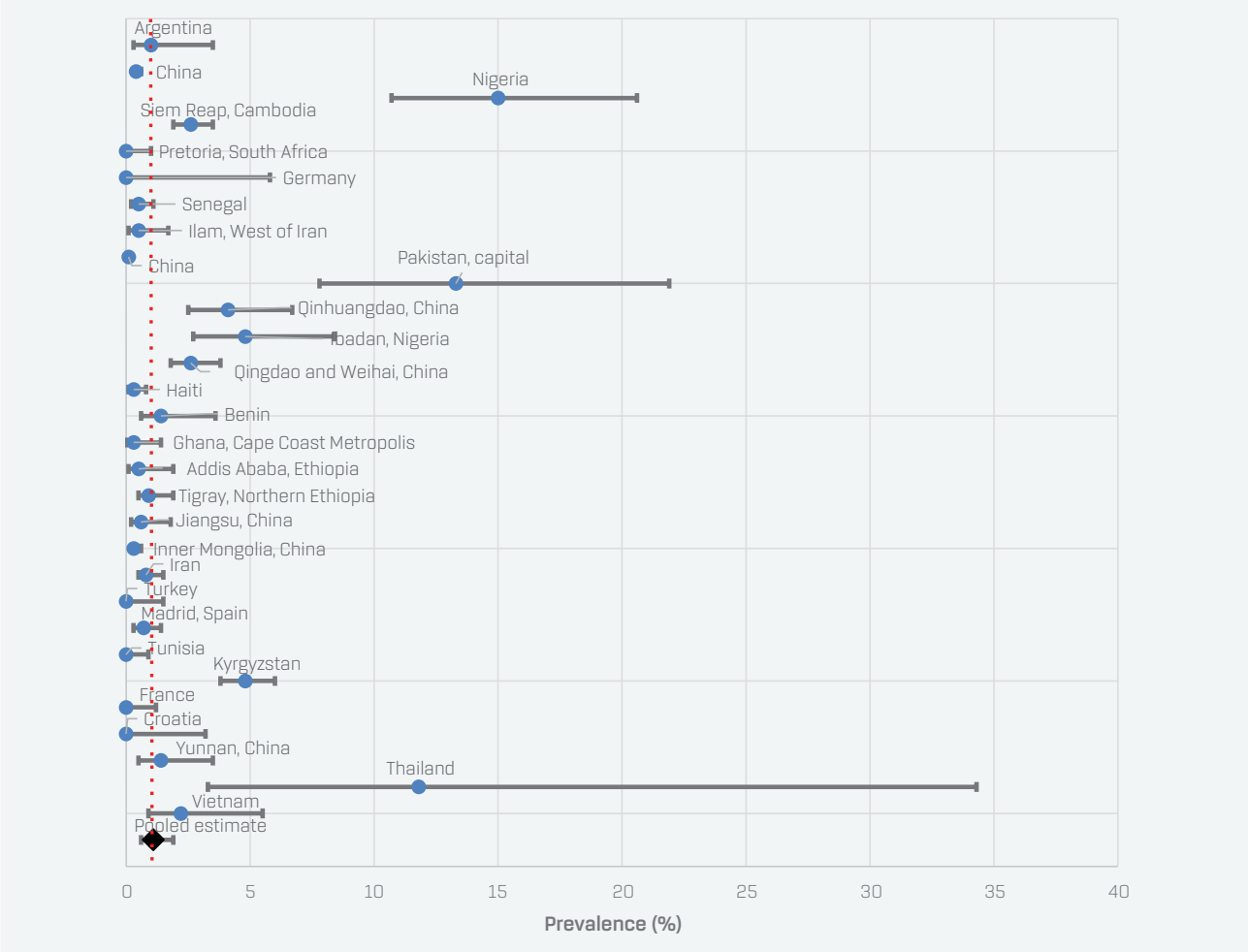

Figure 3. Forest plot of anti-HEV IgM seroprevalence among pregnant women. Individual study estimates and 95% confidence intervals are shown. Zero-event studies were included in the meta-analysis and displayed in the forest plot. The pooled seroprevalence estimate was calculated using a random-effects model with Freeman–Tukey double arcsine transformation.

All extracted prevalence data were cross-checked against the original publications to ensure consistency between reported sample sizes, numbers of seropositive cases, and calculated prevalence estimates.

Publication Bias

Visual inspection of the funnel plots did not reveal marked asymmetry for either anti-HEV IgG or anti-HEV IgM seroprevalence (fig. 4 and 5). Egger's regression test did not indicate statistically significant small-study effects for anti-HEV IgG (intercept = 2.27, p = 0.19).

For anti-HEV IgM, Egger's regression test was also non-significant (intercept = 2.94, p = 0.58). This finding should be interpreted cautiously because IgM positivity was rare and several included studies reported zero events. Consistent with the analytical approach described in the Methods, zero-event IgM studies were retained in the pooled prevalence meta-analysis and forest plot but were excluded from funnel plot visualization and Egger's regression to avoid instability in standard error–based diagnostics. Egger's test was performed using Freeman–Tukey transformed proportions and corresponding standard errors.

Given the extremely high heterogeneity observed (I^2 > 95%) and the methodological limitations of funnel plot asymmetry and Egger's regression in meta-analyses of prevalence – particularly when outcomes are rare and zero-event studies are frequent – the lack of statistically significant small-study effects in this analysis should be interpreted cautiously and cannot be considered definitive evidence against the presence of publication bias.

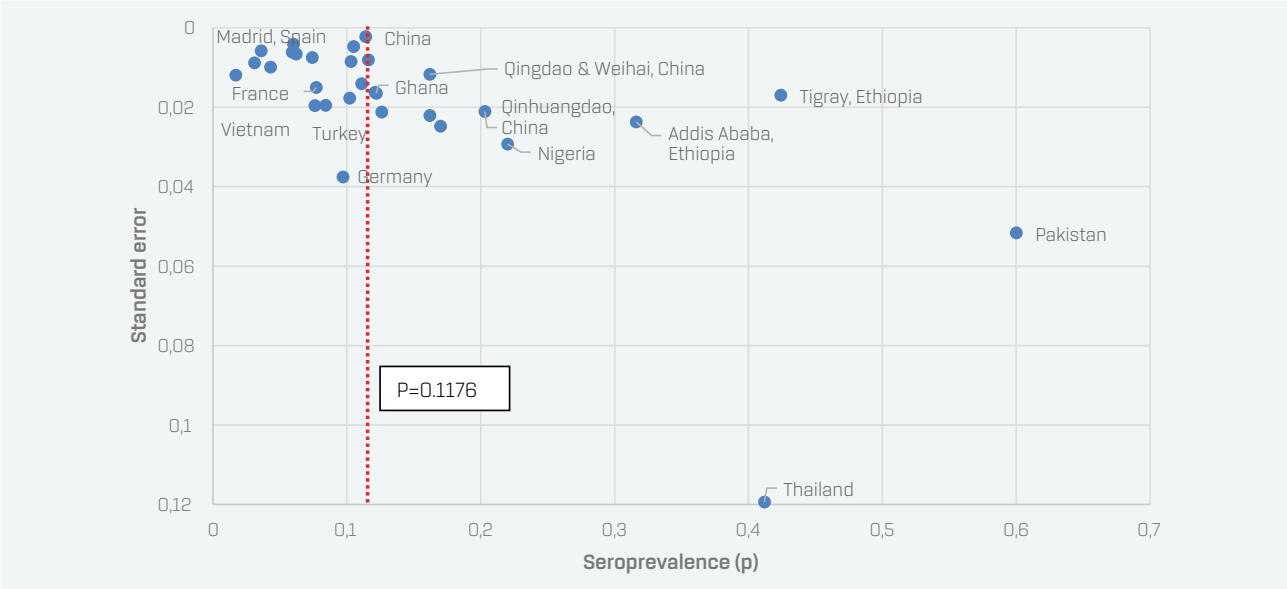

Figure 4. Funnel plot of anti-HEV IgG seroprevalence among pregnant women. Each point represents an individual study. The x-axis shows seroprevalence estimates expressed as proportions, while the y-axis represents standard errors, with smaller standard errors displayed at the top of the plot. The vertical dashed line indicates the pooled seroprevalence estimate (p = 0.1176). The distribution of studies does not suggest marked asymmetry.

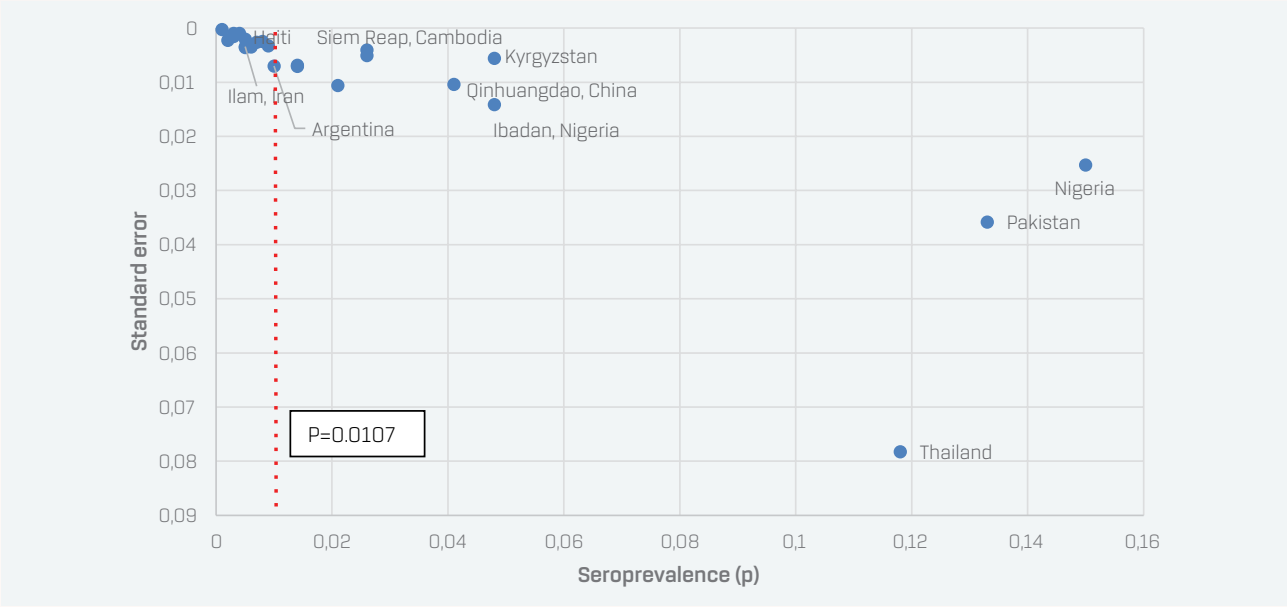

Figure 5. Funnel plot of anti-HEV IgM seroprevalence among pregnant women. Each point represents an individual study reporting non-zero IgM prevalence. The x-axis shows seroprevalence estimates expressed as proportions, while the y-axis represents standard errors, with smaller standard errors displayed at the top of the plot. The vertical dashed line indicates the pooled seroprevalence estimate (p = 0.0107). Studies reporting zero IgM events were excluded from the funnel plot to ensure the stability of standard error–based diagnostics.

DISCUSSION

In this meta-analysis, we estimated a pooled global seroprevalence of anti-HEV IgG of 11.76% and anti-HEV IgM of 1.07% among pregnant women using a random-effects model. These findings suggest that previous exposure to HEV is relatively common worldwide, whereas recent or acute infection during pregnancy is uncommon at the global level. Nevertheless, the substantial heterogeneity observed for both markers indicates pronounced regional and contextual differences in HEV epidemiology.

Comparison with Previous Evidence

Our results are broadly consistent with previous meta-analyses demonstrating wide geographic variability in HEV seroprevalence among pregnant women. For example, Ahmad et al. reported an overall IgG seroprevalence of 16.51%, with marked regional differences, ranging from low prevalence in Europe to substantially higher levels in parts of Africa and Asia (35). Similarly, Dagnew et al. reported high pooled seroprevalence among pregnant women in Africa, accompanied by considerable intra-regional heterogeneity (36). Bigna et al. further highlighted important differences between asymptomatic and symptomatic women, with substantially higher seroprevalence in clinically affected populations (37).

Compared with these earlier reports, the slightly lower pooled IgG estimate observed in our analysis may reflect methodological differences, including broader geographic coverage, stricter inclusion criteria, and exclusive use of a random-effects model. Differences in study populations, time periods, and diagnostic approaches are also likely to contribute to variability across meta-analyses (35-37).

Interpretation of Heterogeneity

The very high heterogeneity observed reflects the complex and multifactorial nature of HEV epidemiology across different settings. Variations in socioeconomic conditions, access to safe drinking water, sanitation infrastructure, dietary practices, and exposure to zoonotic reservoirs differ substantially across regions and are known determinants of HEV transmission (36,37). In addition, disparities in healthcare access and diagnostic capacity may lead to underestimation of HEV exposure in settings with limited serological screening.

Methodological factors may further contribute to heterogeneity. Differences in ELISA kits, assay sensitivity and specificity, and potential cross-reactivity with other endemic infections, such as hepatitis A virus, have been shown to influence reported seroprevalence. Dagnew et al. demonstrated that the choice of diagnostic assay alone can result in large differences in estimated HEV prevalence (36), highlighting the importance of diagnostic standardization.

Although subgroup analyses or meta-regression were considered to further explore sources of heterogeneity, these analyses were not performed due to limited and inconsistently reported covariate data across studies, as well as the risk of generating spurious or unstable findings in the context of highly heterogeneous prevalence estimates.

Clinical and Public Health Implications

Although global anti-HEV IgM seroprevalence was low in this analysis, higher IgM prevalence in specific regions suggests ongoing transmission and potential risk for adverse maternal and fetal outcomes. Previous studies have consistently shown that HEV infection during pregnancy, particularly in the second and third trimesters, is associated with severe maternal disease and poor pregnancy outcomes, including increased risks of fetal loss and maternal mortality (35-37).

The regional disparities observed in our study support the need for context-specific public health strategies, particularly in endemic and high-prevalence settings. Strengthening water, sanitation, and hygiene infrastructure, improving access to safe drinking water, and increasing awareness of HEV transmission routes may substantially reduce disease burden. In high-risk areas, integration of HEV testing into routine prenatal care may facilitate earlier detection and improve maternal management (36, 37).

Methodological Considerations and Limitations

Several limitations should be considered. First, the high heterogeneity across studies limits the interpretability of pooled prevalence estimates and reflects genuine epidemiological diversity rather than a uniform global pattern. Second, incomplete reporting and variability in diagnostic assays may have influenced seroprevalence estimates. Third, restriction to English-language publications may have led to the exclusion of relevant studies from certain regions. Finally, assessment of publication bias for IgM seroprevalence remains limited due to the rarity of the outcome and the presence of multiple zero-event studies (36, 37).

Although exploratory subgroup assessment indicated differences by geographic region and diagnostic assay, formal subgroup meta-analyses and meta-regression were not undertaken. This decision was based on incomplete reporting of key covariates, heterogeneity in study design, and small numbers of studies within several potential subgroups, which could have resulted in unstable or misleading estimates. Consequently, pooled prevalence values should be interpreted as global summaries that encompass substantial regional and methodological variation.

CONCLUSIONS

1. HEV exposure among pregnant women is widespread globally, with substantial regional variability in anti-HEV IgG seroprevalence.
2. Recent or acute HEV infection during pregnancy, reflected by anti-HEV IgM positivity, is relatively rare at the global level but remains elevated in specific high-risk regions.
3. The very high heterogeneity observed across studies highlights the influence of geographic, socioeconomic, and methodological factors on reported HEV seroprevalence estimates.
4. These findings underscore the need for region-specific surveillance strategies, improved diagnostic standardization, and targeted preventive measures to reduce HEV-related risks during pregnancy.

CONFLICT OF INTEREST

No conflict of interest to declare.

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ETHICAL APPROVAL

Ethical approval was not required for this systematic review and meta-analysis, as it was based exclusively on previously published aggregate data and did not involve the collection or analysis of individual-level patient information.

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Octavian Sajin, SCOPUS ID: 57210361596

Adela Turcanu, SCOPUS ID: 57196216983

Veaceslav Gutu, SCOPUS ID: 57210358425

Nina Iziumov, SCOPUS ID: 58643036200

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RADON RISK COMMUNICATION, AWARENESS AND PERCEPTION: RESULTS OF A NATIONAL PUBLIC OPINION SURVEY IN THE REPUBLIC OF MOLDOVA

Liuba CORETCHI[1], Ala OVERCENCO[1], Aurelia ABABII[1,2], Mariana GINCU[3], Angela CAPATINA[1]

[1] National Agency for Public Health, Chișinău, Republic of Moldova
[2] Oncological Institute, Chișinău, Republic of Moldova
[3] Ministry of Health, Chișinău, Republic of Moldova

Corresponding author: Ala Overcenco, e-mail: ala.overcenco@ansp.gov.md

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ABSTRACT

Introduction Radon is a naturally occurring radioactive gas, recognized as a leading cause of lung cancer among non-smokers. The level of public radon awareness remains low in many countries. The study presents the results of a public opinion survey in the Republic of Moldova within the IAEA STEAM Project (RER9153), *aiming* to assess public awareness, risk perception, and willingness to undertake radon mitigation measures.

Materials and methods A structured questionnaire was administered to 391 adults across 20 districts and 2 municipalities during December 2020–February 2021. Statistical analysis was used to assess associations among radon knowledge levels and socio-demographic variables.

Results Showed that 75.4% of respondents knew little or nothing about radon, although 64.5% considered home radon testing a priority. More than half were unaware of how testing is performed, and approximately 30% believed that ventilation could replace testing. While 84.9% correctly linked radon to lung cancer, many associated it with unrelated diseases. Family doctors and public health institutions were the most trusted sources but were rarely used, whereas the internet and social media were frequently used but were less trusted. Radon was perceived as posing a lower risk than nuclear accidents and food contamination.

Conclusions The findings revealed significant knowledge gaps and misconceptions among communities, underscoring the need for targeted, evidence-based risk communication strategies using trusted healthcare channels to promote awareness and action regarding indoor radon exposure.

Keywords Radon, opinion survey, risk perception, radon exposure, risk communication, public health.

COMUNICARE, CONȘTIENTIZARE ȘI PERCEPȚIE RISCULUI DE RADON: REZULTATELE UNUI SONDAJ NAȚIONAL DE OPINIE PUBLICĂ ÎN REPUBLICA MOLDOVA

Introducere Radonul este un gaz radioactiv natural, recunoscut, la nivel internațional, drept una dintre principalele cauze majore ale cancerului bronhopulmonar în rândul nefumătorilor. În pofida celor menționate, nivelul de informare a populației cu privire la riscurile asociate expunerii la radon rămâne redus în numeroase țări. Studiul prezintă rezultatele unui sondaj de opinie publică, realizat în Republica Moldova, în cadrul Proiectului STEAM (RER9153) al AIEA, având ca scop evaluarea nivelului de informare a populației privind expunerea la radon, a percepției riscului și a disponibilității populației de a aplica măsuri de prevenție.

Materiale și metode Un chestionar structurat a fost propus unui eșantion de 391 de persoane adulte din 20 de raioane și 2 municipii, în perioada decembrie 2020 – februarie 2021. În vederea evaluării asocierilor dintre nivelul de cunoștințe despre radon și variabilele socio-demografice, s-a efectuat analiza statistică a datelor.

Rezultate Rezultatele au demonstrat că 75,4% dintre respondenți posedau puține informații sau nu știau nimic despre radon, deși 64,5% considerau testarea locuinței la radon drept o prioritate. Majoritatea nu cunoșteau metodele de testare, iar aproximativ 30% au considerat, în mod eronat, că aerisirea locuinței poate substitui testarea. Deși, 84,9% dintre subiecți au asociat corect expunerea la radon cu riscul de cancer bronhopulmonar, au fost raportate și asocieri greșite cu alte afecțiuni. Medicii de familie și instituțiile de sănătate publică au fost considerate drept cele mai credibile surse de informare, dar la care s-a apelat în rare cazuri. În ansamblu, radonul a fost perceput ca un risc mai redus, comparativ cu accidentele nucleare sau contaminarea alimentelor cu radionuclizi.

Concluzii Constatările studiului evidențiază lacune semnificative la nivel de cunoștințe ale populației vizând radonul și relevă necesitatea aplicării unor strategii mai eficiente de comunicare a riscului pe care îl prezintă acesta, prin canale credibile din domeniul sănătății publice.

Cuvinte-cheie Radon, sondaj de opinie, percepția riscului, expunere la radon, comunicarea riscului, sănătate publică.

INTRODUCTION

Radon is a naturally occurring radioactive gas formed by the decay of uranium in soils and rocks. Of the radon isotopes found in nature, the isotope ^{222}Rn is the most relevant for public health because it is produced continuously in the environment and can accumulate indoors. Radon and its decay, with a physical half-life of 3.8 days, can migrate through the ground and enter buildings, where they may accumulate, particularly in enclosed or poorly ventilated spaces (1). Once inhaled, its progeny can deposit in the respiratory tract and contribute significantly to the radiation dose. Globally, radon represents the leading contributor to natural background radiation exposure for the general population, accounting for more than half of such exposure (2). Prolonged exposure to elevated indoor concentrations has been established as a significant risk factor for lung cancer and represents the leading cause of this disease among non-smokers (3, 4). Although the health impacts of radon have been known for decades, awareness in many countries remains limited. Effective radon risk reduction depends heavily on public understanding of the issue, access to reliable information, and the availability of home testing and mitigation measures (5,6).

International bodies, including the World Health Organization (WHO) and the International Atomic Energy Agency (IAEA), emphasize that countries should develop coordinated radon programs aimed at assessing indoor levels, informing the public, and reducing preventable exposures (7). Current safety standards recommend that national authorities provide clear information on indoor radon and implement action plans when necessary. According to Requirement 50 of the IAEA General Safety Requirements Part 3, "The government shall provide information on levels of radon indoors and the associated health risks and, if appropriate, shall establish and implement an action plan for controlling public exposure due to radon indoors." (3). Clear and effective communication with stakeholders, including the general population, forms a key component of these radon action plans.

Recent scientific literature emphasizes that radon risk communication remains one of the most challenging components of national radon action plans, due to the invisible nature of exposure, delayed health outcomes, and persistent public misconceptions. Systematic reviews and population-based studies conducted in Europe and beyond confirm that low awareness, confusion between radon and other radiation sources, and overreliance on ineffective protective behaviors (e.g., ventilation alone) are common across countries with different socio-economic profiles (5,8). Moreover, recent studies highlight that risk perception and behavioral intentions related to radon are not driven solely by knowledge levels, but also by trust in information sources, perceived controllability, and social norms (9,10). A review by Cori et al. demonstrated that low perceived personal relevance, misunderstanding of mitigation effectiveness, and limited self-efficacy are recurrent barriers preventing households from testing for radon or implementing remediation measures (11). More recent empirical research confirms that increased concern alone does not automatically translate into protective behavior. Pacella et al. showed that although a majority of respondents recognized radon as a health risk, fewer than one-third had practical knowledge of testing procedures or mitigation options (12). Similarly, Perko and Hevey demonstrated that risk perception and intention to act are strongly influenced by message framing and trust in information sources rather than by factual knowledge alone (13). These findings highlight the need to move beyond awareness-raising and to better understand how knowledge, perception, and communication channels interact in shaping preventive behavior – a gap that the present study explicitly addresses in the Moldavian context.

In 2019, a population survey was carried out in the Republic of Moldova on the population's knowledge of the radon risk exposure and its health effects (14).

A questionnaire was developed in the Radiation Hygiene and Radiobiology Laboratory based on the European EU-project RADPAR (Radon Prevention and Remediation) recommendations (15). The survey results showed that the general public is insufficiently aware of the health risks associated with radon exposure. The STEAM public opinion survey was developed within the IAEA Technical Cooperation Project RER9153 to support participating countries in understanding how well populations comprehend radon-related risks (16). The present study extends the scope of investigation by incorporating additional dimensions recommended by the IAEA STEAM methodology. In particular, the questionnaire included new items addressing: (i) comparative perception of radon risk relative to other radiation-related hazards; (ii) perceived personal versus societal risk; (iii) behavioral intentions and perceived barriers related to radon testing and mitigation; (iv) patterns of use and trust in different information sources. These additions allow a more nuanced understanding of how knowledge, perception, and communication interact, and provide actionable insights for designing targeted radon risk communication strategies within the future national radon action program.

Twenty-two countries, including the Republic of Moldova, implemented a harmonized questionnaire that explore knowledge, perceptions, and readiness to undertake radon testing and mitigation. Results already published by countries such as Bulgaria, Albania, Romania, and others show consistently low awareness of radon and its health impacts and highlight the persistent communication barriers that exist across various cultural and socio-economic settings (17–20).

In this context, the Republic of Moldova carried out its own national survey. The *goal* was to identify the population's level of understanding, perceived health risks, their willingness to measure indoor radon, and the extent of trust placed in different information sources.

MATERIALS AND METHODS

The Republic of Moldova, situated in Eastern Europe, covers an area of 33 851 km^2 and stretches approximately 350 km from northwest to southeast and around 150 km from west to east. From a geological standpoint, most of the land lies on deep sedimentary formations, with crystalline rocks surfacing only in the northern regions. According to demographic data provided by the National Bureau of Statistics (NBS) (21), the usual resident population of the Republic of Moldova as of January 1, 2020, was 2,643,675 persons. This includes 1,262,198 males (47.7%) and 1,381,477 females (52.3%). The adult population (aged 18 years and older) was 2,071,559 persons, accounting for 78.4% of the total population, while 16.7% were aged 65 and above. The rural population exceeds the urban population (58.7% versus 41.3%). Nearly one quarter of Moldova's population is concentrated in the capital Chișinău, which in 2020 had around 661 798 inhabitants.

Study design and Data collection

A cross-sectional study was conducted using a structured questionnaire administered to adult residents (≥18 years) of the Republic of Moldova. The survey was led within the framework of the IAEA Technical Cooperation Project RER9153 (STEAM), using a harmonized methodology applied across participating countries. The project questionnaire was adapted into Romanian for national implementation. It comprised several thematic sections, covering socio-demographic characteristics, general health status, radon awareness and knowledge, perceived risks, and preferred information sources.

The survey was carried out between December 2020 and February 2021. The study encompassed 20 districts of the Republic of Moldova and the two largest municipalities, Chișinău and Bălți. The sampling model was developed according to demographic data from the National Bureau of Statistics of the Republic of Moldova, taking into account sex, age group, region, and type of settlement. Data were collected through the regional Public Health Centers, where designated specialists administered questionnaires to residents within their respective jurisdictions. Participation was entirely voluntary.

Completed questionnaires were forwarded to the Laboratory of Radiation Hygiene and Radiobiology of the National Agency for Public Health (NAPH) for verification and quality control, including the identification of potential errors or missing data. Responses were collected using predefined categories of Likert-type ordinal scales. Response options for each question also included "no answer" or "prefer not to answer". A feature of the question "What risk factors can most affect the health of Moldavians?" was the possibility of open-ended responses, from which six main categories were formed by the type of factors. All responses were coded and entered into a standardized Excel database. The verified survey responses were used for statistical analysis.

Statistical analysis

The sample size was determined using a standard statistical formula available through an online calculator (22). We selected a 95% confidence level and a 5% margin of error, which are widely accepted standards in social research (23). Questionnaires from 391 respondents were selected for statistical analysis, with a minimum required number of 385. Descriptive statistics were used to summarize categorical variables as absolute frequencies and percentages. For Likert-scale items (1 = strongly disagree, 5 = strongly agree), mean values (M) and standard deviations (SD) were calculated to facilitate comparisons across groups and variables. Associations between ordinal variables were assessed primarily using Spearman correlation coefficients, given the approximately symmetric distribution of responses and the use of numeric coding for Likert-scale categories. Correlation strength was interpreted using conventional thresholds from the National Institutes of Health (NIH) (weak/poor: $|r| < 0.39$; moderate: 0.4-0.69; strong: > 0.7) (24). Statistical significance was evaluated at $p < 0.05$ and $p < 0.01$ levels. All tests were two-tailed.

To verify robustness, correlation patterns were additionally examined using nonparametric Spearman's rank correlation coefficients, which yielded comparable directions and significance of associations (data not shown). Correlation coefficients were interpreted as indicators of directional association rather than causal relationships, providing insight into how perceived knowledge and risk appraisal co-vary within the population. Data were analyzed using Microsoft Excel and Statgraphics Centurion software.

Sample characteristics

Of the total number of verified responses (391 respondents), 62.4% were female, and 37.6% were male. The age distribution of respondents was close to the national average: 32.0% were under 45 years old, 52.2% were 45-64 years old, 14.8% were 65 years old and older, and 1,0% did not indicate their age.

Regarding educational attainment, 49.1% of respondents held a university degree, 32.2% had completed community college, 14.1% had completed high school, and 4.6% did not disclose their education level. A vast majority (95.14%) reported not being employed in fields involving ionizing radiation. About 50% of respondents lived in a single-detached house, whereas 36% lived in an apartment in a high-rise building. Approximately 45.78% of participants reported an average income, while 21.74% did not respond to this question.

RESULTS

Risk factors affecting the health

The assessment began with two introductory questions: "How do you think your health is in general?" and "How do you think the health of Moldavians in general is?" Nearly half of the participants (47.8%) rated their own health as "fair," while 33.5% described it as "good." A combined 65% of responses characterized the health of Moldavians as either "fair" or "good," whereas 26.3% of participants regarded the general health status of the Moldavian population as "poor." Respondents tended to perceive their personal health more positively than that of the broader Moldavian population (81.3% vs. 65.0%, respectively ($t = 5.22$, $p < 0.001$). A considerable proportion of respondents (62.7%) reported being aware of health risk factors, whereas only 12.8% reported lacking such awareness. Typically, individuals demonstrate a higher level of awareness regarding their personal health risks than those they attribute to the general population (25).

When asked, "Which risk factors can most affect the health of Moldavians?", participants were invited to list at least three perceived threats without being given predefined options. Based on their open-ended responses, several broad categories of risk factors were identified (tab. 1). The social environment emerged as the most frequently cited determinant, mentioned by 63% of respondents. This category encompasses lifestyle-related behaviors such as smoking, substance abuse, excessive alcohol consumption, poor diet, physical inactivity, domestic violence, inadequate hygiene, and unsafe sexual practices. The natural environment ranked second, named by approximately 60% of participants, with concerns centered on climate change, air pollution, extreme weather events, and floods. The living and working environment ranked third (32.5%), encompassing aspects such as housing and workplace conditions, indoor air quality, poverty, the quality of the healthcare system, migration, unemployment, political instability, and other socio-economic factors that indirectly shape public health outcomes. Technological risks ranked fourth, which were given greater importance by men (19.7%) than women (8.2%).

Table 1. Data for risk factors affecting the health of Moldavians.

What risk factors do you think can affect the health of Moldavians the most?	All respondents	Gender		Age				
		Male	Female	18-24	25-44	45-64	over 65	I prefer not to answer
Total, abs.	391	147	244	9	116	204	58	4
Natural environment, %	59.8	57.1	61.5	66.7	52.6	65.2	55.2	50.0
Technological risks, %	12.5	19.7	8.2	11.1	12.9	12.2	13.8	0.0
Living and working environment, %	32.5	27.2	35.7	11.1	32.8	32.8	36.2	0.0
Social environment (lifestyle), %	62.9	59.2	65.2	33.3	58.6	62.2	79.3	50.0
Health conditions and genetics, %	6.9	4.8	8.2	0.0	6.9	7.3	6.9	0.0
Others, %	8.2	14.3	4.5	11.1	6.0	10.3	5.2	0.0
No responses, %	10.0	7.5	11.5	22.2	17.2	7.3	0.0	50.0

Almost half of Moldavians (55.5%) claimed to know how to protect themselves from potential health risks, and 30.7% believed they were able to control all risk factors affecting their health (tab. 2). Also, more than half of the respondents (57.0%) agreed that decisions concerning health risks should be made by experts. The statement "Indoor air quality is very important for health" received the strongest support, with 97.7% of respondents agreeing. Finally,

84.4% of participants reported that, regardless of weather conditions, they make an effort to keep their homes well-ventilated, combining those who "agree" and "strongly agree" with this statement – an encouraging indicator of public awareness regarding indoor environmental health.

Table 2. Respondents' agreement with statements related to their health control, %.

Answer options	Statements				
	I protect myself from any risk factors that could affect my health	I have control over all risk factors for my health	Decisions about health risks should be left to the experts	The indoor air quality from my home is very important for my health	Regardless of the weather, I make sure that my home is well ventilated
Strongly Disagree	1.0	2.0	1.8	0.3	0.5
Disagree	24.3	40.7	25.8	1.0	2.8
Neither agree nor disagree	16.9	22.8	8.4	0.8	7.4
Agree	48.6	24.3	46.5	75.4	67.8
Strongly Agree	6.9	6.4	10.5	22.3	16.6
I don't know	0.8	3.1	3.8	0.3	4.1
I prefer not to answer	1.5	0.8	3.1	0.0	0.8

Awareness of radon exposure and associated risks

The level of knowledge of the respondents regarding indoor radon exposure was initially measured by self-assessment using two types of statements: respondents were asked to assess the amount of knowledge they have about "indoor radon" and "health risk due to exposure to indoor radon" (tab. 3). Overall, public awareness of radon and the health risks associated with its exposure in the Republic of Moldova was found to be relatively low. Nearly half of respondents (46.6%) reported knowing very little or nothing about radon, and only 23.5% reported having significant knowledge ("quite a lot" or "a lot"). Regarding health risks, 48.6% reported minimal or no knowledge, and only 23.8% reported being sufficiently aware.

Table 3. Respondents' answers on knowledge about radon and health risk due to indoor radon, %.

Answer options	Questions	
	How much would you say you know about indoor radon	How much do you say you know about the health risk due to radon exposure?
Nothing, (%)	18.2	20.2
Only a little, (%)	28.4	28.4
Something, (%)	28.9	27.6
Quite a bit, (%)	13.0	13.6
A lot, (%)	10.5	10.2
I prefer not to answer, (%)	1.0	0.0
Mean value* (M)	2.69	2.65
Standard Deviation (SD)	1.22	1.23

*In the IAEA questionnaire, responses to these two questions are rated on a Likert scale from 1 to 5, where 1 = nothing and 5 = a lot

An analysis of the correlation between the level of knowledge about radon and its impact on health and socio-demographic variables (tab. 4) has shown strong and significant positive correlations between perceived knowledge about radon and knowledge of health risks ($r = 0.88$, $p < 0.01$), weak and significant correlations between radon knowledge and income ($r = 0.14$, $p < 0.05$). No statistically significant correlation was observed between age and knowledge of radon and radon-related health risks. Education showed no meaningful association with radon knowledge, while income was moderately correlated with education ($r = 0.37$, $p < 0.01$). Overall, socioeconomic factors are associated with knowledge more than age or education alone, but the effects are small.

Table 4. The correlation (r) between the level of knowledge about radon and its impact on health and socio-demographic variables.

	How much would you say you know about radon?	How much do you say you know about the health risk due to radon exposure?	Age	Education	Income
How much would you say you know about radon?	-	0.88**	0.05	-0.01	0.14*
How much do you say you know about the health risk due to radon exposure?		-	0.04	0.03	0.15**
Age			-	0.01	-0.07
Education				-	0.37**
Income					-

** The correlation is significant at $p < 0.01$
* The correlation is significant at $p < 0.05$

A considerable majority of respondents – 84.9% (those who selected “agree” or “completely agree”) – correctly recognized radon as a causative factor for lung cancer (tab. 5). Nevertheless, despite the provision of contextual information prior to the survey, a notable share of respondents attributed radon exposure to other unrelated health conditions. Specifically, 40.7% of respondents associated it with asthma, 34.0% with allergies, 41.7% with skin diseases, and 45.0% with other respiratory ailments. Such responses reflect the presence of uncertainty and the risk of distorted perceptions – conditions under which myths about radon could easily proliferate if communication strategies lack scientific rigor and clarity.

Table 5. Respondents' agreement with the statement "Radon exposure in high concentrations increases the risk of developing the following diseases", %.

Answer options	Disease					
	Asthma	Allergies	Lung cancer	Skin diseases	Other types of cancers	Other respiratory conditions
Strongly Disagree	0.5	0.5	0.3	6.4	0.0	0.3
Disagree	13.3	13.3	0.0	6.9	5.1	3.6
Neither agree nor disagree	17.1	17.6	4.9	17.6	22.5	22.0
Agree	37.6	32.0	65.7	37.9	39.4	38.9
Strongly Agree	3.1	2.0	19.2	3.8	2.8	6.1
I don't know	23.8	28.9	9.5	24.0	26.6	24.6
I prefer not to answer	4.6	5.6	0.5	3.3	3.6	4.6

Risk perception

Responses concerning the perception of radon as a significant health threat and the prioritization of home testing (fig. 1) were markedly inconsistent. One third of respondents (32.2%) disagreed with the statement that radon poses a health risk to them personally, while 14.1% expressed uncertainty ("neither agree nor disagree") and 18.9% don't know the answer to this question. Conversely, 28.4% viewed residential radon exposure as a serious health hazard, and a large majority (71.4%) believed that testing one's home for radon should be a priority.

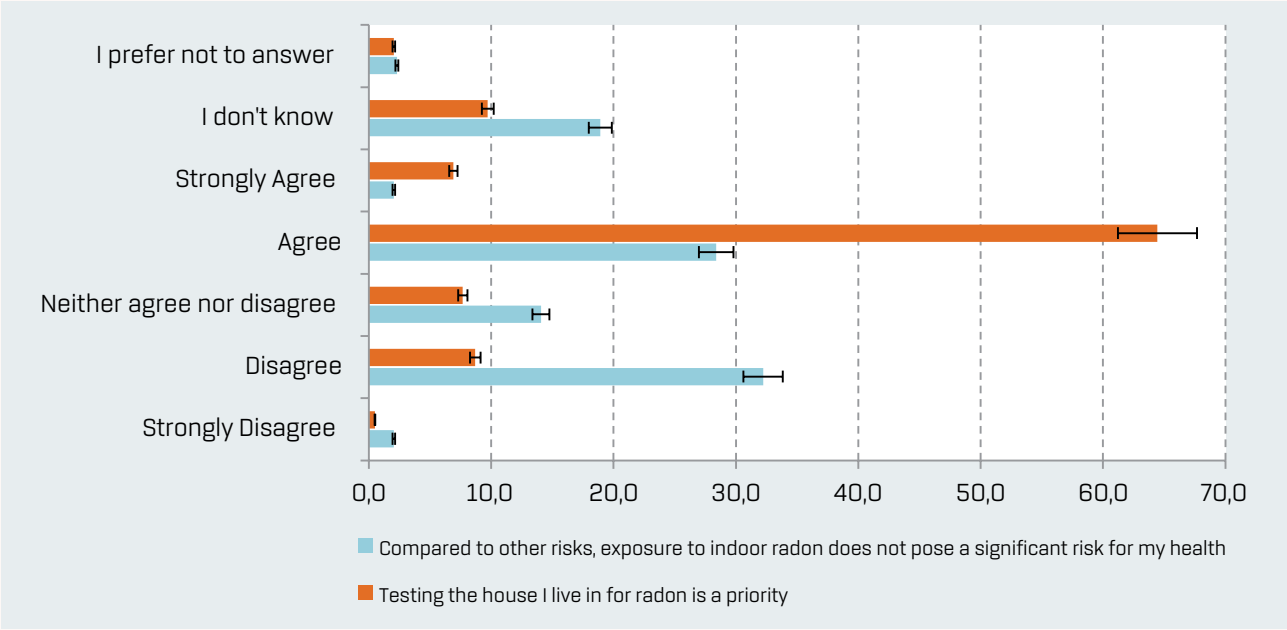

Figure 1. Respondents' assessment of their awareness of residential radon risk perception and home radon test priority, %.

Pearson correlation analysis (tab. 6) revealed several statistically significant associations between perceived radon risk, awareness and susceptibility indicators. Perception of radon risk to one's own health showed a moderate positive correlation with the belief that radon is a problem in the area of residence ($r = 0.55$, $p < 0.01$), indicating that personal risk perception is strongly linked to local risk awareness. A weaker but statistically significant relationship was found between perceived personal risk and self-reported knowledge of radon ($r = 0.18$, $p < 0.01$) and of health risks associated with radon exposure ($r = 0.13$, $p < 0.05$). No statistically significant correlations were found between perceived radon risk to one's health and the statement that indoor radon exposure does not pose a significant health risk compared to other risks ($r = -0.03$), indicating a lack of systematic association between these perceptions.

Table 6. The correlation (r) between the level of knowledge about radon and its impact on health and socio-demographic variables showed that.

	Perception of radon risk to one's own health	How much would you say you know about radon?	How much do you say you know about the health risk due to radon exposure?	Radon is a problem in the area where I live	Compared to other risks, exposure to indoor radon does not pose a significant risk for my health
Perception of radon risk to one's own health	-	0.18**	0.13*	0.55**	-0.03
How much would you say you know about radon?		-	0.88**	0.10	0.03
How much do you say you know about the health risk due to radon exposure?			-	0.14*	-0.01
Radon is a problem in the area where I live				-	-0.07
Compared to other risks, exposure to indoor radon does not pose a significant risk for my health					-

* The correlation is significant at $p < 0.05$
** The correlation is significant at $p < 0.01$

A pronounced knowledge gap was also identified regarding practical aspects of radon measurement in residential environments. More than half of respondents reported not knowing how radon levels are assessed in homes. Only one-third regarded radon testing as a simple procedure, whereas 10% perceived it as difficult or overly complex.

To explore respondents' attitudes toward radon exposure and mitigation, participants were presented with a series of statements designed to gauge their opinions and intended behaviors. Five key questions focused on the actions they would consider taking to reduce radon levels in their homes (fig. 2).

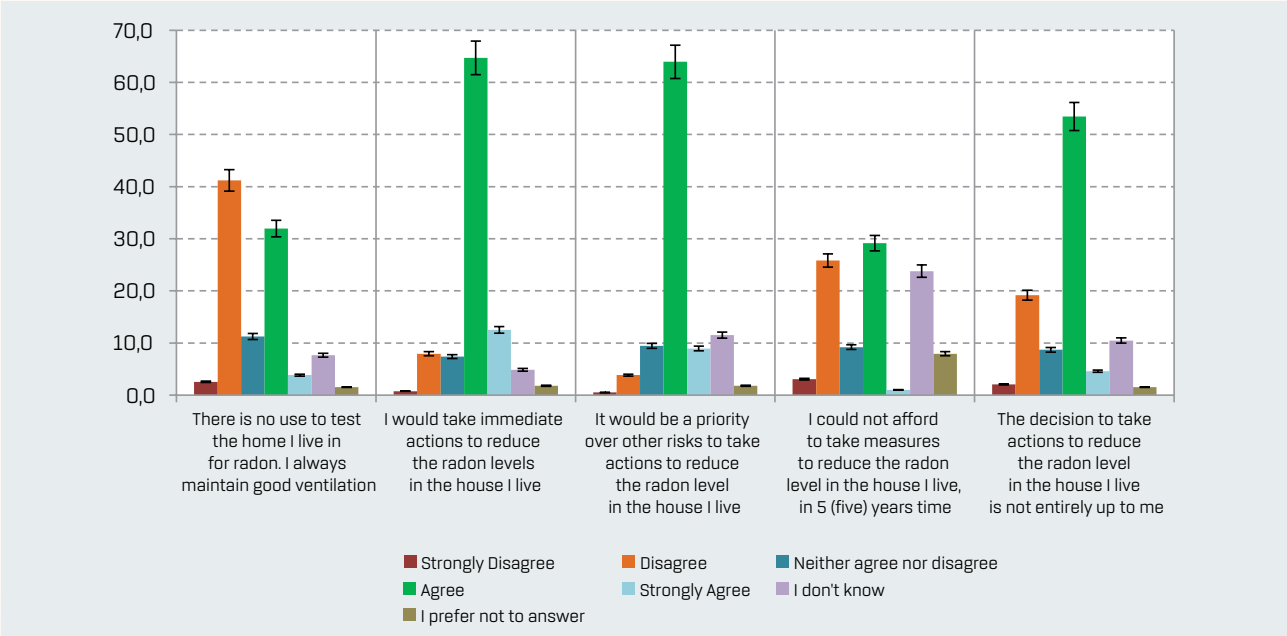

Figure 2. Respondents' assessment of the actions they would take to reduce radon levels, %.

The responses revealed a diverse range of perceptions: 32.0% of participants believed that testing their homes for radon is unnecessary because they already ventilate their living spaces adequately. In contrast, 41.2% disagreed, acknowledging that ventilation alone may be insufficient and that their homes should be tested for radon. Encouragingly, a large majority (77.2%) stated that they would take immediate measures to reduce radon levels if elevated concentrations were detected, and an equivalent proportion viewed such measures as a health priority, even above other potential household risks. However, financial and motivational barriers remain substantial. Nearly one-third of respondents indicated that they would not be able to afford radon mitigation measures within the next five years. Another third reported being ready to act immediately, while the remaining group remained undecided, uncertain whether addressing radon now would justify the required effort and costs ("I don't know" responses). Moreover, approximately 60% reported that they could not make independent decisions regarding mitigation actions within their households, suggesting that decisions are often shared or contingent on other family members or authorities.

Findings from our survey indicated a marginal difference between perceptions of radon at the personal and societal levels. Figure 3 presents a comparative overview of how respondents perceive radon in relation to other radiation-related hazards. When considering personal risk, 77.8% of participants viewed ionizing radiation from nuclear power plants or reactors as the greatest threat to their own health.

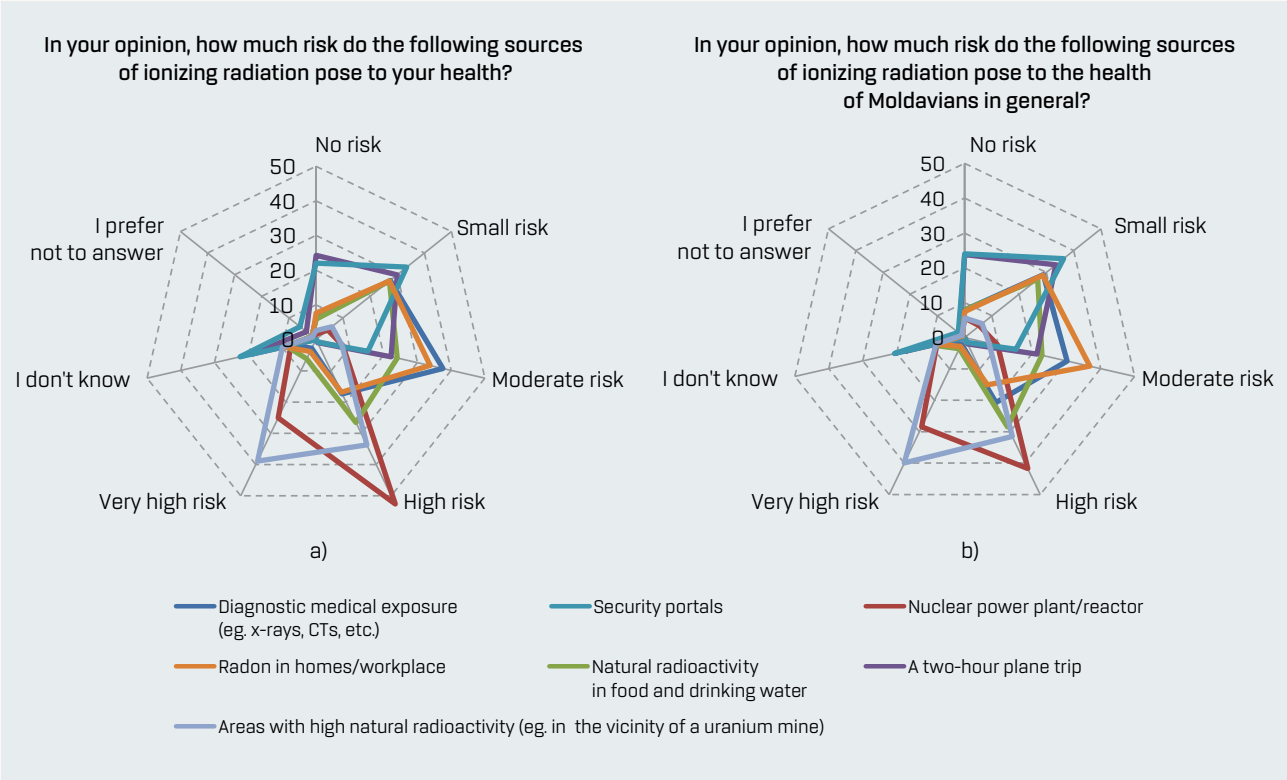

Figure 3. Comparison of respondents' perception of radon as a risk with other radiation risks: a) for themselves personally, and b) for Moldavians in general, %.

However, when assessing risks to the population as a whole, respondents identified areas with naturally high radioactivity (e.g., those surrounding uranium mines) as the most significant source of risk.

After receiving introductory information about radon during the survey, respondents ranked radon as the fourth most serious radiation-related health hazard, after exposure from nuclear power plants, highly radioactive areas, and natural radioactivity in food and drinking water. Notably, over two-thirds of respondents (68.5% for personal risk and 72.9% for societal risk) classified radon risk as "moderate," "low," or "absent." Only 20.7% perceived it as "high" or "very high" risk for themselves, and an even smaller proportion (17.9%) expressed similar concern for the general public. These results suggest that while radon is increasingly recognized as a potential hazard, it remains comparatively underestimated relative to more visible or dramatized radiation risks.

Information sources about health risk

To evaluate the potential of different information channels in supporting effective radon risk communication, the survey also included questions about how respondents access and trust health-related information. Statistical analysis of responses regarding use and trust of informational sources confirm a misalignment between use and trust, where highly trusted health sources are underused, while accessible but less credible channels are overused (tab. 7). To avoid subjective interpretation, predefined thresholds for mean values, variation coefficients, and mismatch categories were applied, as detailed in the table footnote. *Internet* – high mean for use (3.4) but lower for trust (3.0) indicates it is widely relied on but only moderately credible. The similar standard deviation (1.0) for both suggests relatively consistent opinions. Variation is moderate, showing some differences in individual behavior. *Family doctor* – use (2.7) and trust (3.2) are both moderate, with low SD (1.0; 1.0), indicating stable and shared perceptions.

This confirms family doctors as a consistently trusted and reliable source, though not the most used. *Friends/Family* – moderate mean values for both use (2.6) and trust (2.7) and low SD (0.8) show frequent reliance, but limited credibility. This reflects dependence on informal sources despite a modest level of trust. *Social media* – similar means for use (2.6) and lower trust (2.5). A correlation analysis of social media use by age showed that the relationship was weak but statistically significant, indicating a tendency: the older a person is, the less often they use this source of information ($r = -0.17$, $p < 0.001$). This suggests that social media use acts as a stratifying factor contributing to response dispersion. Despite low trust, it remains in use, posing a risk of exposure to misinformation. *Public health experts (National Agency for Public Health)* are estimated to have a high level of use and trust (3.1 and 3.2) as sources of information for the public.

Table 7. Comparison of respondent's Use vs Trust of various sources of information about health risk*.

Source	Mean		SD		CV, %	
	Use	Trust	Use	Trust	Use	Trust
Internet	3.4	3.0	1.0	1.0	30.5	33.2
Family Doctor	2.7	3.2	1.0	1.0	35.8	32.4
Friends/Family	2.6	2.7	0.8	0.8	31.9	28.9
Social Media	2.6	2.5	0,9	0.9	39,3	35.6
National Agency for Public Health	3.1	3.2	1.2	1.1	39.9	33.8
Television/Radio	3.0	2.8	1.0	1.0	33.0	35.2

** SD – standard deviation, CV (%) – coefficient of variation, calculated as (SD / Mean) × 100*

A comparison of patterns in information use and trust (tab. 7) underscores several key insights:

- Medical professionals and public health institutions remain the most credible and trusted sources of information.
- The Internet and personal networks serve as the most frequently accessed channels but are regarded with only moderate trust.
- Social media and traditional media (radio, television, newspapers) suffer from pronounced credibility deficits.
- There is a clear communication gap: institutions that already command strong public trust (such as family doctors and the National Agency for Public Health) are not yet fully utilized as strategic conduits for disseminating accurate and accessible information on radon and related health risks.

DISCUSSION

The Moldavian STEAM survey, like the other published national surveys (Bulgaria, Albania, Romania, and others), reflects a general pattern regarding the persistently low awareness of the population about radon and its impact on health. Although people generally showed interest in maintaining health and recognized the importance of environmental factors, awareness of radon remained strikingly low (11–13,26,27).

According to our study, 75.4% of respondents indicated “nothing”, “very little”, and “some” regarding knowledge about radon, and 76.2% regarding risks associated with it. A strong correlation between these indicators ($r = 0.88$, $p < 0.01$) is apparently due to the same sources of information. A majority of respondents (over 70%) correctly identified radon as a radioactive gas; however, more than one-third (36.6%) were unsure whether it posed a problem in their residential area.

The weak correlations between knowledge about radon, risk perception, and behavioral intentions suggest limited practical significance rather than predictive relationships.

Compared with the earlier Moldavian survey on radon risk perception (14) the present study shows a modest improvement in general awareness and interest in radon-related issues, particularly regarding preparedness to test residences for radon.

Bulgarian respondents also indicated minimal familiarity with radon (non-acquaintance, 76.9%) and the risks associated with it (78.1%) (19). In Albania, survey data showed better results, where 53% knew about radon and 43% about its risks, with the options “quite a bit” and “a lot”, the rest did not have sufficient knowledge on this topic (46% and 56%, respectively) (17). Preliminary data from Croatia (18) confirmed widespread unfamiliarity (68%); 50% of participants reported not knowing whether they lived in areas with potentially elevated radon levels. However, 85% would immediately take measures to reduce it (64.5% in our study).

In contrast to the Romanian study, where awareness of radon as a local problem did not translate into higher perceived personal health risk ($r = 0.38$, $p < 0.01$) (20), the Moldavian data reveal a moderate positive association between perceived radon risk to one’s health and recognition of radon as an issue in the area of residence ($r = 0.55$, $p < 0.01$). However, the overwhelming majority of Moldavian respondents (85%) correctly identified the link between radon and lung cancer. The frequent attribution of radon exposure to non-specific conditions such as asthma, allergies, or skin diseases indicates not only limited

knowledge, but also a tendency to generalize health risks in the absence of clear guidance. This pattern reinforces the importance of precise, disease-specific messaging in radon communication strategies, particularly emphasizing lung cancer risk and evidence-based mitigation measures beyond ventilation alone.

A synthesis of the responses about the actions they would take to reduce radon levels illustrates several important behavioral tendencies:

- Approximately one-third of the population would choose not to test their home for radon radiation.
- The majority indicated willingness to act if high radon concentrations were confirmed in their home environment.
- More than half of the respondents acknowledged that the decision to implement radon-reduction measures does not rest entirely with them.
- Although most participants considered home testing for radon a personal priority, fewer than one-third found the testing process straightforward or accessible.
- Roughly 30% of Moldavians believe that regular ventilation renders radon testing unnecessary, while an additional 10% remain ambivalent, neither agreeing nor disagreeing with that assumption.

This suggests that curiosity or perceived responsibility may motivate behavior even in the absence of detailed knowledge. However, financial barriers, uncertainty about procedures, and limited confidence in one's ability to take corrective actions may hinder follow-through. Similar discrepancies between high willingness to test and limited procedural knowledge were reported in Romania (20) and England and Wales (27), where awareness campaigns increased concern but did not automatically translate into action without clear guidance. These results underscore a complex blend of awareness, concern, and constraint: while the perceived importance of radon mitigation is rising, limited knowledge, financial capacity, and self-efficacy continue to hinder proactive testing and remediation behavior.

Compounding this, about one-third of participants believed that adequate home ventilation alone provides sufficient protection against radon exposure – a misconception that persists in many populations. This inconsistency between perceived and actual protective behaviors demonstrates features of the Dunning-Kruger effect (28), where individuals with limited understanding may overestimate their ability to manage risk effectively.

Respondents also tended to rate other sources of radiation, such as nuclear accidents, as far more dangerous than radon, reflecting a broader trend in radiation-risk perception: people often fear rare but dramatic events more than continuous, everyday exposures. These perceptions make radon a challenging risk to communicate effectively.

The survey also revealed a clear mismatch between the sources people rely on for health information and those they trust most. The Internet is heavily used but not considered highly reliable, whereas family doctors and public health institutions are trusted yet underutilized. Strengthening communication efforts through these trusted channels would likely improve the population's understanding and encourage proactive radon testing and mitigation. While the sample size was sufficient for statistical analysis, there was some heterogeneity in responses, which may reflect differences in information sources and individual interpretations of questionnaire items.

CONCLUSIONS

The STEAM survey in the Republic of Moldova indicates that, although the population expresses concern about general health and environmental conditions, awareness and understanding of radon risks remain critically low. The main conclusions of the study are:

1. Low Radon Awareness: Over 75% of the population lacks sufficient knowledge about radon and its health effects, despite acknowledging its link to lung cancer.
2. Discrepancy between Risk Perception and Behavior: A significant portion of respondents view radon as a low-priority risk, yet express interest in testing and mitigation, suggesting confusion and insufficient information.
3. Misconceptions Persist: Many Moldavians believe good ventilation is an adequate defense against radon, and myths about radon causing unrelated illnesses (e.g., skin conditions, allergies) were identified.
4. High Trust in Health Professionals: Family doctors and national health institutions are the most trusted sources of health risk information, but they are currently underused for radon communication.
5. Need for Targeted Communication: There is a pressing need for culturally adapted, clear, and actionable public health messaging to raise radon awareness and promote testing and mitigation actions.

These results contribute to a better understanding of radon risk perception patterns in Moldova and provide a baseline for future research and monitoring.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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ETHICAL APPROVAL

This study does not require Ethics Committee approval, as the respondent's completion of the questionnaire constituted informed consent and was anonymous. No personal data was used in the study or published.

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Liuba Coretchi, WoS Researcher ID: WNAX-4967-2025, SCOPUS ID: 55661674800

Ala Overcenco, WoS Researcher ID: IQV-5018-2023, SCOPUS ID: 36545158500

Aurelia Ababii, SCOPUS ID: 57297365600

Angela Capatina, SCOPUS ID: 58076908000

MEDICAL SCIENCES

OPEN ACCESS

INFORMED CONSENT: CHALLENGES AND PERSPECTIVES OF PATIENTS AND HEALTHCARE PROVIDERS IN GEORGIA

Nino GONGLADZE[1], Nato PITSKHELAURI[1]

[1] Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia

Corresponding author: Nino Gongladze, e-mail: gongladzeen@gmail.com

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ABSTRACT

Introduction The informed consent process is crucial in ensuring patient autonomy and ethical medical practice. The study aimed to assess understanding, experiences, and perceptions of informed consent among hospital personnel and the general population in Georgia, and to identify key challenges in its implementation.

Materials and methods Two structured questionnaires were developed, one targeting healthcare professionals and the other the general population. The surveys explored respondents' knowledge, experiences, and opinions on informed consent. Data were analyzed to identify key topics and areas for improvement in the process.

Results Among the general population, 68.8% reported receiving the informed consent form before medical services, while only 50.2% were informed of their right to accept or decline it. Nearly half (48.3%) reported misunderstandings of information provided by doctors. For hospital personnel, while there was unanimous agreement on the necessity of obtaining informed consent before procedures, only 59.3% demonstrated full understanding of required consent content, and only 10.2% correctly identified who else can sign the consent form. Notably, only 6.8% comprehended the nuances of verbal consent.

Conclusions Significant gaps persist in the informed consent process in Georgia, including communication barriers, time constraints, and inconsistent understanding among patients and providers. Enhanced training, clear communication strategies, standardized practices, and the integration of technology are recommended to improve the informed consent process.

Keywords Informed consent, patient autonomy, healthcare professionals, patient comprehension, doctor-patient communication, Georgia.

CONSIMȚĂMÂNTUL INFORMAT: PROVOCĂRI ȘI PERSPECTIVE ALE PACIENȚILOR ȘI FURNIZORILOR DE ASISTENȚĂ MEDICALĂ DIN GEORGIA

Introducere Consimțământul informat este esențial pentru asigurarea autonomiei pacientului și a unei practici medicale etice. Acest studiu investighează perspectivele și experiențele personalului spitalicesc și ale populației generale din Georgia, cu privire la procesul de consimțământ informat.

Materiale și metode Au fost aplicate două chestionare structurate, unul destinat personalului medical și altul – populației generale. Studiul a explorat cunoștințele, experiențele și opiniile respondenților despre consimțământul informat. Datele au fost analizate pentru a identifica subiectele-cheie și domeniile care necesită ameliorări în acest proces.

Rezultate 68,8% din populația generală, au raportat că li s-a oferit formularul de consimțământ informat înainte de a primi servicii medicale, și doar 50,2% au fost informați despre dreptul lor de a accepta sau de a refuza acest consimțământ. Aproape jumătate (48,3%) s-au confruntat cu neclarități. În cazul personalului spitalicesc, deși toți au fost de acord cu necesitatea obținerii consimțământului informat înainte de proceduri, doar 59,3% au înțeles complet informațiile necesare ce trebuie incluse în formularul de consimțământ, și doar 10,2% dintre respondenți au identificat corect un alt semnatar al formularului. Este de remarcat că, doar 6,8% au înțeles specificul consimțământului verbal.

Concluzii Studiul evidențiază lacune și provocări semnificative ale consimțământului informat din Georgia, inclusiv bariere de comunicare, constrângeri de timp și niveluri variabile de înțelegere atât în rândul pacienților, cât și al furnizorilor. Se recomandă îmbunătățirea formării, implementarea unor strategii clare de comunicare, standardizarea practicilor, campanii de informare publică și integrarea tehnologiei, pentru a optimiza procesul de consimțământ informat.

Cuvinte-cheie Consimțământ informat, autonomia pacientului, profesioniști din domeniul sănătății, înțelegerea pacientului, comunicarea medic–pacient, Georgia.

INTRODUCTION

Informed consent (IC) is a foundational principle in medical ethics and a cornerstone of patient autonomy. It ensures that patients are provided with sufficient information regarding the risks, benefits, and alternatives of medical procedures, enabling them to make informed decisions about their treatment. The concept of IC is rooted in the Nuremberg Code (1947), which emphasized the importance of voluntary participation in medical treatments and research (1). Since then, the concept has evolved beyond a procedural obligation into a complex ethical, legal and communicative process embedded within modern clinical practice.

From an ethical perspective, informed consent is grounded in the core principles of biomedical ethics – respect for autonomy, but also beneficence and non-maleficence. It serves as the ethical basis that legitimizes medical intervention by ensuring that patients are not treated merely as passive recipients of care but as active decision-makers. In contemporary healthcare, informed consent is not only a legal requirement, but a moral obligation that reflects respect for persons and supports ethically responsible clinical practice (2).

Research on informed consent for medical treatment has developed alongside the broader concept of patient decision-making across three interrelated fields: medicine, law and the social sciences (3). Ethical analyses have further emphasized informed consent as part of a structured model of moral reasoning in medicine, highlighting the patient's right not only to receive information, but also to refuse or withdraw from treatment (2). Within this framework, informed consent is closely linked to respect for autonomy and the promotion of shared decision-making between physicians and patients.

Patient participation in medical decision-making has been shown to influence satisfaction, trust and treatment adherence. Trust in healthcare providers plays a key role in facilitating patient involvement and meaningful engagement in informed consent process (4). However, studies have shown that, despite its critical importance, the process of obtaining informed consent remains inadequate in many healthcare settings. Communication failures, limited time for discussion and insufficient adaptation of information to patients' needs have been identified as significant barriers to obtaining valid informed consent, rather than merely obstacles to building therapeutic relationships (5).

In countries with diverse ethnic and linguistic populations, including Georgia, these challenges may be further exacerbated by social and systemic inequalities. Research has shown that ethnic minorities and socially vulnerable groups are disproportionately affected by barriers to healthcare communication and require adapted policies to ensure equitable access to information and services (6). Such factors may directly influence patients' understanding of informed consent and their ability to engage in informed decision-making.

The legal framework surrounding informed consent also is significant in shaping its practice. Landmark cases like Canterbury v. Spence (1972) have established the reasonable patient standard, which dictates that physicians should disclose information that a reasonable patient would need to make an informed decision (7). Despite these legal standards, studies indicate substantial variation in how informed consent is implemented across healthcare institutions. Research has demonstrated that different formats of consent documentation can influence patient anxiety, satisfaction and understanding (8), while other studies reveal persistent gaps in physicians' legal knowledge regarding patients' rights to informed consent (9).

Importantly, informed consent is a basic concept of autonomy-based medical practice and a key mechanism for facilitating shared decision-making between

physicians and patients. The ethical validity of medical practice therefore depends significantly on patients' ability to comprehend the information presented to them. However, empirical research consistently demonstrates that patients' understanding of the basic components of informed consent is often limited, raising concerns about whether consent obtained in routine clinical settings is truly informed (10).

Despite the central ethical and legal role of IC, there is limited empirical evidence from Georgia on how it is understood and implemented in everyday clinical practice by both patients and healthcare providers. Most existing studies examine only single groups or specific settings. This study addresses that gap by jointly assessing hospital personnel and the general population, providing novel comparative evidence and identifying practical targets for improving informed consent processes.

The aim of this study was to assess the knowledge, understanding, experiences and perceptions of informed consent among hospital personnel and the general population in Tbilisi, Georgia, and to evaluate how informed consent is practiced in relation to patient autonomy and decision-making.

MATERIALS AND METHODS

This study utilized a cross-sectional survey design to assess the understanding and experiences of informed consent among two groups: the general population of Tbilisi and hospital personnel practicing within the same region. Separate structured questionnaires were developed for each group to capture perspectives and insights relevant to each. The questionnaires were disseminated online through Google Forms, allowing for a broad reach and promoting participant anonymity.

The study population comprised individuals aged 18 and older who had previously accessed healthcare services in Tbilisi and could provide informed consent to participate in the survey. The second group targeted licensed hospital personnel working in clinical settings within Tbilisi.

To establish a statistically representative sample size, a sample size calculation was conducted based on Tbilisi's population, estimated at approximately 3.5 million. A confidence level of 95% and a margin of error of 5% were applied, resulting in a target of 385 respondents for the general population sample. This calculation was performed using a standard sample size formula for population-based surveys. For hospital personnel, a non-probability convenience sampling approach was applied. Participants were recruited voluntarily through professional networks and online dissemination, and the sample size was determined based on feasibility and response availability rather than formal population-based calculation. A total of 59 hospital personnel completed the questionnaire, exceeding the initially targeted minimum of 50 respondents. Given the exploratory nature of this component, the hospital personnel sample was intended to provide insight into professional perspectives rather than statistical representativeness of all healthcare workers in Tbilisi.

Data collection occurred over a 1.5-month period. The questionnaire links were distributed through social media networks, leveraging online platforms to maximize the participation rate and accessibility for diverse population segments. Of the responses collected, three were excluded due to insufficient completion, resulting in a total sample of 450 responses: 391 from the general

population and 59 from hospital personnel. To maintain confidentiality, no personally identifiable information or signatures were collected from respondents.

The general population questionnaire contained 27 items, which included socio-demographic characteristics (such as age, gender and education), general awareness, and understanding of informed consent, and experienced-based questions for individuals, who had visited hospitals in Tbilisi since 2020. Several questions specifically assessed how respondents understood informed consent, including whether it was perceived primarily as a formal legal requirement or as part of a shared decision-making process with healthcare providers.

The hospital personnel questionnaire comprised 20 items, focusing initially on general informed consent knowledge, with additional items presented only to respondents who reported direct involvement in obtaining informed consent from patients. These items explored practical aspects of consent delivery, perceived challenges and understanding of legal and ethical requirements.

Both questionnaires included multiple-choice, yes/no, and open-ended questions, as well as Likert scale items (ranging from 1 to 5, with 5 representing complete agreement or understanding, and 1 indicating strong disagreement or lack of understanding). Likert scale questions were specifically designed to assess respondents' understating of informed consent, clarity of information provided and perceived involvement in decision-making. Each questionnaire was written in clear, accessible language to facilitate accurate comprehension.

Data were analyzed using IBM SPSS Statistics version 27. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated to summarize participant demographics and response patterns. Inferential statistical tests, including chi-square and one-sample t-tests, were applied to examine associations between respondents' socio-demographic characteristics (gender, age, education) and their knowledge, perceptions and experiences related to informed consent. A p-value of <0.05 was considered statistically significant. Responses to open-ended questions were categorized based on thematic relevance to enable qualitative insights.

RESULTS

The study investigated respondents' experiences, understanding, and perceptions of the informed consent process, with a focus on both patients and medical providers in Tbilisi.

Questionnaire for Tbilisi population

The study included a diverse sample of individuals from Tbilisi, Georgia, ranging across different demographic categories. Table 1 summarizes the demographic characteristics of the participants, highlighting key aspects such as age distribution, gender representation, educational backgrounds, employment status, and their affiliation with the medical field where applicable.

Table 1. Social and demographic characteristics of the population.

Categories and Indicators	n	%
Age		
18-30	256	65.5
31-40	91	23.3
41-50	19	4.8
51-60	13	3.3
61 and more	12	3.1
Gender		
Female	287	73.4
Male	104	26.6
Education Level		
University complete	106	27.1
University Incomplete	248	63.4
Basic Education Complete	34	8.7
Basic Education Incomplete	3	0.8
Employment Status		
Employed	287	73.3
Unemployed	23	5.9
Student	62	15.9
Housewife	9	2.3
Pensioner/Retired	10	2.6
Connection to Field of Medicine		
Yes	183	46.8
No	208	53.2

Respondents' perceptions and experiences regarding informed consent are summarized in Table 2.

Table 2. Respondents' perceptions and experiences regarding informed consent.

Statement	Respondents (%)
Identified risks associated with the procedure as essential information	78.3
Identified possible complications as essential information	73.9
Identified information about the recovery process as essential	52.4
Believed patients should thoroughly read all sections of the IC form before signing	85.4
Agreed that doctors should actively ensure patient understanding before signing	90.8
Reported misunderstanding information provided by a doctor at least once	47.6
Were aware of their right to receive detailed information (risks, benefits, alternatives) before signing	80.3
Felt that public education on the informed consent process is necessary	96.7

Most participants identified risks (78.3%) and possible complications (73.9%) as critical elements of informed consent, while fewer emphasized information on recovery (52.4%). A large majority believed that patients should read all sections of the consent form before signing (85.4%) and that physicians should actively ensure patient understanding prior to consent (90.8%). Nearly half of respondents (47.6%) reported having misunderstood information provided by a doctor at least once.

Respondents perceived understanding and experiences related to the informed consent process, as measured by Likert-scale items, are presented in Table 3.

Table 3. Mean Likert-scale scores for perceived understanding and experiences of the informed consent.

Item assessed	Mean	p-value
Ability to ask questions during the consent process	3.78	<0.001
Explanation of unfamiliar medical terms	3.18	0.072
Explanation of benefits and risks	3.5	<0.001
Information provided on alternative treatment options	3.18	0.095
Explanation of possible complications	3.52	<0.001
Information provided on rehabilitation or recovery	3.89	<0.001
Sufficiency of time given to read the consent form	3.29	0.006
Clarity and understandability of the consent form	3.6	<0.001
Satisfaction with information received before signing	3.72	<0.001

Note: Likert-scale responses ranged from 1 (strong disagreement/lack of understanding) to 5 (complete agreement/full understanding). One-sample t-tests were conducted using the neutral midpoint value of 3 as the reference. Statistically significant results ($p < 0.05$) indicate mean scores differing significantly from the neutral midpoint.

Overall, respondents reported a moderate to high perceived understanding of the informed consent process (Table 3). Mean scores for most items exceeded the neutral midpoint, particularly for the ability to ask questions, explanation of risks and complications, clarity of the consent form, and satisfaction with the information received. Lower mean scores were observed for the explanation of alternative treatment options and unfamiliar medical terms, indicating potential gaps in patient involvement and comprehension.

Associations between selected socio-demographic characteristics and familiarity with informed consent are presented in Table 4.

Table 4. Association between selected socio-demographic characteristics and familiarity with informed consent.

Variable	χ^2	df	p-value	Interpretation
Age × familiarity with informed consent	3.896	4	0.420	Not statistically significant
Education level × familiarity with informed consent	7.691	3	0.034	Statistically significant
Gender × familiarity with informed consent	6.686	1	0.010	Statistically significant

Inferential analysis demonstrated a statistically significant association between education level and familiarity with informed consent, as well as between gender and familiarity. No significant association was observed for age. Respondents with higher educational attainment reported greater familiarity with informed consent concepts.

More than half of the respondents (53.2%) had received medical services at hospitals in Tbilisi since 2020, and 68.8% reported being shown and asked to sign a consent form before receiving care. About half (50.2%) were informed that they had the option to accept or decline the consent form, whereas the other half were not.

Qualitative analysis of open-ended responses identified recurring themes, including insufficient explanation by healthcare providers, limited opportunity to ask questions, and the perception that informed consent is primarily a formal document to be signed rather than a collaborative decision-making process. These qualitative findings were consistent with quantitative results.

Questionnaire for Hospital Personnel

The study included hospital personnel representing different professional tasks. Table 5 presents the social and demographic characteristics of the respondents.

Table 5. Social and demographic characteristics of hospital personnel.

Categories and Indicators	n	%
Age		
18-30	24	40.7
31-40	28	47.5
41-50	6	10.1
51-60	0	0.0
61 and more	1	1.7
Gender		
Female	45	76.3
Male	14	23.7
Position		
Doctor	38	64.4
Nurse	8	13.6
Clinic management/administration	13	22.0

Perceptions and practices related to the informed consent process among hospital personnel are summarized in Table 6.

Table 6. Perceptions and practices regarding informed consent.

Statement	Respondents (%)
Importance of detailed information before consent	
Consider detailed information essential	83.1
Believe informed consent enhances patient trust	76.3
Understanding of informed consent content	
Demonstrated comprehensive understanding of essential consent elements	59.3
Information considered essential in informed consent forms	
Risks associated with the procedure	89.8
Possible complications	81.4
Benefits of the procedure	79.7
Rehabilitation or recovery process	71.2
Expected outcomes or results	67.8
Alternatives to the proposed procedure	61.0
Who can sign informed consent (besides the patient)	
Legal representative or guardian	84.7
Family member	59.9
Only the patient	15.3
Person designated by the patient	6.8
Situations where verbal consent is considered acceptable	
Emergency situations	54.2
Routine follow-up visits	37.3
Procedures with minimal risk	23.7
When a legal representative is present	15.3
Strategies used to improve patient understanding	
Simplifying language	80.6
Repeating information	58.3
Seeking help from multilingual staff	47.2
Providing translated written materials	30.6
Training	
No formal training in informed consent	69.4

The majority of respondents, regardless of professional position, considered the provision of detailed information to patients prior to obtaining informed consent to be essential. Although no statistically significant association was observed between professional role and the perceived importance of detailed information (χ^2=2.655, df=4, p=0.617), high levels of agreement were reported across all groups. Perceptions regarding the need for improvement in the informed consent process varied slightly by role, with a higher proportion of nurses and physicians indicating that improvements were needed compared to clinic management.

Hospital personnel were also asked about who, in addition to the patient, may legally sign an informed consent form. Most respondents identified a legal representative or guardian as an acceptable alternative, while family members were also frequently considered appropriate signatories. Only a minority believed that informed consent should be signed exclusively by the patient unless the patient is unable to do so.

Although there was unanimous agreement on the necessity of obtaining informed consent prior to medical procedures, only a proportion of respondents demonstrated a comprehensive understanding of the essential elements that should be included in a consent form. The most frequently identified components included risks associated with the procedure, possible complications, benefits, expected outcomes, alternatives to the proposed procedure, and details regarding rehabilitation or recovery. Differences between professional groups in opinions regarding verbal consent and consent content were examined using chi-square analysis; no statistically significant associations were identified (χ^2=12.47, df=6, p=0.052), although the result approached statistical significance and some variability across professional roles was observed (Table 6).

Despite the perceived importance of informed consent, a majority of hospital personnel (69.4%) reported having received no formal training on the informed consent process, indicating a potential gap in professional preparation and standardization of practice.

Communication challenges were commonly addressed through adaptive strategies. Nearly half of respondents reported seeking assistance from multilingual staff when language barriers arose, while others provided translated written materials. Additional approaches included simplifying medical language, repeating information using different wording or examples, and using visual aids to support patient understanding.

Some respondents reported situations in which family members requested that certain medical information be withheld from patients. Nevertheless, most providers indicated that information should not be concealed, emphasizing respect for patient autonomy even when faced with family pressure.

The results suggest that while patients generally feel satisfied with the information and time provided during the consent process, a notable proportion have experienced misunderstandings, indicating areas for improvement in patient education. Hospital personnel, particularly doctors, view detailed information as essential but may require additional training to enhance their role in ensuring patient comprehension. Both patients and providers agree on the need for more public education on the informed consent process, reflecting a shared recognition of its significance in patient care and autonomy.

DISCUSSION

The survey results reveal several critical insights into patient and provider perspectives on the informed consent process, highlighting both strengths and areas for potential improvement in medical settings.

The demographic composition of respondents, largely young, female, and well-educated, likely influenced responses regarding informed consent. The online survey format may have impacted older adults' participation, as some may be less familiar or comfortable with digital platforms, potentially affecting the representativeness of the sample.

A majority (85.4%) emphasized the importance of thoroughly reading informed consent forms, aligning with ethical principles of patient autonomy. Participants valued information about procedure risks, complications, and rehabilitation, but only 39.4% rated information on alternative options as essential, suggesting that this aspect is sometimes overlooked. Lower mean scores on Likert-scale items related to alternative options and shared decision-making further support this finding, indicating that informed consent is often perceived more as an informational or administrative requirement than as a collaborative process. Educating patients on alternatives supports shared decision-making and further empowers patient autonomy.

Results also shed light on experiences with informed consent during hospital visits. While 68.8% reported seeing a consent form prior to medical services, some respondents indicated that they may not have fully understood its purpose. Qualitative responses reinforced this observation, revealing that informed consent was frequently interpreted as a formality requiring a signature rather than an interactive discussion. Confusion surrounding the document's significance may stem from unclear communication by providers, stress associated with hospital visits, or assumptions that patients are familiar with the consent process. Addressing this issue could involve reinforcing the importance of informed consent through clearer explanations of the form's content and purpose, as mandated by Georgian law (14).

Notably, only 50.2% of respondents felt adequately informed of their right to accept or decline the consent form, suggesting a possible lack of explicit communication regarding patient rights. This gap may be influenced by the complexity of medical language, time pressures in clinical settings, or provider assumptions about patient knowledge. Research indicates that factors such as education level, medical background significantly affect patients' comprehension of informed consent, highlighting the need for tailored communication strategies (10, 15). Ensuring that all patients fully understand their options, regardless of background, may help mitigate this issue.

The medical providers' responses also reveal their perspectives on the informed consent process and its application. All providers agreed on the importance of obtaining informed consent before procedures, reflecting a commitment to ethical standards in patient care. Moreover, 83.1% emphasized that patients should receive comprehensive information about procedures before consenting, showing dedication to both legal compliance and patient-centered care.

The low rate of provider understanding (6.8%) regarding when verbal consent is appropriate suggests a potential gap in comprehension and application of verbal consent policies (16). Enhanced training on verbal consent guidelines could promote a more consistent approach and reinforce best practices in obtaining informed consent.

These findings align with international research, which has also identified gaps in healthcare providers' knowledge and application of informed consent. Surprisingly, studies from institutions in Western countries such as Europe, the Netherlands, Croatia, report that many doctors lack adequate understanding of the informed consent process, affecting the quality of patient-provider communication (17, 18). Research further suggests that inadequate working knowledge and attitudes toward informed consent persist among medical professionals, reinforcing the need for targeted education and standardized training protocols (19). Strengthening educational programs and institutional guidelines on informed consent could bridge these gaps and enhance ethical, patient-centered care worldwide (20).

Language and cultural barriers also emerged as significant challenges. Providers often addressed language differences by seeking assistance from bilingual staff (47.2%) and providing translated materials (30.6%), reflecting efforts to enhance communication. However, Georgia's linguistically diverse population may still encounter challenges in understanding informed consent, especially among patients from varying linguistic backgrounds. This may contribute to disparities in patient comprehension, particularly in complex or high-stress settings. Studies have shown that miscommunication due to language barriers can lead to inadequate informed consent, potentially resulting in legal and ethical issues (21, 22). To mitigate these challenges, healthcare providers should utilize professional interpreters and culturally appropriate materials to ensure patients fully understand the information being conveyed (23).

Responses to open-ended questions further highlighted barriers to informed consent, such as time constraints, language difficulties, and cultural tendencies to limit information shared with patients. Addressing these challenges could involve standardized training, resources for patient education, and the use of simplified language or visual aids to facilitate understanding.

The important contribution of this study is the parallel assessment of both hospital personnel and the general population within the same healthcare context. Most previous research has examined informed consent either from the patient perspective or the provider perspective separately. By combining these viewpoints, the present study makes it possible to identify mismatches between perceived practice, knowledge gaps and communication barriers across both sides of the consent process. In addition, locally generated evidence from Georgia remains limited in this field, and these findings provide context-specific data, that can support targeted educational and institutional improvements.

In conclusion, the findings from this study underscore the importance of effective communication, patient education, and respect for patient autonomy in the informed consent process. While most respondents expressed positive perceptions and experiences, there remain clear opportunities for improvement. The results indicate that informed consent in practice is still frequently experienced as a formal requirement rather than a shared decision-making process. By implementing enhanced communication strategies, providing comprehensive information, and addressing knowledge disparities, healthcare providers can strengthen the informed consent process and support patient-centered, ethical care practices.

CONCLUSIONS

1. This study on informed consent in healthcare, based on surveys of the general population and medical providers in Tbilisi, Georgia, provides new comparative evidence on perceptions, practices, and challenges by examining both patient and provider perspectives within the same study framework. The findings confirm that informed consent is widely recognized as an essential ethical and legal requirement, underscoring its role in protecting patient autonomy, fostering transparent communication, and promoting ethical standards in healthcare decision-making.
2. From the patient perspective, most respondents showed a basic understanding of informed consent; however, a significant portion had limited familiarity with its specifics, emphasizing the need for broader public education initiatives. Enhancing patient awareness of their rights and responsibilities in healthcare is essential to supporting informed decision-making and patient empowerment.
3. Hospital personnel demonstrated a shared commitment to informed consent, underscoring the importance of detailed information provision. However, variation in knowledge regarding the essential elements of informed consent and appropriate consent procedures, as well as challenges such as communication gaps, time constraints, and language barriers were highlighted as areas for improvement. These findings suggest that standardized institutional protocols and targeted professional training could help address inconsistencies and improve communication strategies across diverse healthcare settings.
4. The study emphasizes the dynamic nature of the informed consent process, shaped by evolving healthcare practices, cultural norms, and legal requirements. By addressing identified challenges and leveraging best practices, healthcare institutions can strengthen patient trust and satisfaction, leading to improved patient outcomes and alignment with ethical principles.

CONFLICT OF INTEREST There is no conflict of interest to declare.

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ETHICAL APPROVAL The study received ethical approval from the NCDC regional ethics committee. Informed consent was obtained via the questionnaire's introduction, highlighting confidentiality and voluntary participation. Only de-identified, aggregated data were collected.

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GROWTH PATTERNS IN DUCHENNE MUSCULAR DYSTROPHY

Iulia RODOMAN[1,2], Victoria SACARA[2], Ina PALII[1,3]

[1] Cardiology Unit, Institute of Mother and Child, Chisinau, Republic of Moldova
[2] Laboratory of Human Molecular Genetics, Institute of Mother and Child, Chisinau, Republic of Moldova
[3] Department of Pediatrics, *Nicolae Testemitanu* State University of Medicine and Pharmacy, Chisinau, Republic of Moldova

Corresponding author: Iulia RODOMAN, e-mail: iulia.rodoman@gmail.com

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ABSTRACT

Introduction Duchenne muscular dystrophy (DMD) is a genetic disorder that significantly affects growth and development, characterised by progressive degeneration of skeletal and cardiac muscles, typically beginning in early childhood, between 2 and 5 years old.

Purpose of the study To assess longitudinal growth parameters (height, weight, BMI) in children with genetically confirmed DMD compared with healthy age- and sex-matched controls.

Materials and methods A total of 100 children were included: 50 with DMD and 50 controls. Anthropometric data were collected at 3 follow-up visits over a 12-month period and analysed using Microsoft Excel (Office 365) and StatTech v.4.6.3.

Results Children with DMD exhibited impaired growth compared with controls: lower height (median 1.25 m [1.10–1.44] vs 1.56 m [1.37–1.68]; p<0.001), lower height z-score (–0.95±1.57 vs 0.42±1.41; p<0.001), and lower height percentile (16.0 vs 63.7; p<0.001). Body weight was also lower (27.7 kg [18.5–34.0] vs 46.0 kg [29.3–58.0]; p<0.001), with reduced weight z-score (–0.61 vs 0.57; p=0.003) and percentile (26.9 vs 71.6; p=0.003). BMI was lower in the DMD group (15.9 vs 18.4 kg/m^2; p=0.007), whereas BMI z-scores and percentiles did not differ significantly (p>0.05). Growth velocity declined over time (height increase of 0.03 m from Visit 1 to Visit 2 vs 0.01 m from Visit 2 to Visit 3; p<0.01). Among patients with DMD stratified by duration of deflazacort treatment, the >12-month subgroup showed the greatest growth gains, although differences between subgroups were not statistically significant.

Conclusions Children with DMD had a delayed growth compared with their peers, with progressive slowing over time. Regular auxological monitoring is essential, and further studies are needed to clarify the effects of corticosteroid therapy.

Keywords Duchenne muscular dystrophy, children, growth patterns.

PATTERNUL DE CREȘTERE ÎN DISTROFIA MUSCULARĂ DUCHENNE

Introducere Distrofia musculară Duchenne (DMD) este o afecțiune genetică cu impact major asupra creșterii, provocând degenerarea progresivă a mușchilor scheletici și cardiaci, care debutează în copilăria timpurie – la 2-5 ani.

Scopul Evaluarea longitudinală a creșterii (înălțime, greutate și IMC) la copiii cu DMD comparativ cu martori sănătoși, potriviți după vârstă și sex.

Materiale și metode Studiul a inclus 100 copii: 50 pacienți cu DMD și 50 martori. Datele antropometrice au fost colectate la 3 vizite pe parcursul a 12 luni și analizate cu Office365 Excel și StatTech v.4.6.3.

Rezultate Comparativ cu lotul martor, copiii cu DMD au prezentat creștere semnificativ afectată: talie mai mică (mediana 1,25 m [1,10–1,44] vs 1,56 m [1,37–1,68]; p<0.001), scor z al taliei mai redus (–0,95±1,57 vs 0,42±1,41; p<0.001) și percentilă mai joasă (16,0 vs 63,7; p<0.001). Greutatea a fost, de asemenea, mai mică (27,7 kg [18,5–34,0] vs 46,0 kg [29,3–58,0]; p<0,001), cu scor z redus (–0,61 vs 0,57; p=0.003) și percentilă inferioară (26,9 vs 71,6; p=0.003). IMC a fost mai mic la DMD (15,9 vs 18,4 kg/m^2; p=0.007), însă scorurile z/percentilele IMC nu au diferit (p>0.05). Viteza de creștere s-a redus (0,03 m V1–V2 vs 0,01 m V2–V3; p<0,01). Subgrupul cu durata de tratament cu deflazacort >12 luni a înregistrat cele mai mari îmbunătățiri, deși diferențele între subgrupuri nu au atins semnificație statistică.

Concluzii Copiii cu DMD prezintă întârziere de creștere comparativ cu semenii, cu încetinire progresivă în timp. Monitorizarea auxologică regulată este esențială, iar studiile suplimentare sunt necesare pentru clarificarea efectului corticosteroizilor.

Cuvinte-cheie Distrofia musculară Duchenne, copii, pattern de creștere.

INTRODUCTION

Duchenne muscular dystrophy (DMD) is one of the most common types of muscular dystrophy, caused by mutations in the *DMD* gene on the X chromosome, and affecting approximately 1 in 3,500–5,000 male births worldwide. The lack of dystrophin, a protein essential for maintaining muscle strength and stability, leads to progressive muscle damage and weakness (1,2). This condition predominantly affects boys and typically manifests in early childhood with progressive muscle weakness that initially involves the pelvic and thigh muscles and later the additional muscle groups, ultimately leading to respiratory and cardiac failure (3).

Patients with DMD commonly exhibit altered growth trajectories that complicate clinical management. Boys with DMD show significant deviations in growth patterns compared with their peers, characterised by reduced growth velocity and developmental delays, particularly between 2 and 12 years of age (4). Although height may fall within normal ranges at around 2 years of age, a progressive decline in growth velocity is typically observed in later childhood (5). Children with DMD also frequently experience metabolic complications, including obesity, which may further affect their health status and growth patterns (6).

The use of glucocorticoids to manage symptoms of DMD has been associated with impaired linear growth. Although glucocorticoid therapy can delay the loss of ambulation and prolong motor function, it may also contribute to growth suppression and delayed puberty in a substantial proportion of patients (4,7,8). Several studies have shown that long-term corticosteroid therapy is associated with adverse effects on bone health and increased body weight, further complicating growth trajectories in affected individuals (5). However, recent evidence suggests that growth hormone therapy may improve growth velocity in prepubertal boys with DMD without adversely affecting neuromuscular function (9).

Growth velocity in boys with DMD has been reported to improve with appropriate therapeutic interventions. Some studies have shown that, prior to growth hormone therapy, growth velocity was recorded at 0 cm/year, increasing to a maximum of 7.8 cm/year following treatment (10). Nevertheless, height-for-age z-scores in these patients generally continue to decline, highlighting the persistent challenges in achieving normal growth trajectories despite therapy (11).

Research also highlights the importance of multidisciplinary management in tackling the many symptoms and complications of DMD, requiring coordinated care from specialists across multiple disciplines (12). Early diagnosis and timely intervention are essential for optimizing growth and functional outcomes, facilitating access to appropriate therapies and supportive services (13). Continuous monitoring of growth parameters—including height, weight, and body mass index—is essential for identifying potential treatment-related adverse effects and ensuring comprehensive care for affected children (14).

MATERIALS AND METHODS

This longitudinal observational study with a control group was conducted at the Paediatric Cardiology Clinic of the PMHI Institute of Mother and Child, Chișinău, Republic of Moldova. The study included 50 children with DMD, aged 1 year to 17 years, 11 months, and 29 days, from both urban and rural areas. Patients were consecutively enrolled during scheduled outpatient evaluations between November 2017 and February 2023.

The purpose of the study was to assess longitudinal growth (height, weight, and BMI) in children with genetically confirmed Duchenne muscular dystrophy and to compare anthropometric parameters with those of healthy age- and sex-matched controls. To achieve the purpose of the study, the following objectives were defined: to evaluate auxological parameters (height, body weight, and body mass index), including standardized indicators (z-scores and percentiles), in children with Duchenne muscular dystrophy compared with healthy peers; to assess longitudinal growth dynamics and growth velocity by analyzing shifts in anthropometric parameters across three follow-up visits over a 12-month period ; and to investigate the potential influence of glucocorticoid therapy (deflazacort) on growth patterns based on the duration of corticosteroid exposure.

The research comprised several stages.

The 1st stage included a total number of 100 paediatric participants : 50 patients with a genetically confirmed diagnosis of Duchenne muscular dystrophy (DMD) forming the study group, and 50 age- and sex-matched children with no known chronic pathologies serving as the control group.

Inclusion criteria for the study group were an age range of 1 to 17 years and 11 months, a DMD diagnosis confirmed via molecular genetic testing, informed consent from parents or legal guardians, and written assent from participants aged 14 years or older. The control group was selected based on demographic matching (age and sex) and a confirmed healthy status (classified as Health Level I or II), while adhering to the same consent and assent protocols as the study group. Exclusion criteria for both cohorts included pre-existing cardiac pathology, significant comorbidities potentially impacting cardiac function, an inadequate echocardiographic acoustic window, or the absence of required consent/assent. Participants were enrolled consecutively from eligible inpatient admissions and outpatient referrals during the study period.

During the 2nd stage, all participants underwent a standardized clinical examination. Particular emphasis was placed on collecting anthropometric data, including height, weight, and body mass index (BMI). Body weight was recorded using calibrated scales to the nearest 0.1 kg. Height was measured with a stadiometer and expressed in meters to one decimal place. BMI was calculated using the standard formula of weight divided by the square of height (kg/m^2). To allow for age- and sex-adjusted comparisons, anthropometric indices were further standardized by calculating z-scores and percentiles based on reference values. Additionally, data regarding deflazacort therapy, including dosage and duration, were recorded. Participants were then stratified according to their cumulative glucocorticoid exposure

In the 3rd stage of the study, the collected data were introduced into an electronic database. Statistical analysis was performed using Office 365 Microsoft Excel and StatTech version 4.6.3. Descriptive statistics included means, standard deviations, medians, interquartile ranges (IQR), z-scores, and percentiles. Group comparisons were performed using the Mann–Whitney U test for non-normally distributed variables and Student's t-test for normally distributed data. Categorical variables were analyzed using χ^2 tests with Cramér's V effect size. Repeated comparisons across visits were assessed using paired tests (paired t-test or Wilcoxon), and intergroup comparisons by ANOVA where appropriate. Statistical significance was defined as $p \leq 0.05$.

Subsequently, in the 4th stage, practical conclusions and evidence-based recommendations were formulated based on the study findings. All participants were included only after receiving an individual explanation of the study objectives and procedures. No financial incentives were provided, and participation involved no costs for the families.

RESULTS

Auxological Analysis

To evaluate differences in anthropometric parameters between the study and control groups, absolute values and standardized indicators—specifically z-scores and percentiles for height, weight, and BMI—were compared using appropriate statistical methods (Fig. 1).

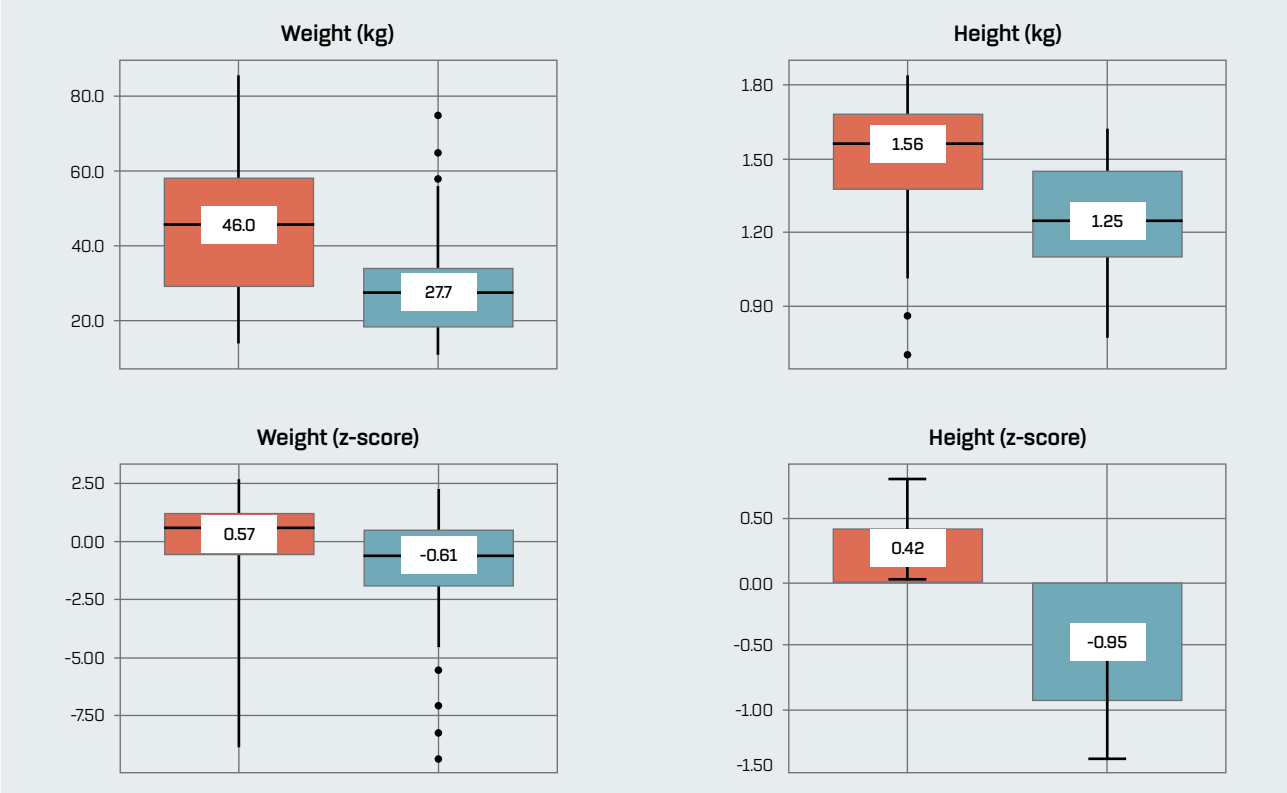

Figure 1. Boxplot comparison of body weight, height, and corresponding z-scores between the control group (red) and the DMD group (turquoise).

Height. Upon the first visit, the median height in the DMD group was 1.25 m (Q_1–Q_3: 1.10–1.44 m), significantly lower than the control group 1.56 m (Q_1–Q_3: 1.37–1.68 m; $p < 0.001$, $U = 596.5$). The mean height z-score was –0.95 ± 1.57 in the DMD group versus 0.42 ± 1.41 in the control group ($p < 0.001$; $t = 4.584$). The height percentile was also significantly lower in the DMD group (median 16.0; Q_1–Q_3: 3.84–59.4) compared to controls (median 63.7; Q_1–Q_3: 25.8–90.8; $p < 0.001$). These data highlighted a significant deficiency in physical development in children with DMD. Categorical analysis of height revealed marked disparities between the groups ($\chi^2 = 22.64$; $df = 4$; V Cramér = 0.48; $p < 0.001$), with a higher incidence of low stature in the DMD group (32.0%) relative to controls (8.0%). Normal stature was recorded in 40.0% of DMD patients versus 50.0% of controls, whereas tall and very tall stature were exclusively observed in the control group.

Weight. Children with DMD had significantly lower body weight (median 27.7 kg; Q_1–Q_3: 18.5–34.0) compared to control group (46.0 kg; Q_1–Q_3: 29.3–58.0; $p < 0.001$; $U = 663$). The z-score for weight was also lower (median –0.61; Q_1–Q_3: –1.88 to 0.49 vs. 0.57; Q_1–Q_3: –0.53 to 1.17; $p = 0.003$). Similarly, the weight percentile was lower in DMD patients (median 26.9 vs. 71.6 in controls; $p = 0.003$), indicating a delayed weight gain and growth restriction.

Body Mass Index. The median BMI was significantly lower in the DMD group (15.9 kg/m²; Q_1–Q_3: 14.6–19.5) than in the control group (18.4 kg/m²; Q_1–Q_3: 16.1–20.7; p = 0.007). However, BMI z-scores and percentiles showed no significant differences between the groups (p > 0.05), suggesting relatively similar distribution patterns once adjusted for age and sex. Analysis of BMI categories likewise revealed no significant overall disparities between the two cohorts (χ^2 = 3.89; df = 3; V Cramér = 0.2; p = 0.274). However, when stratified by disease stage, the distribution of BMI categories differed significantly (χ^2 = 22.88; df = 12; V Cramér = 0.39; p = 0.029). Underweight status was most prevalent during the presymptomatic, late ambulatory, and late non-ambulatory stages of the disease.

Analyses of growth pattern through 3 visits

To assess physical growth dynamics, body weight, height, and BMI were recorded at three follow-up visits conducted over 6- and 12-month intervals. Violin plots (Fig. 2) illustrate the distribution density of these parameters across the three evaluation time points. An observed rightward shift in median values, accompanied by changes in distribution morphology, reflects an active growth process consistent with established pediatric developmental trends within this cohort.

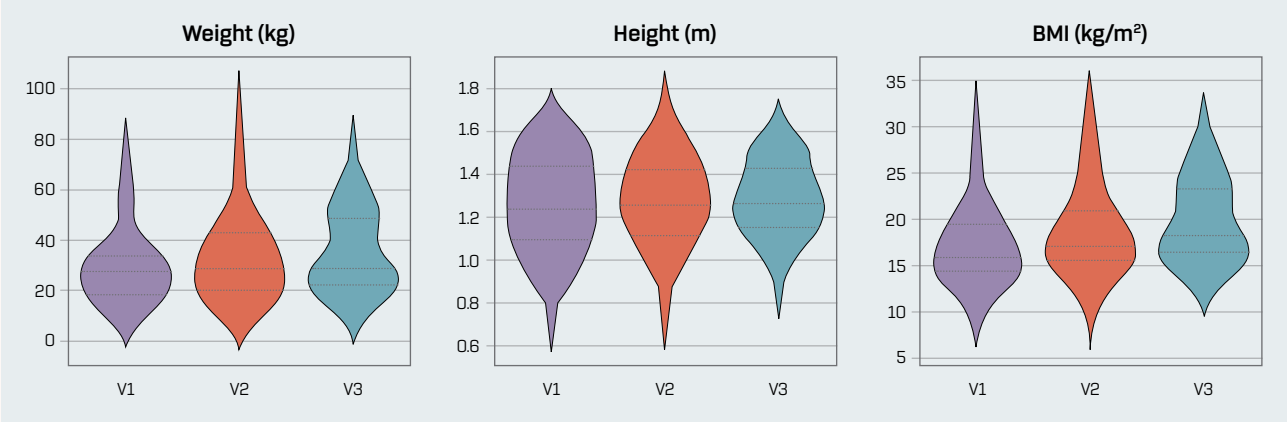

Figure 2. Violin plot distribution of body weight (kg), height (m), and BMI (kg/m²) across three follow-up visits (V1–V3), with V1 shown in purple, V2 in red, and V3 in green.

Height demonstrated a modest upward trend, with the mean increasing from 1.277 ± 0.218 m at visit 1 to 1.291 ± 0.200 m (visit 2) and 1.297 ± 0.175 m (visit 3). The median rose from 1.245 m to 1.27 m, with a slight narrowing of the range, indicating growing homogeneity in height across the cohort.

Body weight showed a progressive increase over time. At the first visit, the mean weight was 29.19 ± 14.30 kg (median: 27.7 kg; range: 10.9–75.0 kg). At the second visit, the mean increased to 33.62 ± 17.61 kg, and at the third visit to 35.15 ± 15.63 kg, with a stable median of 29.0 kg for the latter two. The interquartile range increased from 18.5–34.0 kg (visit 1) to 22.25–48.75 kg (visit 3), suggesting increased variability in weight gain among subjects.

Body Mass Index exhibited a clear upward trend across the three visits: 17.08 ± 4.44 kg/m² at visit 1, 18.92 ± 4.86 kg/m² at visit 2, and 19.79 ± 4.30 kg/m² at visit 3. The median values increased from 15.92 to 18.32 kg/m², and the interquartile range expanded from 14.55–19.55 to 16.47–23.35 kg/m², reflecting an increase in the variability of nutritional status among the participants over time.

Growth Velocimetry

To further examine growth dynamics, absolute and relative changes in weight, height, and BMI between Visits 1–2 and 2–3 were evaluated using paired t-tests. The results, as illustrated in Figure 3, demonstrated statistically significant changes across all assessed parameters.

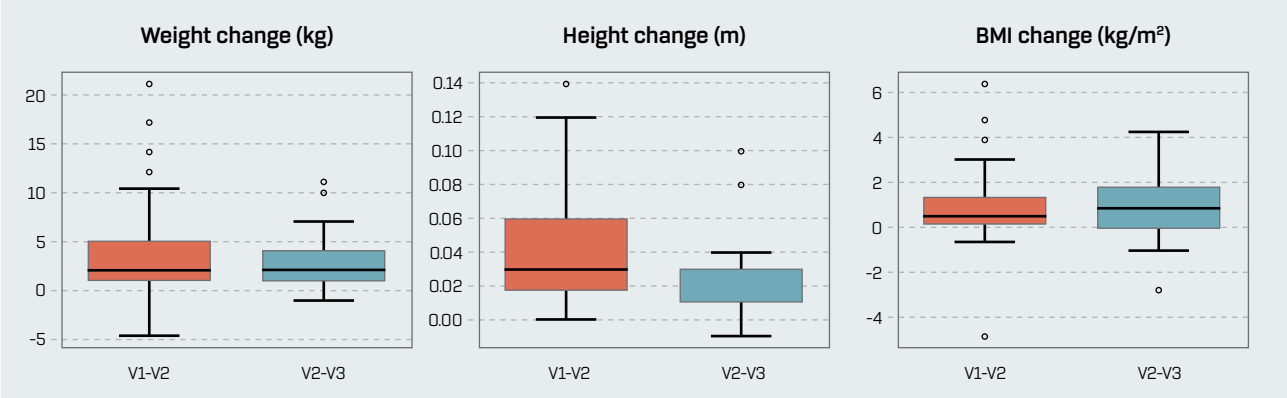

Figure 3. Growth velocimetry: distribution of absolute changes in body weight (kg), height (m), and body mass index (BMI, kg/m²) between consecutive visits (V1–V2 and V2–V3), presented as boxplot diagrams.

Weight gain velocity decreased from a median of 2.0 kg between visits 1–2 to 2.0 kg in visits 2–3, with lower mean and variability in the second period. Height growth also slowed significantly, with the median change decreasing from 0.03 m to 0.01 m. BMI changes were more variable and nonlinear, suggesting a disproportionate progression between height and weight in some subjects. Overall, these data reflect a physiological transition toward slower growth in the later observation period.

Impact of deflazacort exposure on growth

To assess the potential impact of deflazacort exposure on growth, patients were stratified into four groups based on the cumulative duration of corticosteroid use: 0 – no exposure, 1 – short-term use (≤6 months), 2 – intermediate use (7–12 months), and 3 – long-term use (>12 months). Longitudinal changes in height, weight, and BMI were evaluated across three visits (Fig. 4).

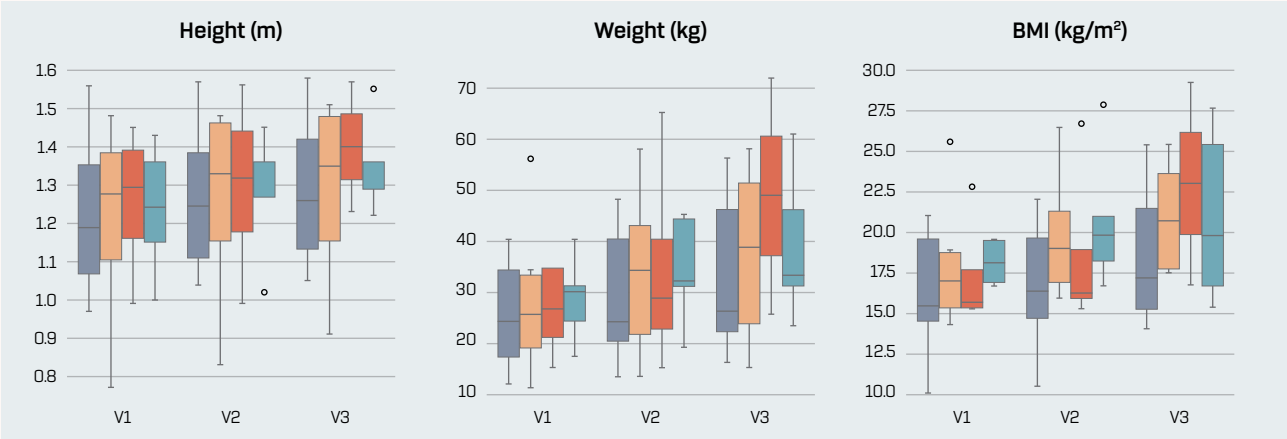

Figure 4. Impact of deflazacort exposure on growth patterns. Boxplots of height (m), weight (kg), and BMI (kg/m²) across three visits, stratified by deflazacort exposure duration: no use (blue), 0–6 months (orange), 7–12 months (red), and >12 months (green).

Height. At baseline (Visit 1), mean height was comparable across groups, ranging from 1.21 m (Group 0) to 1.26 m (Group 1), with no statistically significant difference ($p = 0.978$). All groups demonstrated incremental height increases over the study period. The most substantial gain was observed in Group 3 (long-term deflazacort), which increased from 1.24 m at Visit 1 to 1.34 m at Visit 3. While height gains remained relatively consistent between Visits 1 and 2 (mean change: 0.04–0.05 m), Group 3 exhibited the highest mean increase of 0.068 ± 0.083 m between Visits 2 and 3. However, this trend did not reach statistical significance ($p = 0.142$). ANOVA revealed no significant intergroup differences in height at any follow-up visit (Visit 2, $p = 0.993$; Visit 3, $p = 0.824$).

Weight. At Visit 1, mean weight varied from 25.4 kg (Group 2) to 29.0 kg (Group 1), with no significant group differences ($p = 0.899$). Over time, all groups experienced weight gain. By Visit 3, Group 3 exhibited the highest mean weight (38.8 kg), corresponding to a total gain of 10.4 kg. Between Visits 1 and 2, the largest mean increase was observed in Group 3 (+5.8 kg, SD = 5.76; $p = 0.028$), while Group 2 recorded more modest gains (+3.11 kg, $p < 0.001$). ANOVA did not detect significant group differences at Visits 2 or 3 ($p = 0.752$ and $p = 0.831$, respectively).

Body Mass Index. At baseline, mean BMI ranged from 16.57 kg/m² (Group 2) to 18.20 kg/m² (Group 3). All groups exhibited increases in BMI over time. The most notable rise occurred in Group 3, which reached a mean of 21.02 kg/m² by Visit 3, characterized by a pronounced gain of +2.54 units between Visits 1 and 2. In contrast, Group 2 showed the most stable BMI progression (0.38 units between Visits 1 and 2, 1.37 units between Visits 2 and 3). ANOVA results for BMI were not statistically significant across groups at any time point (Visit 1 $p = 0.684$; Visit 2 $p = 0.729$; Visit 3 $p = 0.762$). These findings suggest that while longitudinal gains in anthropometric parameters were observed across all groups, the most pronounced increases—particularly in height and BMI—occurred in patients with >12 months of deflazacort exposure. However, the lack of consistent statistical significance limits the ability to draw definitive conclusions regarding a direct causal effect.

DISCUSSIONS

The present study provides a longitudinal analysis of growth trajectories in children with Duchenne muscular dystrophy, stratified by cumulative deflazacort exposure. These findings have revealed that all patient groups, regardless of GC exposure, experienced positive growth trajectories in height, weight, and BMI over the study period.

In a similar analysis, Stimpson et al. analyzed the growth patterns in boys with DMD using longitudinal anthropometric data from 598 patients with a total of 2604 observations, demonstrating that daily corticosteroid treatment was associated with significant height stunting compared with glucocorticoid-naïve patients. In particular, boys receiving daily deflazacort showed a mean annual height change approximately 0.25 standard deviations below reference growth values, highlighting the potential consequence of prolonged corticosteroid therapy on linear growth (5). These findings also confirmed that boys with DMD generally exhibit lower height trajectories compared with the general paediatric population. In contrast to some prior reports, the results of this study indicated that patients with prolonged deflazacort use (>12 months) showed the most pronounced increases, particularly in height and BMI, although their anthropometric parameters remained lower compared with healthy controls.

Clinical studies indicate that deflazacort administration can result in statistically significant increases in height when compared to other corticosteroids, such as prednisolone. In a study by Singhal et al. children receiving deflazacort demonstrated an average height increase of 2.13 ± 0.50 cm, significantly higher than the 1.44 ± 0.45 cm observed with prednisolone ($p = 0.03$) (15). This finding supports the hypothesis that deflazacort may be more favourable for promoting growth in paediatric populations with conditions such as idiopathic nephrotic syndrome. Such data may provide indirect supportive evidence relevant to DMD cohorts. Furthermore, longitudinal evidence indicates that patients treated with deflazacort exhibit superior overall growth patterns compared to those receiving prednisolone. However, it is important to note that both therapies have well-documented side effects, including growth retardation (5).

Regarding BMI, evidence suggests that deflazacort may lead to less weight gain than prednisolone. Guglieri et al. noted that while both daily prednisolone and deflazacort resulted in slowing growth, the weight gain associated with prednisolone was significantly higher (16). This difference is crucial, as excessive weight gain can complicate the clinical picture in patients with DMD, suggesting that deflazacort may provide a more balanced therapeutic profile, potentially supporting growth while limiting excessive weight gain. Such confirmatory findings were presented in studies where long-term use of deflazacort improved growth markers over time. For example, Marden et al. observed that deflazacort therapy was associated with maintained or improved functional outcomes, suggesting a positive correlation between functional capacity and growth in boys with DMD (17). Conversely, Levine et al. reported that while patients receiving deflazacort generally had better clinical outcomes, prolonged corticosteroid therapy could still result in stunted growth when compared to children not on corticosteroids (18).

Deflazacort has shown potential to improve growth parameters such as height and BMI. However, its effectiveness should be evaluated in comparison with prednisolone, while also considering potential adverse effects, in order to optimise treatment for children with Duchenne muscular dystrophy and other paediatric neuromuscular disorders. Variability in growth responses associated with different corticosteroid regimens may influence clinical decision-making and supports an individualised approach to patient management.

LIMITATIONS OF THE STUDY

The relatively small sample size may increase the risk of type II error (false-negative findings), potentially masking true differences between groups. Additionally, the single-centre design may limit external validity and the generalisability of the findings. Other limitations include the lack of hormonal evaluation (e.g., growth hormone axis, pubertal status) and the absence of bone age assessment to objectively document growth delay. Furthermore, the absence of consistent statistical significance across some comparisons has highlighted the need for larger multicentred cohorts and well-designed prospective studies to better clarify the impact of deflazacort on growth trajectories in DMD patients.

CONCLUSIONS

1. Longitudinal data demonstrate that while children with DMD increase in height and weight over time, their growth remains delayed compared with that of their peers. The findings underscore a higher prevalence of short stature and underweight status in the DMD group, with significant differences in both absolute and standardized anthropometric measures.
2. Analysis of growth velocity further revealed a deceleration of growth in height and weight between the second and third visits, reflecting a progressive slowing of growth as the disease advances.
3. Regular monitoring of auxological parameters in DMD remains essential for individualized clinical management.
4. Further longitudinal studies with larger cohorts are required to clarify the dose–response relationship between corticosteroid duration and growth outcomes and to identify modifiable clinical factors that may help optimize growth and nutritional status in this vulnerable population.

CONFLICT OF INTEREST The authors declare no conflicts of interest.

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ETHICAL APPROVAL Ethical approval was obtained from the Research Ethics Committee of the *Nicolae Testemițanu* State University of Medicine and Pharmacy (approval report no. 1 dated 27.11.2019).

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Iulia Rodoman, WoS Researcher ID: AAI-2287-2021, SCOPUS ID: 57468128500

Victoria Sacara, WoS Researcher ID: Y-3880-2018, SCOPUS ID: 57205301327

Ina Palii, WoS Researcher ID: AAI-2319-2021

MEDICAL SCIENCES

OPEN ACCESS

PERSONALIZED APPROACH TO NON-COMMUNICABLE DISEASE PREVENTION IN THE WORKING POPULATION

Lyubov VLASYK[1], Leonid VLASYK[2,3], Nataliia RYNHACH[4]

[1] Department of Social Medicine and Public Health, Bukovinian State Medical University, Chernivtsi, Ukraine
[2] Department of Hygiene and Ecology, Bukovinian State Medical University, Chernivtsi, Ukraine
[3] Department "Institute of Environmental Hygiene and Toxicology of Pesticides and Achrochemicals", State Enterprise "L.I. Medved's Research Center of Preventive Toxicology, Food and Chemical Safety of the Ministry of Health of Ukraine", Kyiv, Ukraine
[4] Ptoukha Institute for Demography and Quality of Life Research of the National Academy of Sciences of Ukraine, Department of Demographic Modeling and Forecasting, Kyiv, Ukraine

Coresponding author: Lyubov VLASYK, e-mail: vlasyk.lyubov@bsmu.edu.ua

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ABSTRACT

Introduction Effective prevention of noncommunicable diseases (NCDs) requires shifting from generalized advice to personalized interventions.

Aim To develop and justify personalized approaches to NCD prevention for the working population, by identifying key behavioral predictors, focusing on the interplay between diet, physical activity, and social barriers.

Materials and methods A mixed-methods study was conducted, integrating quantitative survey data (pre-pandemic baseline, N = 1252) and qualitative interviews with market employees in early January 2026 (n = 30). Statistical analysis included Odds Ratios (OR), Sensitivity (Se), Specificity (Sp), and Likelihood Ratios (LR).

Results Individual Nutritional Control (INC) and Daily Physical Exercise (DPE) were identified as core markers of health engagement. DPE demonstrated exceptional diagnostic power in ruling out perceived physical inactivity (LR– 0.05, Positive Predictive Value, PPV 0.93). Absence of INC was associated with 4-fold higher odds of physical inactivity (OR 4.03; 95% CI 2.83–5.72). Qualitative data from 2026 revealed "preventive inertia" and a shift toward telemedicine and "proxy" family consultations under extreme environmental stress and power outages.

Conclusions A personalized approach involves identifying "leading components," such as DPE, to catalyze broader lifestyle changes. Integration of tailored health coaching and workplace wellness programs is essential for sustainable NCD prevention.

Keywords Non-communicable diseases, individual nutritional control, physical activity, personalized approach, working population.

ABORDARE PERSONALIZATĂ ÎN PREVENIREA BOLILOR NETRANSMISIBILE LA POPULAȚIA ACTIVĂ

Introducere Prevenirea eficientă a bolilor netransmisibile (BNT) necesită trecerea de la recomandări generalizate la intervenții personalizate.

Scop Obiectivele principale ale acestui studiu rezidă în dezvoltarea și fundamentarea unor abordări personalizate pentru prevenirea BNT în rândul populației active, prin identificarea principalilor predictori comportamentali, cu accent pe interacțiunea dintre alimentație, activitatea fizică și barierele sociale.

Materiale și metode A fost realizat un studiu de tip mixed-methods, care a integrat date cantitative din sondaj (linia de bază pre-pandemică, N = 1252) și interviuri calitative cu angajați din piețe, la începutul lunii ianuarie 2026 (n = 30). Analiza statistică a inclus Raportul de șanse (OR), Sensibilitatea (Se), Specificitatea (Sp) și Raporturile de verosimilitate (LR).

Rezultate Controlul nutrițional individual (CNI) și exercițiul fizic zilnic (EFZ) au fost identificate ca markeri principali ai implicării în sănătate. EFZ a demonstrat o putere diagnostică excepțională în excluderea percepției de inactivitate fizică (LR– 0,05, valoare predictivă pozitivă, PPV 0,93). Absența CNI a fost asociată cu o probabilitate de 4 ori mai mare de inactivitate fizică (OR 4,03; IC 95% 2,83–5,72). Datele calitative din 2026 au evidențiat „inerția preventivă" și o orientare către telemedicină și consultații familiale de tip „proxy" în condiții de stres ambiental extrem și întreruperi de energie electrică.

Concluzii O abordare personalizată implică identificarea „componentelor dominante", precum EFZ, pentru a cataliza schimbări mai ample ale stilului de viață. Integrarea coachingului de sănătate adaptat și a programelor de wellness la locul de muncă este esențială pentru prevenirea durabilă a BNT.

Cuvinte-cheie Boli netransmisibile, control nutrițional individual, activitate fizică, abordare personalizată, populație activă.

INTRODUCTION

Non-communicable diseases (NCDs), including cardiovascular diseases (CVDs), diabetes, and cancer, account for 80% of the disease burden in EU countries and remain the leading causes of premature death. NCDs cost EU economies approximately €115 billion annually due to healthcare expenses and lost workforce productivity (1). Improving health promotion and disease prevention can reduce the prevalence of NCDs by as much as 70% (2).

Accumulating evidence from recent decades identifies eight core risk factors (RFs) responsible for up to 75% of NCD-related mortality (3). Among them, unhealthy diet and lack of physical activity (PA) are the most common and play an important role. The mortality rate and DALY indicators associated with insufficient fruit and vegetable consumption are the highest in European countries (4). Physical inactivity is the fourth most important RF for global mortality, responsible for 9% of premature deaths and significant percentage of diabetes and coronary heart disease cases (5–7). Lifestyle modifications, including a balanced diet, regular PA are essential to reduce the burden of CVDs (8). Today, PA is seen as a public health issue requiring multi-sectoral solutions (transport, urban design, sports) and leads to numerous individual and societal benefits (9, 10). Recent studies explore real-life situations, such as the influence of transport proximity (11) or the common PA of people and their companion dogs (12).

To increase the impact of preventive interventions, we must evaluate the effectiveness of routine practices and expand their coverage (13, 14). In real life, a combination of RFs is more common, requiring multifactorial interventions (15) adapted for primary care (16–18). Modern technologies for tracking PA do not diminish the importance of communicating with the doctor (19–21). Awareness and acceptance of knowledge by different populations must be considered when designing an intervention (22).

By 2022, 2.5 billion adults were overweight, including over 890 million living with obesity (23), a major factor in NCD morbidity (24). Differences in income and education significantly affect food choices and PA options (25, 26). Individual public health strategies developed before the pandemic, now require re-evaluation to address emerging communication patterns and socioeconomic challenges (27). As evidence on occupational PA and gender differences remains inconsistent (28), there is a need for personalized approaches.

Aim: to develop and justify personalized approaches to NCD prevention for the working population, by identifying key behavioral predictors, focusing on the interplay between diet, physical activity, and social barriers.

MATERIALS AND METHODS

Study Design and Setting

This research followed a mixed-methods design, integrating data from two distinct but complementary studies to evaluate lifestyle-related risk factors (RFs) and their diagnostic value in clinical practice. This mixed-methods approach allowed for the triangulation of large-scale behavioral data with specific socio-economic and environmental realities.

1. The Quantitative Study (pre-pandemic baseline): An observational cross-sectional study of the working population in Chernivtsi region, Ukraine (N = 1252), providing a reference point for the distribution of behavioral RFs in the pre-pandemic and pre-war period.

2. The Qualitative Study (January 2026): Structured interviews (n = 30) with market employees were conducted to contextualize lifestyle patterns within modern socio-economic conditions.

Sample Formation and Representativeness

The study population was formed using stratified random sampling to ensure qualitative representativeness. The sample comprised working-age individuals, represented in balanced proportions by market personnel (entrepreneurs and hired employees) and fair attendees. The study was conducted at a semi-enclosed, sprawling market complex covering several dozen hectares, where indoor trading zones are interconnected by unsheltered open-air walkways, exposing both employees and visitors to ambient environmental conditions.

The mean age was 40.49 (SD, 13.22) years. Comparative analysis of the age and gender structure showed no statistically significant differences from the official regional statistics ($p > 0.05$). The 30-39 age group accounted for 26.9% of the regional population and 26.04% of the study sample. The final sample size of N = 1252 was purposefully structured to ensure a minimal overall margin of error of ±2.8% (at a 95% confidence level). Percentage values in the results were presented alongside their calculated standard errors or confidence intervals.

Data Collection and Variables

Data collection involved a direct, face-to-face approach throughout the study period. For the quantitative component (2019), an anonymous survey was conducted using a specifically developed questionnaire; depending on the respondents` preference, they either completed the forms themselves or were interviewed by the researcher. This process was supplemented by direct observation of the study environment. In January 2026, data were gathered through structured face-to-face interviews. Due to extreme weather conditions (severe frost), responses were recorded manually by the researcher to ensure the integrity of the data collection process.

The research instrument was based on the WHO STEPS (29) approach and focused on two key behavioral domains: Individual Nutrition Control (INC) (regulating salt, sugar, and fats) and Physical Activity (PA) (evaluating activity levels according to preventive standards). Additionally, the survey examined the patient experience, as respondents were also asked about their experience as patients of their family physicians.

Statistical Analysis

Quantitative data were processed using IBM SPSS Statistics (v. 27.0). Statistical methods included Association Analysis using Odds Ratios (OR) with 95% Confidence Interval (CI). Diagnostic Validation was performed via cross-tabulation analysis to calculate the sensitivity (Se) and specificity (Sp), and predictive values (PPV, NPV) of lifestyle habits as screening indicators. To assess the clinical utility of behavioral markers, positive and negative likelihood ratios (LR+, LR–) were calculated using sensitivity (Se) and specificity (Sp) values following standard diagnostic accuracy formulas. Comparative Statistics utilized the χ^2 (chi-square) test for categorical variables with significance level set at $\boldsymbol{p < 0.05}$.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Informed written consent was obtained from all participants prior to their inclusion in the research.

RESULTS

The study focused on a detailed analysis of self-reported **Individual Nutrition Control (INC)** and **Physical Activity (PA)**, including participants' experiences (frequency of preventive medical consultations, and doctor-patient communication as a source of health information). Furthermore, we evaluated the behavioral RFs that were associated with low patient engagement in health management among the working population.

Interdependence of INC, Lifestyle Recommendations, and Risk Factor Clustering

Participants adhering to INC were 2.8 times more likely to be preventive care users (OR 2.82; 95% CI, 1.77-4.51; $P < .001$). However, among respondents who engaged in preventive medical consultations, only 48% demonstrated adherence to INC (specificity, Sp 0.48). Among those who identified the physician as their primary source of health information, only 38% followed INC (Sp 0.38). Respondents adhering to INC were 3.7 times more likely to follow Healthy Lifestyle (HLS) recommendations (OR 3.69; 95% CI, 1.94-7.02) and 2.7 times more likely to follow Healthy Diet (HD) guidelines (OR 2.66; 95% CI, 1.25-5.64).

Among participants who did not maintain INC, 54% reported not receiving HLS guidelines; of those who did receive them, 89% failed to follow them. A similar pattern was observed for HD advice, with 75% and 84% respectively. Notably, for individuals who followed either HLS or HD recommendations, there was an 80% negative predictive value (NPV 0.80) regarding their adherence to INC. As expected, the intake of beneficial and harmful dietary components differed significantly depending on adherence to INC. The most sensitive indicators of insufficient INC were the absence of restrictions on harmful components (Se 0.92-0.94) and the lack of fish consumption (Se 0.93) (Table 1). Conversely, for individuals who consumed adequate healthy foods and limited harmful ones, the probability of INC presence was 80-87% (NPV 0.80-0.87). In cases where the diet lacked beneficial components (e.g., fish) or failed to limit all harmful ones (e.g., fats), this indicated the absence of INC in approximately half of the instances (Positive Predictive Value, PPV 0.54-0.56) (Table 1).

Among the surveyed population, young men as well as middle-aged and elderly women (with approximately 30 years of employment history), rarely practiced INC. In other categories, adherence to dietary composition among male respondents increased with age. Conversely, the majority of women (65%) maintained INC regardless of age. Physically inactive individuals were four times more likely to lack INC (OR 4.03; 95% CI 2.83-5.72), while smokers were twice as likely (OR 2.18; 95% CI 1.51-3.14). Frequent alcohol consumption (daily or several times a week) was associated with a 1.5-fold increase in the likelihood of insufficient INC (OR 1.48; 95% CI 1.02-2.14). However, among those with established INC, nearly one in three remained physically inactive, and one in five was either a smoker or a frequent alcohol consumer.

Table 1. Comparative characteristics of dietary risk factors based on respondents' self-assessment of Individual Nutritional Control (INC)

Dietary Factors and Statistical Metrics	Individual Nutrition Control (INC) (%)		Predictive Value / χ^2/ P-value
	Negative INC (-)	Positive INC (+)	
1. Fruit			
Insufficient Consumption (-)	85.93±2.12	41.81±2.85	PPV 0.65
Sufficient Consumption (+)	14.07±2.12	58.19±2.85	NPV 0.82
Se / Sp	Se 0.86	Sp 0.58	χ^2 118.1
OR 95% CI	8.499 (5.624-12.843)		P < .001
2. Vegetables			
Insufficient Consumption (-)	80.00±2.43	37.79±2.80	PPV 0.66
Sufficient Consumption (+)	20.00±2.43	62.21±2.80	NPV 0.80
Se / Sp	Se 0.80	Sp 0.62	χ^2 103.64
OR 95% CI	6.584 (4.507-9.617)		P < .001
3. Fish			
Insufficient Consumption (-)	92.96±1.56	72.24±2.59	PPV 0.54
Sufficient Consumption (+)	7.04±1.56	27.76±2.59	NPV 0.81
Se/ Sp	Se 0.93	Sp 0.28	χ^2 41.41
OR 95% CI	5.076 (2.986-8.630)		P < .001
4. Salt			
Excessive Intake (-)	92.22±1.63	61.54±2.81	PPV 0.58
Adherence to restrictions (+)	7.78±1.63	38.46±2.81	NPV 0.85
Se / Sp	Se 0.92	Sp 0.39	χ^2 73.44
OR 95% CI	7.411 (4.483-12.250)		P < .001
5. Fat			
Excessive Intake (-)	94.44±1.39	66.89±2.72	PPV 0.56
Adherence to restrictions (+)	5.56±1.39	33.11±2.72	NPV 0.87
Se / Sp	Se 0.94	Sp 0.33	χ^2 67.24
OR 95% CI	8.415 (4.741-14.936)		P < .001

Note: *Se / Sp* – Sensitivity / Specificity (presented as fractions of 1.0); *PPV* – Positive Predictive Value; *NPV* – Negative Predictive Value (presented as fractions of 1.0); *OR* – Odds Ratio; 95% *CI* – 95% Confidence Interval.

Physical Activity Patterns and Behavioral Associations

According to the study, physical activity (PA) was primarily realized through daily physical exercises (DPE 15%), and regular structured physical activity (SPA), including moderate-intensity exercises performed 4-5 times a week (11%) or 2-3 times a week (13%). Notably, 53.71±1.58% of respondents perceived themselves as physically active, with walking (45%) and outdoor activities (52%) played a significant place in their routines. Among inactive

individuals, the absence of DPA or scheduled classes yielded a high sensitivity (Se 0.99) and an NPV 0.96-0.98 regarding overall PA (Table 2). Self-assessed PA was significantly associated with all analyzed mobility factors ($P < .01$, Table 2). Low occupational PA, the absence of gardening, and especially a walking duration of less than 30 minutes per day served as the strongest predictors of perceived inactivity.

Table 2. Comparative characteristics of mobility types based on respondents' self- assessment Physical Activity (PA)

Mobility Factors and Statistical Metrics	Physical Activity (PA) (%)		Predictive Value / χ^2 / P-value
	Negative PA (-) (Consider themselves inactive)	Positive PA (+) (Consider themselves active)	
1. Daily Physical Exercises (DPE)			
Absence (-)	98.48±0.87	82.09±1.66	PPV 0.31
Regular (+)	1.52±0.87	17.91±1.66	NPV 0.97
Se/ Sp	Se 0.99	Sp 0.18	χ^2 33.31
OR 95% CI	1.182 (4.439-45.305)		P < .001
2. Regular Structured Physical Exercise (SPA)			
Absence (-)	98.48±0,87	84,70±1,55	PPV 0.30
Presence (+)	1.52±0.87	15.3±1.55	NPV 0.96
Se/ Sp	Se 0.99	Sp 0.15	χ^2 17.18
OR 95% CI	3.691 (1.941-7.020)		P < .001
3. Occupational Physical Activity (PA)			
Low activity (-)	82.29±2.89	67.16±2.17	PPV 0.31
Moderate load (+)	17.71±2.89	32.84±2.17	NPV 0.83
Se/ Sp	Se 0.82	Sp 0.33	χ^2 14.23
OR 95% CI	2.271 (1.472-3.503)		P < .001
4. Gardening and yard work			
Absence (-)	81.31±2.77	69.59±1.99	PPV 0.30
Seasonal/Regular (+)	18.69±2.77	30.41±1.99	NPV 0.82
Se/ Sp	Se 0.81	Sp 0.30	χ^2 10.03
OR 95% CI	1.902 (1.272-2.842)		P < .01
5. Walking (Commuting or Leisure)			
< 30 min/day (-)	78.28±2.93	48.51±2.16	PPV 0.37
> 30 min/day (+)	21.72±2.93	51.49±2.16	NPV 0.87
Se/ Sp	Se 0.78	Sp 0.52	χ^2 52.17
OR 95% CI	3.826 (2.622-5.584)		P < .001

Note: *Se / Sp* – Sensitivity / Specificity (presented as fractions of 1.0); *PPV* – Positive Predictive Value; *NPV* – Negative Predictive Value (presented as fractions of 1.0); *OR* – Odds Ratio; 95% *CI* – 95% Confidence Interval.

Using an objective proxy for PA (performing SPA ≥ 30 min, 2-3 times/week) showed that physically active individuals had a high probability of adhering to INC (Sp 0.76), though among those with established INC, only 29% were also physically active (NPV 0.29). Notably, in 91% of cases, frequent alcohol consumption or smoking was not accompanied by regular SPA (PPV 0.91; $p < 0.05$), with an error probability of 5.1-6.3%.

Physically active patients demonstrated higher rates of dental visits (Sp 0.42), while 79% of inactive respondents did not (Se 0.79). However, the data showed a low probability that preventive consultations with either a family physician or a dentist serve as a catalyst for initiating regular SPA (NPV 0.26). Regarding PA recommendations specifically, only 27% of those who exercised had received professional recommendations, among them, the specificity of adherence was 0.37 (Sp 0.37). These data indicate that clinical advice in its current form serves as a weak predictor of actual behavioral change toward SPA. Receiving general HLS recommendations showed no significant impact on the decision to engage in regular SPA ($p < 0.05$).

DPE were significantly associated with all analyzed dietary risk factors ($P < .01$ for all parameters, Table 3). Respondents who neglected DPE were 3.5 times more likely to demonstrate poor INC compared to those who exercised regularly (OR 3.50; 95% CI 2.10-5.83). Specifically, 75% of individuals engaging in DPE adhered to INC (Sp 0.75), whereas among those with established INC, only 20% performed daily exercises (NPV 0.20). Similar predictive patterns were observed for specific dietary restrictions. The absence of DPE showed high sensitivity for excessive intake of fat (Se 0.78), sugar (Se 0.75), and salt (Se 0.69). Furthermore, regular DPE was a significant predictor for sufficient fruit consumption (OR 2.72; Sp 0.66) and adherence to sugar restriction (OR 2.81) (Table 3).

The calculated likelihood ratios for self-reported behaviors showed that a negative INC was a predictor of a lack of fruit and vegetables (LR+ 2.05–2.11), while a positive INC corresponded to the absence of excessive salt and fat intake (LR– 0.18–0.21). DPE and SPA yielded LR values of 0.05 and 0.07, respectively. Furthermore, the absence of DPE was associated with poor INC (LR+2.16).

Respondents who did not engage in DPE were 1.5 times more likely to be smokers ($P = .045$) and significantly less likely to have annual visits to the doctor ($P < .001$). The absence of DPE showed high sensitivity for identifying individuals who were not screened for blood sugar (Se 0.70, $P < .01$) and cholesterol testing (Se 0.84, $P < .001$).

Table 3. Association between dietary risk factors and daily physical exercises (DPE): predictive metrics and odds ratios (OR)

Dietary Factors and Statistical Metrics	Daily physical exercises (DPE) (%)		Predictive Value / χ^2 / P-value
	Absent (-)	Present (+)	
1. Individual nutrition control (INC)			
Negative INC (-)	53.86±2.09	25.00±4.62	PPV 0.93
Positive INC (+)	46.14±2.09	75.00±4.62	NPV 0.20
Se / Sp	Se 0.54	Sp 0.75	χ^2 25.40
OR 95% CI	3.502 (2.103-5.831)		P < .001
2. Fruit			
Insufficient Consumption (-)	58.36±1.51	34.04±3.46	PPV 0.91
Sufficient Consumption (+)	41.64±1.51	65.96±3.46	NPV 0.22
Se / Sp	Se 0.59	Sp 0.66	χ^2 38.15
OR 95% CI	2.716 (1.962-3.760)		P < .001
3. Sugar			
Excessive Intake (-)	74.59±1.39	51.12±3.75	PPV 0.89
Adherence to restrictions (+)	25.41±1.39	48.88±3.75	NPV 0.26
Se / Sp	Se 0.75	Sp 0.49	χ^2 40.32
OR 95% CI	2,807 (2.024-3.893)		P < .001
4. Salt			
Excessive Intake (-)	69.31±2.65	50.00±6.06	PPV 0.86
Adherence to restrictions (+)	30.69±2.65	50.00±6.06	NPV 0.21
Se / Sp	Se 0.69	Sp 0.50	χ^2 9.20
OR 95% CI	2.258 (1.323-3.853)		P < .01
5. Fat			
Excessive Intake (-)	78.43±1.47	60.47±4.30	PPV 0.89
Adherence to restrictions (+)	21.57±1.47	39.53±4.30	NPV 0.23
Se / Sp	Se 0.78	Sp 0.40	χ^2 19.53
OR 95% CI	2.378 (1.607-3.520)		P < .001

Note: *Se / Sp* – Sensitivity / Specificity (presented as fractions of 1.0); *PPV* – Positive Predictive Value; *NPV* – Negative Predictive Value (presented as fractions of 1.0); *OR* – Odds Ratio; 95% *CI* – 95% Confidence Interval.

Qualitative Analysis: Barriers and Facilitators of Preventive Care (2026)

The problem of an inadequate number of preventive visits to a family doctor was confirmed through in-depth interviews with market workers. These were conducted during periods of low ambient temperatures, limited customer flow, and frequent 3-4-hour power outages accompanied by generator exhaust. Despite these challenging conditions at workplaces in the winter of 2026 (low temperature, lack of light, and generator emissions), market workers showed high resilience, stating that such conditions "strengthened" them and fostered a deep respect for their workplaces as essential providers.

The qualitative study also revealed behavioral resilience among workers. The main lifestyle patterns were influenced by age and economic factors. INC was supported mainly by the consumption of home-cooked meals, which was associated with the high cost of public catering.

Data revealed that many respondents reported positive shifts in physician-participant interaction, largely due to the expanded telemedicine phone-based consultations. However, many respondents, especially men, accessed medical advice indirectly through family members rather than through direct professional consultation. Two out of three workers with hypertension resolved all medical issues remotely. One respondent, following a negative past experience, sought care only from familiar doctors at a hospital. Only every third person had consulted a family doctor, notably, most of them had completed their annual screenings. Common barriers included: a "nothing bothers me" attitude, reliance on phone consultations, "proxy" contact via relatives, and the use of personal acquaintances to bypass formal waiting lines.

DISCUSSION

The "unpacking" method (30) identifies effective intervention components for complex social issues (31, 32). Our study established regularities in the distribution of behavioral RFs, within a representative working population, where insufficient intake of fruits and vegetables was associated with 5-9 times lower odds of INC (Table 1). The calculated likelihood ratios confirm the clinical utility of self-reported data: negative INC was a moderate predictor for nutritional deficits (LR+ 2.05-2.11), while positive INC reliably excluded excessive salt and fat intake (LR- 0.18-0.21).

Our findings indicated that individuals who did not maintain INC were 4 times more likely to be physically inactive (OR 4.03; 95% CI 2.83-5.72). While STEPS (2019) (33) reported high activity rates in Ukraine, our data suggested this was primarily due to "forced mobility" driven by employment conditions, explaining why traditional medical recommendations had a limited impact (Sp 0.37).

A personalized approach requires identifying age-specific markers to increase diagnostic specificity across all groups. DPE served as a robust "proxy" indicator for health engagement. The use of a specific factor for assessing the activity of a patient from an atypical age group increased its specificity; engaging in regular SPA the likelihood of activity in middle and old age, while DPE increased the likelihood of activity in young age. Notably, DPE emerged as a definitive clinical marker (LR– 0,05; PPV 0.93) for ruling out perceived inactivity.

Effective intervention must assess health literacy (34), which correlates with exercise adherence and life satisfaction (35, 36). Interventions should develop the patient's self-efficacy and demonstrating the benefits of healthy behavior, while avoiding fear-based messages, as these can lead to the opposite result (37, 38).

Health-related behaviors, information seeking, and physician-patient interactions are shaped by a complex of sociodemographic and economic determinants (39–41), with online search increasingly shaping lifestyle choices (42). However, workplace conditions and time constraints remain major barriers for workers, necessitating the integration of individualized health coaching (43) into family medicine. Such coaching should take into account unique cultural and environmental contexts (43), enabling patients to implement the most appropriate lifestyle changes despite existing professional challenges (37, 38).

Identifying the leading component of a risk factor allows the physician to gradually, "like unwinding a ball of thread", guide the patient toward positive changes. The success of a single patient could catalyze similar changes among colleagues and family (1, 38, 44–46).

Study limitations. Data collection in early January 2026 coincided with extreme weather, mobilization, and power outages, which temporarily altered health-seeking behaviors and limited the sample size. Furthermore, relying on self-reported data on INC and PA may lead to recall bias. Future longitudinal research is needed to track the changes in worker behavior and the receipt of preventive interventions.

CONCLUSIONS

1. Daily physical exercise (DPE) was identified as the primary behavioral marker and a "leading component" for NCD prevention, showing exceptional power in ruling out perceived inactivity (LR– 0.05) and indicating high health engagement (PPV 0.93). The established systemic interplay between DPE and INC suggests that starting interventions with this "proxy" marker can catalyze a structured sequence of further lifestyle modifications, including dietary restrictions and enhanced health literacy.
2. Qualitative data from the winter of 2026 demonstrated that extreme environmental and social stressors shifted health-seeking motivation toward "survival-mode" behaviors, characterized by a preference for telemedicine and "proxy" family-based support. Despite these shifts, "preventive inertia" and asymptomatic bias remain significant barriers, necessitating a transition from passive observation to proactive, screening-oriented medical interactions within primary care.
3. The effectiveness of a personalized preventive approach relies on identifying key risk factor components and addressing them through tailored health coaching. To ensure sustainable lifestyle changes under challenging occupational and environmental conditions, this strategy must integrate family-oriented elements and workplace wellness programs aligned with European standards, focusing on patient self-efficacy and the physician-patient interaction.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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ETHICAL APPROVAL

The study was conducted in accordance with the Declaration of Helsinki. The study involved the analysis of fully anonymous survey data and qualitative interviews conducted for the purpose of assessing public health. Informed consent was obtained from all study participants. Data confidentiality was maintained throughout all stages of research.

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Lyubov Vlasyk, WoS Researcher ID: D-4871-2017, SCOPUS ID: 57210070713

Leonid Vlasyk, WoS Researcher ID: D-1548-2017, SCOPUS ID: 10241313900

Nataliia Rynhach, WoS Researcher ID: X-3983-2018, SCOPUS ID: 57203427877

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Rules of drafting

The manuscripts should be written in font Cambria, size 11 points, spaced at 1.0, fully justified alignment, fields 2 cm on all sides. All pages must be numbered consecutively (in the right bottom corner) and continuously. Abbreviations should be explained at first occurrence in the text and should not be excessively used. The manuscripts must not exceed the number of words (without the title, affiliation, abstract and references): review articles – 4,500 words; original articles – 3,000 words; opinions/perspectives – 2,500 words; case reports / clinical-laboratory images – 1,700 words; short experimental/clinical notes – 1,300 words; book reviews – 2,000 words; didactic (educational) articles – 4,000 words. The volume of tables and figures should not exceed 1/3 from the volume of the manuscript. The journal reserves the right to make any other formatting changes.

All manuscripts submitted for publication should be accompanied by two abstracts: in English and Romanian.

Title and authors

The title must be as concise as possible (maximum 120 characters including spaces) and clearly reflect the content of the manuscript. The names of the authors should be written in full: name, surname (e.g.: Ion RUSU). Affiliation should include: Department/Unit/Chair, University/Hospital, City, Country for each author. The corresponding author must provide a valid e-mail address, preferably an institutional one (e.g., Corresponding author: Ion RUSU, email: ion.rusu@usmf.md).

The structure of the manuscript

Original Article / Review Article

The manuscript should comprise the following sub- headings (capitalized):

- **SUMMARY** (Structured Abstract)
- **INTRODUCTION**
- **MATERIALS AND METHODS**
- **RESULTS**
- **DISCUSSION**
- **CONCLUSIONS**
- **DECLARATIONS** (Conflict of Interest, Acknowledgements and Funding, Ethics, Contributions)
- **REFERENCES**

Case Report

Recommended sections:

- **ABSTRACT**
- **INTRODUCTION**
- **CASE PRESENTATION**
- **DISCUSSION**
- **CONCLUSIONS**
- **DECLARATIONS** (Conflict of Interest, Acknowledgements and Funding, Ethics)
- **REFERENCES**

The **summary** should contain 1,600 signs with spaces:

- **Introduction**
- **Materials and methods**
- **Results**
- **Conclusions**
- **Keywords:** 5-7 words

The abstract should not contain tables, figures, bibliographic citations, or results that do not appear in the main text.

Figures and **tables** must be cited consecutively in the text (e.g., Figure 1, Table 1).

Text included in figures must be written in Cambria font, size 10 pt. Each figure must be accompanied by a title and legend. Figures must be numbered with Arabic numerals and cited in the text in round brackets (e.g., Figure 1). The figure title (e.g., Figure 1) and legend must be centered below the figure.

Figures must also be uploaded separately as files (TIFF/JPG/PNG at min. 300 dpi for images; 600–1200 dpi for line art/diagrams; or PDF/EPS).

For graphs and diagrams, the source file must also be uploaded (e.g., .xlsx/.csv + R/Python script when applicable) for verification purposes.

Screenshots from Excel are not accepted; use clear symbols and legends.

References must be numbered in the order of appearance in the text. Citation must follow the AMA style, placed at the end of the article, and must include only references cited in the text (indicating the reference number in round brackets). Each bibliographic source shall include the DOI, if available, in the form of a hyperlink. Official journal title abbreviations must be used. If the same reference is cited multiple times, it must appear in the text with the same number as in the first citation. The total number of references should not exceed 50 sources (for review articles, the recommended number of references is up to 80 sources), at least 70% of which should be indexed in recognized international databases within the last 3–5 years.

For more information see: https://journal.ohrm.bba.md/index.php/journal-ohrm-bba-md/editing_guidelines

CERINȚE PENTRU AUTORI

Reguli de tehnoredactare

Manuscrisele trebuie să fie cu font Cambria, dimensiune 11 puncte, spațiat la interval 1,0, aliniere justificată, câmpurile 2 cm pe toate laturile. Toate paginile trebuie să fie numerotate consecutiv (în colțul de jos, în partea dreaptă) și să includă numerotarea continuă a paginilor. Abrevierile trebuie să fie explicate la prima apariție în text și nu trebuie utilizate excesiv. Manuscrisele nu trebuie să depășească (fără a număra titlul, afilierea, rezumatul și referințele): pentru articole de sinteză – 4500 de cuvinte; pentru articole originale – 3000 de cuvinte; pentru opinii/perspective ale experților – 2500 de cuvinte; studii de caz/imagini clinice de laborator – 1700 de cuvinte; note experimentale și clinice – 1300 de cuvinte; recenzii și prezentări de carte – 2000 de cuvinte; articole didactice – 4000 de cuvinte. Volumul tabelelor și figurilor nu trebuie să depășească 1/3 din volumul manuscrisului. Revista își rezervă dreptul de a face orice alte modificări de formatare.

Toate manuscrisele transmise spre publicare trebuie să fie însoțite de două rezumate: în engleză și în română.

Titlul și autorii

Titlul trebuie să fie cât mai concis posibil (maximum 120 de caractere, inclusiv spațiile) și să reflecte clar conținutul manuscrisului. Numele autorilor vor fi scrise deplin: prenume, nume de familie (ex: Ion RUSU). Afilierea va include: Secția/Departamentul/Catedra, Universitatea/Spitalul, Orașul, Țara pentru fiecare autor. Autorul corespondent trebuie să furnizeze o adresă de e-mail validă, preferabil instituțională (de exemplu, Autor corespondent: Ion RUSU, e-mail: ion.rusu@usmf.md).

Structura manuscrisului

Articol original /Articol de sinteză

Manuscrisul va cuprinde următoarele subtitluri (scrise cu majuscule):

- **REZUMAT** (rezumat structurat)
- **INTRODUCERE**
- **MATERIALE ȘI METODE**
- **REZULTATE**
- **DISCUȚII**
- **CONCLUZII**
- **DECLARAȚII** (conflict de interese, mulțumiri și finanțare, etică, contribuții)
- **REFERINȚE**

Studiu de caz

Secțiuni recomandate:

- **REZUMAT**
- **INTRODUCERE**
- **PREZENTAREA CAZULUI**
- **DISCUȚII**
- **CONCLUZII**
- **DECLARAȚII** (conflict de interese, mulțumiri și finanțare, etică)
- **REFERINȚE**

Rezumatul va conține până la 1600 de semne cu spații și va cuprinde:

- **Introducere**
- **Materiale și metode**
- **Rezultate**
- **Concluzii**
- **Cuvinte-cheie**: 5-7 cuvinte

În rezumat nu vor fi incluse tabele, grafice și note bibliografice; informații care nu sunt prezentate în studiu.

Figurile și **tabelele** se citează în text în ordinea în care apar în text (fig. 1; tab. 1).

Textul inclus în figuri se redactează cu font Cambria, mărimea 10 pt. Fiecare figură trebuie însoțită de titlu și legendă. Figurile se numerotează cu cifre arabe și se citează în text în paranteze rotunde (de exemplu, fig. 1). Titlul figurii (de exemplu, Figura 1) și legenda trebuie centrate sub figură.

Figurile trebuie încărcate și ca fișiere separate (TIFF/JPG/PNG la minimum 300 dpi pentru imagini; 600-1200 dpi pentru line art/diagrame; sau PDF/EPS).

Pentru grafice și diagrame, se încarcă și fișierul sursă (de exemplu, .xlsx/.csv + script R/Python, unde este cazul), în scop de verificare.

Capturile de ecran din Excel nu sunt acceptate; utilizați simboluri și legende clare.

Referințele trebuie numerotate în ordinea apariției în text. Citarea trebuie să respecte stilul AMA, să fie plasată la sfârșitul articolului și să includă numai referințele citate în text (indicând numărul referinței în paranteze rotunde). Fiecare sursă bibliografică trebuie să includă DOI-ul, dacă este disponibil, sub formă de hyperlink. Se vor utiliza abrevierile oficiale ale titlurilor revistelor. Dacă aceeași referință este citată de mai multe ori, în text trebuie să apară cu același număr atribuit la prima citare. Numărul total de referințe trebuie să depășească 50 de surse (pentru articolele de sinteză, numărul total de referințe trebuie să fie de cel puțin 80 de surse), predominant din ultimii 3-5 ani (cel puțin 70%) și indexate în baze de date internaționale recunoscute.

Pentru mai multe informații consultații: https://journal.ohrm.bba.md/index.php/journal-ohrm-bba-md/editing_guidelines

The *One Health* concept

Globally, the One Health concept is a worldwide strategy to expand interdisciplinary collaborations and communications in all aspects related to the health care of humans, domestic animals or wildlife, which can no longer be approached separately, but only jointly.

One Health addresses not only human and animal disease concerns, but also issues related to lifestyle, diet, exercise, the impact of different types of human-animal relationships, and environmental exposures that can affect both populations. In order to achieve the expected effects, it is also necessary to educate the population to make them aware of the risk factors and benefits of prevention, as well as communication and understanding between patients and healthcare providers.

HUMAN HEALTH

The WHO defined health in 1946 as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”, with the later addition of “the capacity to lead a socially and economically productive life”.

ANIMAL HEALTH

The OIE defines animal welfare in 2008: an animal is in good condition if it is healthy, enjoys comfort, is well fed, is safe, is able to display its innate (natural) behavior and does not suffer from unpleasant conditions such as pain, fear and stress.

PLANT AND ENVIROMENTAL HEALTH

Environmental health refers to those aspects of human health that include the quality of life determined by physical, biological, socio-economic and psycho-social factors in the environment. The interrelationships of people with the environment concern medicine, when an ecological system is in a state of equilibrium, the health of the population prevails.


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