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# Human-centred Artificial Intelligence in Education: Conceptual Definition and Key Characteristics

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# Human-centred Artificial Intelligence in Education: Conceptual Definition and Key Characteristics

# Ανθρωποκεντρική Τεχνητή Νοημοσύνη στην Εκπαίδευση: Εννοιολογική Οριοθέτηση και Βασικά Χαρακτηριστικά

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## Abstract

The present paper focuses on the conceptual definition of Human-Centred Artificial Intelligence (HCAI) and its significance for the field of education. The findings of this systematic review of the international literature (2018–2025) reveal a distinct shift from a technology-centred perspective on Artificial Intelligence (AI) towards a human-centred approach focused on enhancing human capabilities, human control, reliability, personal data protection and an emphasis on human values. Concurrently, the significance of user participation in design and evaluation is underscored, as is the necessity for the general public to comprehend the fundamental operations of AI.

Within the field of education, human-centred AI is associated with the empowerment of students and teachers, the promotion of autonomy, fair and inclusive learning, transparency in decision-making and data security. Applications such as Smart Learning Analytics are highlighted for personalised feedback and self-regulation, provided that an appropriate pedagogical framework is in place. Finally, challenges are highlighted regarding the transparency of algorithms and the potential for bias in AI applications in line with stereotypes, as well as the need for meaningful teacher training and the development of a coherent pedagogical framework, so that AI can contribute to the transformation of education in terms of social justice, prosperity and sustainability.

## Introduction

In the contemporary educational landscape, educators and learners are confronted with a substantial predicament, namely the integration of artificial intelligence (AI) applications in both personal and educational contexts. The rapid proliferation of AI applications engenders novel opportunities for learning, support and personalisation. However, concomitantly, it gives rise to critical issues of transparency and control, privacy and security, and equal opportunities.

In this context, human-centred AI is emerging as a necessary orientation, shifting the focus from algorithms and large language models (technology-centred approach) to the possibilities of empowering users, so that teachers and students can cultivate critical cognitive and social skills to respond critically and creatively to new circumstances.

Aim of the paper: The present paper, through a review of the international literature (2018-2025), aims to contribute to the systematic investigation of human-centred AI and its pedagogical use in education, highlighting the need for a holistic framework that will support pedagogical design and the use of AI applications to transform the educational process by empowering teachers and students and promoting education in terms of equality, justice and social cohesion.

The structure of the paper is as follows: The initial section meticulously delineates the methodological framework upon which the study is founded. The second part of this study focuses on the conceptual definition and characteristics of anthropocentric TN. The third part attempts to highlight the prerequisites and possibilities for the pedagogical use of human-centred TN in educational practice, while the fourth section highlights the main challenges posed by its use. The paper concludes with a series of conclusions and recommendations for future research.

## Methodology

A comprehensive search strategy was employed, encompassing articles published in scientific journals and conference proceedings relevant to the subject of the paper, in addition to books and reports by official organisations and bodies. These materials were meticulously evaluated, analysed, and synthesised to inform the study.

The following keywords were utilised in the search for bibliographic sources: The following terms are to be considered: "Human-Centred Artificial Intelligence (HCAI)" and "Artificial Intelligence in Education (HCAI in ED)". The search was conducted using Google Scholar, ScienceDirect, ERIC and ResearchGate.

The search focused primarily on the period 2018–2025, during which there has been increased research interest in human-centred artificial intelligence. The search also included some older sources that were deemed necessary for conceptual delimitation and understanding of the field's development.

The initial search yielded a total of 142 scientific publications. After an initial review of titles and abstracts, sources were excluded that:

i) were not relevant to the subject of the thesis,

ii) did not meet basic criteria for scientific documentation,

iii) were not in English, and

iv) were duplicates.

A systematic study of the remaining sources was then carried out, and 43 sources were finally selected based on relevance, quality, documentation and theoretical or research contribution (31 scientific articles, 7 scientific conference proceedings, sections from 3 books, 2 reports from organisations – bodies). These form the bibliographic basis of this paper.

## Human-centred Artificial Intelligence

*Conceptual Definition*

A study of the bibliography from 2018 to 2025 reveals a substantial transition from a technological focus to a human-centred approach in the context of AI. This transition has been acknowledged by numerous researchers as a crucial prerequisite for the cohesion and effective development of modern societies (Riedl, 2019; Shneiderman, 2022; Yang, 2021; Zhao et al., 2023).

Indeed, the necessity of the human-centred dimension of AI is emerging as a universal demand, given the numerous concerns relating to the absence of social responsibility, transparency and trust during the design stage (Ahmad et al., 2023) and in terms of the catalytic effects on people's lives, social cohesion and the environment (Nakao et al., 2022).

In the international literature, there are various approaches to the term Human-Centred Artificial Intelligence (HCAI).

As posited by Anastasiades et al. (2024), the objective of Human-Centred Artificial Intelligence (HCAI) is not to supplant human existence. Conversely, in terms of social responsibility, it is essential to prioritise the optimisation of the potential of modern humans, thereby ensuring their capacity to respond to the ever-increasing demands of a socially, economically and culturally uncharted environment.

Shneiderman (2020) posits that the term 'human-centred artificial intelligence' refers to a particular type of artificial intelligence that is focused on the enhancement, empowerment and improvement of human performance in ways that render systems reliable, safe and trustworthy. In addition to these benefits, the systems under discussion have also been demonstrated to support human self-efficacy, encourage creativity, clarify responsibility and facilitate community participation.

Rogers (2022) posits that the term 'Human-Centred Artificial Intelligence' denotes the design of artificial intelligence systems that enhance human capabilities and improve human experiences, as opposed to the replacement of human labour through automation.

According to Bond et al (2019), the development of HCAI has been informed by research in the fields of HCI (Human Computer Interaction) and AI (Artificial Intelligence), with the overarching objective being the prioritisation of human interests in the development of Artificial Intelligence.

A fundamental principle of human-centred artificial intelligence is that people and their needs must be placed at the centre of design in terms of social responsibility and technology ethics (Nagitta et al., 2022), with the ultimate goal not being to replace but to support and enhance human existence (Bond et al., 2019; Li & Gu, 2023) and defend their interests by strengthening their need for skill improvement, participation in the process and well-being (Mhlanga, 2022) as well as developing a framework of continuous interaction so that AI applications can work in a complementary and supportive manner with humans (Herrmann & Pfeiffer, 2022).

Human-centred artificial intelligence must put people back at the centre of its focus with the aim of improving human performance in ways that are reliable and safe, while

allowing for high levels of human control. (Ozmen Garibay et al, 2023), with the following pillars:

- Human well-being.
- Human participation in both the design and evaluation stages.
- Understanding of the basic functions of AI by the general public.
- Protection of human personal data.

It is evident that the fundamental purpose of A.T.N. is to provide support to individuals and communities in their sustained endeavours to promote innovation and creativity, enhance social well-being and cohesion, address social inequalities, safeguard personal data, and nurture environmental responsibility, all in accordance with the universal principles of peace, democracy, and social justice. (Anastasiades et al., 2024).

*The characteristics of human-centred Artificial Intelligence*

Human-centred design can be defined as a creative approach to problem solving that commences with the identification of the individuals for whom a design is intended, focusing on their requirements and viewpoints. The term "human-centred design" is frequently employed as a synonym for "user-centred design". However, a more precise delineation would emphasise its broader scope. This issue impacts all stakeholders, not solely the end users of a system. The theoretical underpinnings of this design pertain to a range of disciplines, including ergonomics, psychology, computer science, anthropology, engineering, and the arts (Schmager, Pappas, & Vassilakopoulou, 2025).

A fundamental aspect of HCI is the centralisation of the human element, which facilitates the development of reliable and ethically aligned AI systems (Shneiderman, 2020).

These systems have the capacity to provide a suitable framework for the exploitation of linguistic, cultural and geographical diversity as a source of information (Cooley, 2000), provided that they do not operate in isolation but are part of a broader framework that includes people-stakeholders (Riedl, 2019). Trust in such a system is

ensured when users are involved from the early stages of its development (Le Dinh et al., 2025).

In order to ensure that a human-centred artificial intelligence system is user-friendly, there are several prerequisites that must be met. Xu (2019) posits that the system should be designed from a human perspective so that the result is easily explainable, understandable, useful and user-friendly. According to the International Organization for Standardization (ISO), it is crucial that continuous and active user participation be ensured throughout the design and development process of a system. This is to ensure that designers have a comprehensive understanding of the needs of users and the requirements of their tasks and duties. It is also emphasised that user participation is a valuable source of information, and that the effectiveness of the system is increased by the closer interaction between users and system designers (ISO 9241-210:2019; 5.3, 5.2).

The fundamental distinction between "imitating intelligence" and augmenting or enhancing it is the human-centred approach to Artificial Intelligence (Markoff, 2016). The characteristic of imitation of intelligence is usually associated with negative connotations, while its enhancement is perceived more positively and in a more human-centred manner (Hansen, 2022). As asserted by Schmager, Pappas and Vassilakopoulou (2025), the concept of intelligence mimicry is founded on the autonomy and automation of Artificial Intelligence. Conversely, the objective of intelligence augmentation is to enhance human capabilities.

The primary objective of human-centred Artificial Intelligence should be to enhance, rather than replace, human intelligence. The objective of this paradigm is to facilitate collaboration between humans and machines, rather than to substitute the former for the latter (Shneiderman, 2020). As posited by Ford et al. (2015), the augmentation of human intelligence has been demonstrated to engender a number of outcomes, including the enhancement of skills and the refinement of decision-making processes, which, in turn, have been shown to precipitate improved performance and outcomes. Fischer (2021) emphasises that ATN is closely related to intelligence augmentation, focusing on improving people's quality of life by creating systems that enhance human performance in ways that make these systems safe, reliable and trustworthy (Shneiderman, 2020). Another aspect of augmentation is the variable of human

cognitive effort when interacting with the Artificial Intelligence system. Gajos and Mamykina (2022) posit that the level of cognitive engagement could be used to develop a conceptual understanding of human engagement with AI systems. The distinction between passive engagement, whereby individuals adhere to AI recommendations without critical evaluation, and deeper forms of engagement, wherein recommendations are met with rigorous examination in relation to existing knowledge and judgement, is a key focus.

According to Schmager, Pappas and Vassilakopoulou (2025), a second characteristic that artificial intelligence must possess in order to be considered human-centred is values. It is widely accepted that values refer to the fundamental beliefs and ideals that shape the judgement and behaviour of both individuals and societies. These values facilitate comprehension of what is right, important and essential. The establishment of ATN systems necessitates processes such as the identification of social values, the selection of an ethical discussion method, and the integration of these values into the system's official specifications and functions (Dignum, 2019).

A third characteristic that Schmager, Pappas and Vassilakopoulou (2025) attribute to ATN relates to the assurance of specific properties and characteristics of AI, with a view to ensuring that systems are reliable, comprehensible and socially responsible. The aforementioned properties are said to include accountability and responsibility, with the purpose being to clarify the identification of responsibility (Shneiderman, 2020).

**Human-centred Artificial Intelligence in education**

The rapid development of Artificial Intelligence technologies has also had a significant impact on the field of education (Roll & Wylie, 2016). In light of these rapid advancements, Dignum (2019) has raised the issue of accountability for the power wielded by Artificial Intelligence (Dignum, 2019). In contrast to attributing culpability to artificial intelligence technologies for actions and decisions, the focus is instead placed on human responsibility for the design and development of AI systems that are consistent with human values and ethics. The overarching objective of this approach is to ensure human well-being and sustainable development. This approach by Dignum (2019) essentially outlines human-centred Artificial Intelligence, as it

emphasises the critical role of humans in the design and consequences of Artificial Intelligence systems (Fu & Weng, 2024).

The prevailing research trend in the field of Artificial Intelligence (AI) is undergoing a shift from technology-oriented applications, which primarily aim to enhance productivity and performance, towards human-centred applications that seek to augment human intelligence through machine assistance (Yang, 2021). As posited by Yang et al. (2021), the fundamental nature of learning technology is such that it must be human-centred in essence, given its direct interaction with human beings.

Klimova et al. (2023) posit that there are four ethical principles that should guide the use of artificial intelligence in education. The human-centred dimension that should govern artificial intelligence in education is emphasised by the values of beneficence, accountability, justice and human values.

The value of the educator is derived primarily from their capacity to employ teaching strategies and methods judiciously. Appropriate pedagogical approaches and tools facilitate the design of comprehensive learning activities, which have been shown to enhance students' learning outcomes and help them develop effective learning strategies (Tempelaar et al., 2021).Concurrently, the use of learning data analysis and assessments is a critical element in improving teaching (Alyahyan, 2020). The primary function of the Smart Learning Analytics system is the identification of students experiencing difficulties with their courses, with the subsequent provision of immediate assistance. It is incumbent upon educators to identify and address issues that are of concern to students, as well as to ascertain which students are experiencing difficulties and with which specific topic (Zawacki-Richter et al., 2019). The Smart Learning Analytics system facilitates continuous enhancement of educational content, ensuring its alignment with students' comprehension levels. This, in turn, enables pedagogues to adapt their instructional methods. Concurrently, it enables students to assume responsibility for their learning and to compare their performance with that of their peers. Smart Learning Analytics has been demonstrated to facilitate the development of skills and knowledge in a more personalised and self-regulated manner (Yang et al., 2021).

Fairness and equity are also important issues. Human-centred Artificial Intelligence systems should be designed to identify and address students' needs, rather than

homogenise them and ignore their individual learning differences (Fu & Weng, 2024). In order to circumvent the potential for bias and discrimination, it is crucial that AI incorporates a diverse array of perspectives when data is being collected (Shih et al., 2021).

Privacy and security have been identified as a key factor by Fu & Weng (2024). Privacy and security pertain chiefly to data (its collection, management, storage, access and use), with particular emphasis on the privacy of students and teachers (Fu & Weng, 2024). As Holmes et al. (2022) particularly emphasise, the sensitivity of data and its intended utilisation by systems is a key consideration.

Kousa and Niemi (2023) posit that the optimal and most efficient ATN system in education is predicated on the symbiotic integration of human and machine capabilities. Within such a system, individuals seeking to pursue academic endeavours with the assistance of an artificial intelligence instructor have the option to do so. Concurrently, those requiring more substantial human support are also catered for, thereby ensuring the provision of learning autonomy to the learner.

Another feature of AI in education is transparency (Fu & Weng, 2024). In essence, users must possess the capacity to comprehend the rationale underpinning system decisions, while designers are expected to exhibit transparency with respect to data collection and dissemination processes.

Furthermore, Kong, Cheung and Tsang (2023) posit that creators of AI systems must consider that the advantages of each system must exceed the disadvantages. It can thus be concluded that sustainability should be considered a fundamental principle of AI in education. Yu & Yu (2023) posit that the development of artificial intelligence should, under no circumstances, result in any harm to human beings. Researchers and educators in the field of AI in education should thoroughly examine the implications of integrating AI into teaching and learning, consulting the views of students, especially those who are disadvantaged in education systems compared to the majority (Fu & Weng, 2024).

Fu & Weng (2024) also emphasise that in educational environments, the empowerment of students and teachers is linked to the action and autonomy in the use of AI. It is essential that the educational community not merely integrate AI applications into the educational process; rather, it must transform it in order to

support teachers' pedagogical goals and meet the learning needs of their students (Kotsidis & Anastasiades, 2025). It is therefore incumbent upon educators to be endowed with the requisite knowledge and skills to autonomously determine the application of AI for their own benefit and that of their students, with a view to achieving the expected learning outcomes.

It is essential that teachers at all levels are equipped with a firm grasp of Artificial Intelligence, undergo comprehensive training, and engage in continuous professional development to ensure their efficacy in promoting education (Crompton et al., 2022; Holmes et al., 2023).

Contrary to the hypothesis that the implementation of Artificial Intelligence (AI) results in the elimination of teaching positions, Renz & Vladova (2021) propose that AI systems should be subject to human control as much as possible and that their basis should be human-centred. The objective of these interventions should be to enhance human performance, self-efficacy, creativity, and mastery.

Wang et al. (2023) identify four key areas for teachers to focus on in order to integrate AI into their teaching practice. Firstly, there is the necessity to cultivate cognitive readiness in the functions of AI, its roles in education, and the relationship between AI and educators. Secondly, teachers must be able to integrate AI into learning activities and adapt pedagogical methods to enhance education. Thirdly, there is a need for knowledge about the advantages and disadvantages of AI, as well as the opportunities and challenges it brings to education. Finally, teachers must understand ethics surrounding AI in education and comply with ethical and legal rules.

**Concerns Regarding the Integration of Human-Centred Artificial Intelligence within Educational Contexts**

As posited by Li & Gu (2023), the assessment of risks associated with the implementation of human-centred Artificial Intelligence within educational settings can be facilitated by the consideration of seven pivotal indicators:

1. This paper sets out the argument that the concept of "human-centred Artificial Intelligence" is being misinterpreted.
2. The utilisation of artificial intelligence resources in an inappropriate manner constitutes a form of misuse.

3. The present study explores the discrepancy between the pedagogical approach and the application of artificial intelligence.
4. The potential for unauthorised access to personal data and information is a matter of concern.
5. Lack of transparency
6. The issue of accountability is one that is frequently discussed in academic discourse.
7. The present study explores the phenomenon of risk of bias and perception.

Ryan (2024) has highlighted that the disproportionate emphasis on anthropocentric Artificial Intelligence and its position at the core of technological development has the effect of creating a mechanism that effectively compels individuals to endorse it. Failure to do so often results in individuals being labelled as nihilists or misanthropes. It is important to note that the term 'human-centred Artificial Intelligence' provides a progressive and ethical facade to companies that claim to support it. However, it should be noted that the requirements and specifications for this implementation are minimal, and there is no pressure to prove its use. Furthermore, he considers the assumption that strengthening human control over AI will automatically reduce bias or lead to fairer outcomes to be oversimplified. In this regard, he emphasises that such assumptions ignore the complexities – mainly social – that accompany the use of Artificial Intelligence.

Kubes (2025) contends that in order to achieve fairer AI for all, human-centred AI is insufficient. The text under scrutiny falls significantly short of its stated objectives, as it remains firmly androcentric, thereby reproducing gender hierarchies. Furthermore, she asserts that human-centred Artificial Intelligence does indeed address problems of Artificial Intelligence, such as bias and digital 'colonialism'. However, she contends that it does not focus on other very important challenges, such as the environment and sustainability.

**Discussion and Conclusions**

The present paper employed a literature review as its methodological framework, eschewing the utilisation of AI applications. The search was conducted on Google Scholar, ScienceDirect, ERIC and ResearchGate using the keywords "human-centred

Artificial Intelligence (HCAI)" and "Artificial Intelligence in Education", with a main focus on the period 2018–2025. From the original 142 publications, 43 sources were selected on the basis of relevance, quality, documentation, language and the removal of duplicates. The 43 sources comprised articles, proceedings, books and reports.

Based on the above literature review, the final conclusions could be formulated as follows:

1. In order to ensure that the human-centred dimension of artificial intelligence is taken into consideration, there are a number of factors that must be given full consideration:

- The enhancement of human intelligence, as opposed to its replacement by machines, is a concept that has been explored by Anastasiades et al. (2024).
- In accordance with Shneiderman's (2020) assertion, human involvement is to be expected at both the design and evaluation stages of artificial intelligence applications.
- The objective is to facilitate the general public's understanding of the fundamental functions of AI (Fischer, 2021).

T- he protection of people's personal data is a subject that has been extensively researched (Anastasiades et al., 2024).

2. A review of the extant literature was conducted for the purpose of identifying the characteristics that potentially highlight the human-centred dimension of artificial intelligence. The following classification was arrived at:

- User participation in the design process (Dignum, 2019):

It is crucial that users be engaged in the process of determining the objectives, functionalities and limitations of AI applications through collaborative design and continuous feedback. This approach ensures that the applications are aligned with the genuine requirements of users, facilitating optimal adaptation and utility.

- Understanding human values (Schmager, Pappas & Vassilakopoulou, 2025).

It is essential that AI applications not operate neutrally; rather, they should be designed to take into account the rights, needs, ethical principles, and particularities of users. This approach will ensure that AI applications align as closely as possible with the value framework of society. (Anastasiades et al., 2024).

- Transparency, accountability, sustainability and fairness (Dignum, 2019; Tahaei et al, 2023).

Transparency facilitates comprehension of the algorithmic decisions made by the application. Accountability determines the entity responsible for the application's outcomes. Fairness and sustainability ensure equal treatment and respect for present and future generations, thereby enabling the integration of AI into a framework of ethical, social and environmental responsibility (Anastasiades et al., 2024).

3. The development of relevant AI applications in education, as well as human-centred design in this field, must take into consideration the following:

- The provision of services to the population and the promotion of human well-being (Anastasiades et al., 2024) is conducive to the enhancement of autonomy, justice and active human participation in decision-making.

- It is essential that the governance of these systems be underpinned by a set of principles that emphasise responsibility and ethical use. This entails ensuring transparency, accountability, the protection of personal data (Anastasiades et al., 2024), the avoidance of algorithmic bias, and the clear allocation of responsibility for the consequences of decisions made by these systems.

- It is vital to ensure meaningful human oversight. To this end, it is essential to give humans the ability to understand how the system works, control its decisions, and change them, when necessary, based on their needs (Shneiderman, 2020).

- It is vital to provide support for the cultivation of critical thinking and thought processes in people (Anastasiades et al., 2024; Fischer, 2021).

4. The utilisation of AI applications in pedagogical contexts must be founded on pedagogical principles, human values, transparency, and the empowerment of the role of the educator (Li & Gu, 2023).

The following key pillars have been identified:

- The present paper sets out the argument that, in the field of education, the pedagogical orientation of AI: NT should not only aim to improve student performance, but, under certain pedagogical conditions, can contribute significantly to improving the overall learning experience and enhancing students' emotional engagement (Zawacki-Richter et al., 2019; Yang, 2021).

- The role of Information Technology (IT) in education is not one of replacement of the teacher, but rather of support. IT can play a supportive role in the following ways: firstly, by strengthening the teacher's role in making pedagogical decisions; secondly, by differentiating teaching; and thirdly, by providing targeted support to students based on their learning needs (Anastasiades et al, 2024).

- The following discussion will address the concepts of personalisation and self-regulated learning. The utilisation of Smart Learning Analytics facilitates the provision of personalised feedback, the identification of learning gaps, and the enhancement of student self-regulation (Yang, 2021).

- Inclusion in the learning process is of paramount importance. It is essential that AI applications be designed to recognise diversity, avoid the propagation of stereotypes, and function as mechanisms to overcome educational inequalities, with a particular focus on providing support to those who are disadvantaged (Fu & Weng, 2024).

- The present study explores the concept of transparency and data protection in the context of educational practice. The collection and use of educational data should be transparent, with absolute protection of personal data and clear information for students, teachers and parents (Anastasiades et al, 2024; Li & Gu, 2023).

- It is essential to acknowledge the necessity for pedagogical preparation in the domain of artificial intelligence. The pedagogical utilisation of AI applications necessitates the deployment of pedagogically trained teachers who can employ AI applications in a critical and autonomous manner. It is essential to prioritise the dissemination of information to the educational community, with the objective of enhancing awareness among teaching professionals and providing them with comprehensive training. This initiative aims to shape a novel, transformative pedagogical framework for the integration of AI in educational settings (Anastasiades et al., 2024; Klimova et al., 2023).

- It is evident that there is a necessity to establish a pedagogical framework that fosters collaborative exploration and knowledge construction, nurtures critical thinking, and fosters creativity among students and educators (Anastasiades et al., 2024; Kotsidis & Anastasiades, 2025).

5. The challenges identified in relation to the use of AI could be summarised as follows:

- Lack of transparency and accountability (Li & Gu, 2023),

- The issue of data security has been a subject of much debate in recent years (Li & Gu, 2023),
- the potential for bias in applications (Ryan 2024)
- and finally, it should be noted that technology companies are exploiting the concept without demonstrating any genuine commitment to the values they profess to uphold (Kubes, 2025).

6. Future research: The development of a holistic pedagogical framework that highlights and supports the above characteristics is vital to ensuring the human-centred dimension of NT in society and education. The establishment of such a framework is essential for the enhancement of the educational process, thereby ensuring that the pedagogical utilisation of NT applications aligns with the instructional objectives of educators, contingent upon the requirements of their students.

**Declaration of AI Use**

- The authors declare that generative artificial intelligence tools (DeepL Translator & DeepL Write) were used exclusively for language translation and editorial refinement of the manuscript.
- The AI system did not contribute to the conceptualization of the study, research design, methodology, data collection, data analysis, theoretical framing, interpretation of findings, or formulation of conclusions.
- All substantive intellectual contributions were performed solely by the authors. The authors have critically reviewed, validated, and approved the final version of the manuscript and assume full responsibility for its accuracy, integrity, and scientific content.

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