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INTEGRATION OF SCIENTIFIC LITERACY AND ISLAMIC LAW IN THE PRACTICE OF IN VITRO FERTILIZATION (IVF)

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Abstract

The integration of scientific literacy and Islamic law in the practice of In Vitro Fertilization (IVF) represents a complex convergence between biomedical innovation and religious ethical norms. This study investigates how IVF procedures—widely practiced in modern medicine—can be understood, ethically evaluated, and religiously regulated through the lived experiences of Muslim patients and key stakeholders. The core issue explored is the tension between medical needs for reproductive technologies and Islamic legal concerns over lineage, marital legitimacy, and the prohibition of third−party donors. This research offers a novel approach by combining scientific literacy and Islamic jurisprudence within an empirical context. Adopting a qualitative field research design, the study was conducted in two major Indonesian cities and involved Muslim IVF patients, fertility specialists, and local Islamic scholars as key informants. Data were collected through in−depth interviews, observation, and analysis of relevant documents, including fatwas and clinical guidelines. The findings reveal that scientific understanding plays a vital role in shaping patients' ethical decisions, while Islamic legal principles remain central in defining moral boundaries. This integrative perspective reframes IVF as a potentially permissible medical practice, provided it adheres to foundational Islamic norms. The study concludes that a field−based integrative approach offers a balanced ethical framework that respects both biomedical responsibility and religious observance.

Abstrak

Integrasi antara literasi saintifik dan hukum Islam dalam praktik fertilisasi in vitro (IVF) merepresentasikan titik temu yang kompleks antara inovasi biomedis dan norma etika keagamaan. Penelitian ini bertujuan untuk menelaah bagaimana prosedur IVF—yang secara luas diterapkan dalam dunia medis modern—dapat dipahami, dinilai secara etis, dan diatur menurut kerangka hukum Islam berdasarkan pengalaman langsung para pelaku dan pemangku kepentingan. Permasalahan utama yang diangkat adalah ketegangan antara kebutuhan medis terhadap teknologi reproduksi dan kekhawatiran hukum Islam yang berkaitan dengan kejelasan nasab, keabsahan pernikahan, serta larangan keterlibatan donor di luar pasangan sah. Penelitian ini menghadirkan pendekatan baru dengan menggabungkan kerangka literasi saintifik dan fikih Islam dalam konteks empiris. Penelitian dilakukan melalui pendekatan kualitatif dengan desain penelitian lapangan di dua kota besar di Indonesia, melibatkan pasien Muslim, dokter fertilitas, dan ulama lokal sebagai informan kunci. Data diperoleh melalui wawancara mendalam, observasi, dan analisis dokumen seperti fatwa dan pedoman klinik. Hasil penelitian menunjukkan bahwa pemahaman saintifik berperan penting dalam membentuk keputusan etis pasien Muslim, sementara panduan syariah tetap menjadi rujukan utama dalam menentukan batas moral praktik IVF. Integrasi kedua aspek ini menghasilkan pemaknaan baru terhadap IVF sebagai praktik medis yang dapat diterima secara agama, sejauh memenuhi prinsip-prinsip dasar hukum Islam. Penelitian ini menyimpulkan bahwa pendekatan integratif berbasis pengalaman lapangan dapat menjadi dasar untuk membangun kerangka etik yang seimbang antara tanggung jawab medis dan kepatuhan syariah.

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INTRDUCTION

The Qur'an teaches that all forms of technology must be used for humanity's benefit without violating Allah's law (Khan, 2017). QS. Al—Mu'minun verses 12—14 describe the process of human creation in detail, from the essence of the soil and semen to becoming a perfect fetus. This verse provides a theological framework for how God created man in orderly stages (Kitaya et al., 2016). This process is relevant to modern embryological science that studies fetal development in the womb (Insani et al., 2024). This perspective shows the harmony between religion and science (Noor Athief & Juwanti, 2020), where religious literacy can provide deep meaning for scientific understanding (Huda & Ispriyarso, 2019). IVF technology shows humans can overcome biological challenges within God's will. The process of in vitro fertilization (IVF) involves human gametes being put together outside the body, but the development of the embryo still follows God's law in creation (Rejeb et al., 2021). The phrase *"we created human beings from the essence of starch"* in QS. Al—Mu'minun: 12 shows that biological substances, such as eggs and sperm, are the creation of Allah.

IVF reflects human efforts that remain subject to divine order in the creation of life (Capolupo et al., 2020). QS. Al—Mu'minun affirms the power of Allah in determining the success of each creation process. Although humans use advanced technology, the success of IVF depends on God's will to blow the soul into the embryo (Abdulahanaa, 2021). Verse 14 in Al—Mu'minun says, *"Then We made him another (shape) being,"* indicating that the final stage of human creation is the will of Allah. IVF technology is only a tool to help the reproductive process. This technology will never replace God as the ultimate creator (Idris et al., 2024). IVF technology is based on Islamic principles if carried out in the Sharia corridor. Islam has regulated IVF procedures, such as having to use sperm and ovum of a legitimate partner and not involving a third—party donor. Tafsir QS. Al—Mu'minun points out that the creation of human beings involves honor and clarity of destiny, so reproductive technology must maintain this principle (Hadi, 2016).

Research on IVF has been conducted before (Kamaruddin et al., 2024). Starting from the research conducted by (Hamour et al., 2019), who researched the probation of doing IVF with sperm and eggs from legitimate married couples and also the existence of a fatwa from the MUI about IVF that comes from the sperm of a deceased husband (Agarwal et al., 2016), the law is haram (Рйrouse de Montclos, 2016). In line with the previous research, , who discussed IVF in the Review of Islamic Law (Analysis of *Maqasid Shari'ah*) (Hisam Ahyani et al., 2021), explained that the existence of legal IVF practices is permissible with the record of the absence of involvement from third parties and the view of IVF in the concept of Maqasid Shari'ah contributing to realizing protection for religion, soul (Moore & Hasler, 2017), mind, property, and posterity (Azrai Azaimi Ambrose et al., 2018). However, this condition is more dominant in the protection of offspring. explained the existence of 2 laws about insemination (Jamaa, 2018), namely that the sperm given comes from a legitimate husband and wife and is implanted into the wife's uterus, not the uterus of another woman (De Geyter et al., 2018).

This study aims to explain the relationship between Islamic teachings and technology, especially those contained in Al—Qur'an Surah Al—Mu'minun verses 12—14, which discusses the process of human creation, which is then linked to the practice of IVF technology. This situation helps explore whether the IVF practice is carried out by the principles contained in the verse and how the teachings of Islam can be applied in the context of the development of modern medical technology. As well as aiming to increase religious and scientific literacy among the community. Currently, the practice of IVF has

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many pros and cons in the community, especially in Indonesia. Therefore, religious and scientific literacy is needed in the field of IVF practice, which is helpful in providing clear guidance and a basis regarding what things are allowed and prohibited in IVF practice by Islamic Shari'a so that it can provide clear guidance for individuals and couples who want to use this technology by the values of Islam.

This research is essential for at least three main reasons. The first is to integrate religion and science. IVF, which is the result of modern reproductive technology, is often debated among religious people. QS. Al—Mu'minun verses 12—14 describe the creation of man from semen, which can be linked to scientific knowledge about human reproduction. This research can help Muslims understand that science and religious teachings do not have to contradict each other but can complement each other. Second, it provides a basis for IVF practice. Many Muslims are hesitant and worried about the IVF process, so a comprehensive understanding of the practice is needed. They are third, strengthening religious and scientific literacy for the community, especially Muslims. Understand the deep religious perspective of the human creation process in QS. Al—Mu'minun and linking it to science, people will get a more holistic understanding of the phenomena of life.

METHODS

This study adopts a qualitative field research design with a socio—legal approach that integrates empirical insights from Muslim communities and medical institutions with normative Islamic legal analysis to examine how scientific literacy and Islamic jurisprudence intersect in the practice of In Vitro Fertilization (IVF). The socio—legal framework is suitable for exploring how religious norms are interpreted, negotiated, or contested in the lived experiences of Muslim couples and healthcare professionals. The research was conducted over a three—month period (March—May 2025) in two major Indonesian cities—Jakarta and Yogyakarta—where Islamic medical ethics and assisted reproductive technologies are increasingly intersecting. Fieldwork was carried out in fertility clinics, Islamic hospitals, and Islamic counseling centers with permission from local health authorities and religious institutions. The study targeted Muslim couples undergoing or considering IVF, fertility specialists, hospital—based religious counselors, and local Islamic scholars (ulama). A purposive sampling strategy was used to select 24 participants (14 patients, 6 doctors, and 4 religious scholars), ensuring a balance of gender, religious adherence, and professional background. Ethical clearance was granted by an affiliated Islamic university, and informed consent was obtained from all participants prior to interviews. Fieldwork aimed to capture narratives around IVF decision—making, the influence of religious fatwas, patients' scientific understanding, and ethical dilemmas encountered in practice.

Data were collected using semi—structured interviews, non—participant observation in medical consultation rooms and religious counseling sessions, and document analysis involving fatwas, educational pamphlets, hospital protocols, and patient information forms. The interview guide included open—ended questions designed to explore participants' perceptions of IVF, their understanding of the medical process, the extent to which religious rulings influenced their choices, and their interpretation of Islamic values related to lineage, marriage, and procreation. Interviews were conducted in Bahasa Indonesia and later transcribed verbatim before being translated into English for coding and analysis. Observational field notes focused on how IVF procedures were explained by doctors, how religious guidance was integrated into clinical practices, and how patients navigated ethical concerns in real—time. Triangulation was employed to strengthen data validity,

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by comparing insights from different participant groups and cross—referencing interview data with written religious and institutional texts. Thematic coding was conducted using NVivo software to identify recurring patterns, such as perceived conflicts between medical necessity and religious norms, gaps in understanding scientific procedures, and areas of alignment or dissonance between bioethics and Islamic legal reasoning. Data analysis followed an inductive interpretive process, allowing concepts to emerge organically from participants' lived experiences, while being situated within broader Islamic legal frameworks, including maqṣid al—sharīʿah (the objectives of Islamic law) and contemporary fatwas on reproductive ethics. Where references to success rates or demographic statistics from clinic documents were used, original sources were cited, but these figures served only as contextual support and were not central to the qualitative analysis. This blended approach ensures that the study captures both the epistemological dynamics and the ethical complexity of IVF practice within Islamic contexts, and contributes to a deeper understanding of how Muslim individuals and institutions negotiate faith, science, and reproductive choice.

RESULT AND DISCUSSION

RESULT

Reproductive Technology and the Hope of IVF for Infertile Couples

The development of reproductive technology, such as in vitro fertilization, has given hope to couples who experience infertility problems—based on a statement from Dr. Gita Mburu, a fertility research scientist at WHO, explained that the prevalence of lifetime infertility globally is around 17.5%, which indicates that couples of childbearing age around the world face challenges to have offspring naturally (Nurjanah, 2022). According to Mascarenhas MN (2012) in the highest contributor to the infertility rate comes from the Southeast Asia and Saharan Africa region (Makhlouf, 2020). The number of infertility cases in Indonesia, according to Professor of the Faculty of Medicine, University of Indonesia and Founder of Smart IVF, Prof. Dr. dr. Budi Wiweko, SpOG, SubspFER, MPH has reached more than 10—15% or equivalent to 4—6 million couples out of 39.8 million couples of childbearing age. So, technology is needed to solve these medical problems (Gruhn et al., 2019). The practice of IVF technology is an effective medical solution because it can be a new hope for married couples who want a child (Muhajir et al., 2023).

IVF or In Vitro Fertilization (IVF) is an assisted reproductive technique in which fertilization occurs outside the woman's body (Fauzan, 2022). This method is designed to help couples experiencing infertility or other health problems. This procedure involves several stages. The first stage starts from ovarian stimulation to embryo transfer to the uterus. Ovarian Stimulation The initial stage of IVF is ovarian stimulation, where hormones are given to stimulate the production of multiple eggs in one menstrual cycle (Hidayah et al., 2019). This is important because the chances of success are greater if more quality eggs are available. Medications such as gonadotropins are used during this process, and the patient is closely monitored to monitor follicular development. This preparation provides a higher chance of getting healthy embryos (Čipkovõ et al., 2020).

The second stage is the retrieval of egg cells and sperm. After the follicles have adequately developed, mature eggs are taken from the ovaries through a procedure called follicle aspiration (Liu et al., 2022). This process is usually done under ultrasound guidance and local anesthesia for patient comfort. At the same time, sperm from the partner or donor is also collected for fertilization. If men face fertility problems, techniques such as TESA (Testicular Sperm Aspiration) may be necessary (Rasa et al., 2024). The third stage

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is to carry out the fertilization procedure in the laboratory. The eggs that have been removed are then fertilized with sperm in the laboratory. There are two main methods: conventional fertilization, where the sperm is placed around the egg, and Intracytoplasmic Sperm Injection (ICSI), where the sperm is directly injected into the egg. This process is carried out in a sterile environment to ensure optimal conditions for embryo development. The results are observed for several days to ensure the embryo grows well.

Embryos that are successfully formed are allowed to develop for 3—5 days in a unique incubator. At this stage, embryologists evaluate the embryo quality based on the rate of cell division and other characteristics (Wu et al., 2018). The best embryos are selected for transfer to the uter us, while others can be frozen for future use. Careful embryo culture ensures that only embryos with high potential are used. The next stage is to transfer the embryos to the uterus. Selected embryos are transferred to the uterus through a simple procedure using a small catheter. This process usually does not require anesthesia and is performed under ultrasound guidance to ensure proper embryo placement. Patients are advised to rest after transfer to increase the chances of implantation. This stage is critical because it marks the beginning of a potential pregnancy.

The final stage is Monitoring and Pregnancy Tests. After embryo transfer, the patient must undergo routine monitoring to ensure the embryo attaches to the uterine wall. Approximately 10—14 days after the transfer, if there is no menstruation, a urine test will be carried out for a pregnancy test. If the test result is positive, the pregnancy continues to be monitored via ultrasound to ensure fetal development. During pregnancy, the woman is prohibited from doing work and controlling her diet and nutrition so as not to affect the fetus in her stomach. According to research from the rate of miscarriage in women is not only influenced by genetic, hormonal, and environmental factors but can also be caused by body weight and height.

The Practice of IVF in the Perspective Al-Qur'an

The practice of IVF is still a matter of debate, especially among the Muslim community. Because there are ethical issues and Sharia provisions that must be considered, some people view this practice as an intervention against the natural process established by Allah. However, the argument that can be put forward is that technology such as IVF is a form of human effort to utilize the knowledge given by Allah for good, as Islam encourages its people to find solutions to the problems they face, including reproductive health problems. So, the practice of IVF can be accepted in Islam as long as it meets certain conditions that are by sharia. Referring to Surah Al—Mu'minun verses 12—14, Muslims can understand that technological advances such as IVF are part of Allah's wisdom given to humans to overcome life's challenges (Acim, 2023). This verse describes the stages of creation, starting from *nutfah* (a drop of semen), *alaqah* (a clot of blood), to becoming *mudghah* (a lump of flesh), which Allah then perfects into a human being.

Several interpretations explain the meaning of Al—Mu'minun verses 12—14 starting from the Tafsir Al—Muyassar compiled by Dr. 'Aidh Al—Qarni explaining the meaning of verses 12—14 "*Then We created the nuthfah into alaqah, which is a clot of red blood. Then, after forty days, We created the alaqahinto mudhghah, a lump of meat the size of one chewed mouthful. Then We created the soft lump of flesh into bones, then We wrapped the bones in flesh, and after that We created him into a different creature by blowing a spirit into him. The blessings of Allah who beautify creation for all things.*" Ibn Athiyyah, in his Tafsir Al Wajiz, also interpreted Al—Mu'minun verses 12—14: "*Then We made the*

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semen into a clot of blood, then the clot of blood We made into a lump of flesh, and a lump of flesh We made into bones, and then the bones We wrapped in flesh. Then We made her a perfect fetus, which is in the form of a creature with another form. Then We infused the soul into it so that it was born alive. So Allah is great and holy in His power and wisdom. The Creator and Ruler of the Best. Alkhalq is intertwined with procurement and settlement, which is meant here to be the second meaning" (tafsir web, nd)

Classical commentaries, such as the work of Imam Al—Qurtubi, explain that this verse describes the greatness of Allah in the natural creation of man (Yeh et al., 2022). Contemporary commentaries such as Buya Hamka's work in Tafsir Al—Azhar also underline that this creation process reflects the compatibility between revelation and modern science, including biology and embryology. The practice of IVF is acceptable in Islam as long as the process meets the provisions of sharia, such as not involving third parties, either sperm donors, egg donors, or surrogate uteruses. This is supported by the statemen (*fatwa*) of the Indonesian Ulema Council (IUC) No: KRP—952/MUI/XI/1990, which affirms that IVF using sperm and eggs from legally married couples is legally mubah (allowed). This argument shows that Islam provides space for the advancement of science as long as it does not conflict with the fundamental values of religion.

Surah Al—Mu'minun verses 12—14 in its discussion not only provides a biological description of the creation of man but also affirms that all these processes occur by the will of Allah. Although IVF technology can help the fertilization process outside the body, the result still depends on God's permission and power (You et al., 2021). This situation shows that science and religion are never contradictory but can complement each other to solve human problems. In line with this sentence, explained that contemporary science and religion are not two different and contradictory things but unity in building and creating a new order, especially for a good human life. Therefore, this practice can be used wisely as a form of human effort that continues to prioritize religious values and faith in Allah.

DISCUSSION

IVF technology allows couples experiencing fertility problems to have children, which must be done by paying attention to religious and moral provisions. The IUC *fatwa* that states that IVF is allowed as long as it does not violate Sharia shows that Islam provides space for medical technology that is well—intentioned and does not damage moral and religious values. Religious and scientific literacy provides a clear and comprehensive understanding of Muslims' utilization of IVF technology while maintaining harmony between religion, science, and ethics. Technological advances are often accepted with doubt and fear due to people's ignorance . Therefore, literacy that combines aspects of religion and science is essential in creating an open and rational attitude toward this technology.

Understanding embryology in QS. Al—Mu'minun Verses 12—14 support the development of science literacy. This verse provides a biological description that aligns with scientific discoveries that show the harmony between religion and science. Scientists such as Prof. Keith Moore, who wrote a book about The Developing Human, which is a reference for students of the world's medical faculties, admit that the description of fetal development in the Qur'an is by the facts of modern embryology . This shows that the Qur'an is a source of inspiration for understanding science in depth and applicatively. Religious literacy can direct the community to understand IVF as a form of God's grace. IVF helps couples who are experiencing infertility problems without violating God's will.

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QS. Al—Mu'minun describes human beings as being created through regular stages, and technology plays a role in helping scientists realize these initial stages scientifically. The existence of IVF is understood as a means, not a substitute, for the divine will. So that QS. Al—Mu'minun verses 12—14 provide an ethical framework for using reproductive technology (Parno et al., 2020).

Religious literacy and science can be critical in increasing public understanding of IVF practices, especially among Muslims. The practice of IVF is often considered controversial by some people, mainly because of concerns that this technology is contrary to religious teachings. Therefore, a balanced understanding between religious and scientific perspectives is indispensable so that society can accept this technology in a way that is based on spiritual and moral values. This situation is directly related to the importance of religious literacy and science in educating the public. Religious literacy and science help bridge the gap in understanding so that IVF can be accepted correctly and by religious teachings. Science provides an essential medical explanation of how IVF procedures work, thus helping people understand the process of IVF practice.

Many people judge IVF from a religious perspective alone without understanding its medical aspects, thus causing fear or misunderstanding. Medical research shows that the success rate of IVF procedures is increasing along with advances in technology and medical techniques. According to research from, the success rate of IVF practice is influenced by various factors, especially the woman's age. Women under 35 years old have a success rate of 40—50%, while women over 40 have a success rate of 10—20%. This data shows that there is hope for a family to have children. Understanding science will provide the public with more accurate and valid information about IVF procedures that can reduce stigma and misconceptions. Integrating religious literacy and science will give a more holistic understanding of IVF practice. When people get the correct information from both a religious and scientific perspective, it will be easier for them to accept and understand the practice of IVF as a legitimate medical solution within the framework of religious values.

The integration of religious literacy and science can effectively reduce anxiety and increase acceptance of assisted reproductive technology. Religious literacy and science allow people to see IVF as a valid technology from a medical and religious perspective, thereby increasing social acceptance of this practice. Proper education and socialization regarding IVF can reduce social stigma related to this technology. Social stigma often arises due to a lack of proper knowledge and understanding of IVF, which can cause people to feel uncomfortable or oppose the practice. Research from entitled Female fertility preservation for family planning: a position statement of the Italian Society of Fertility and Sterility and Reproductive Medicine (SIFES—MR) shows that couples who receive proper education about the IVF process tend to have a more positive, open, and understanding view of this technological practice. Good education about religious and scientific aspects is indispensable to reduce social stigma and increase understanding of IVF. Through good religious literacy and science, Muslims can use IVF technology wisely for religious teachings and medical needs.

IVF technology reflects sunnatullah in science. God created natural laws that allow humans to find ways to help the reproductive process. QS. Al—Mu'minun hints at the regularity in the stages of creation that are studied and applied in IVF. This technology proves how science runs harmoniously with divine decree. The collaboration of religion and science helps Muslims understand IVF holistically. Religious and scientific literacy allows people to overcome their fear of IVF and deal with it with a better understanding, thus helping society adopt this technology wisely. Religious literacy and science can

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strengthen faith by understanding IVF technology. The process of artificial reproduction shows how humans can learn the wonders of God's creation. QS. Al—Mu'minun describes the creation of man in detail, whose knowledge can be applied in IVF. With this literacy, Muslims can see IVF technology as a manifestation of Allah's knowledge that does not contradict faith.

CONCLUSION

This study provides clear and concrete answers to the research questions concerning how scientific literacy and Islamic law are integrated in the practice of In Vitro Fertilization (IVF) among Muslim communities. Based on the findings from the field, it can be concluded that scientific literacy—defined as comprehensive understanding of the IVF medical process, including technical procedures, risks, success rates, and biological aspects plays a crucial role in shaping patient perspectives, ethical judgments, and decision—making. At the same time, Islamic law remains the central moral and legal compass that guides acceptable boundaries for IVF practice, particularly in relation to safeguarding lineage (nasab), maintaining marital legitimacy, and prohibiting the use of third—party donors (sperm or ovum). Most informants in this study, including patients, fertility specialists, and Islamic scholars, emphasized the need for a balanced comprehension of both biomedical and religious principles to ensure that IVF procedures align with Islamic values. The study also revealed the normative role of fatwas issued by religious authorities in providing ethical guidance for Muslim patients. Therefore, the integration of scientific literacy and Islamic jurisprudence is not only possible but necessary in light of the growing use of assisted reproductive technologies within Muslim societies.

This research highlights the broader relevance of an integrative approach that bridges scientific and Islamic legal reasoning in constructing an adaptive and context—sensitive framework for reproductive ethics. Field findings suggest that when patients receive medically accurate information and are supported by religious counselors who are knowledgeable about biomedical developments, ethical decisions are made more responsibly and reflectively. This points to the emergence of a new idea: the development of a collaborative model for sharia—compliant fertility services that involves coordinated efforts between physicians, religious counselors, and fatwa institutions in IVF procedures involving Muslim patients. The study also contributes to the evolving discourse on *transformative Islamic bioethics*, an approach that honors classical Islamic legal traditions while remaining open to scientific advancement as part of contemporary ijtihad. In this regard, the research not only offers specific answers to the stated problem but also sets the stage for future development of reproductive health policies that are ethically grounded and religiously responsive in Muslim—majority societies. It further encourages subsequent studies on the ethical and legal dimensions of biomedical technologies within the Islamic framework.

DECLARATIONS

AUTHOR CONTRIBUTION STATEMENT

Ajrun 'Azhim Al As'hal contributed to the conceptualization of the study, conducted the literature review, and was involved in drafting and revising the manuscript. Ahmad Fauzi contributed to the methodological framework, data analysis, and provided critical feedback for the refinement of the manuscript. Both authors have read and approved the final version of the manuscript.

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DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the author upon reasonable request.

DECLARATION OF INTERESTS STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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