© JUN 2026 | IRE Journals | Volume 9 Issue 12 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I12-1719055

Artificial Intelligence–Driven Decision Support Systems for Understanding and Managing the Psychological Burden of Childlessness in Clinical Settings

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Abstract- ***Childlessness has been recognized to be associated with important psychological distress, depression, anxiety, stigma and grief. Within the context of the clinical settings, identification and management of this psychological burden has been a challenging situation because of multifaceted, subjective and the depth of personal nature of the experiences. Artificial intelligence driven decision support systems have become innovative technologies that can enhance clinical evaluation and intervention through the integration and analysis of difficult psychological, behavioral and clinical data. Therefore, the study explored the potential of artificial intelligence powered decision support systems in understanding and evaluating the psychological burden of childlessness, showing the potential to support early detections of emotional trauma, personalized psychological care as well as improving clinical decision making. Its applications as algorithms and data driven analytics to capture psychological trends, which are usually overlooked in the conventional evaluation methods. Furthermore, the ethical and clinical as well as the implementation challenges with the inclusion of data privacy, bias in algorithms, interpretability were adequately mentioned. Through responsible design and multifaceted collaboration, this review highlights the potential of artificial intelligence driven decision support systems.***

Keywords: Artificial Intelligence, Decision Support System, Clinicals, Childlessness, Psychological Burden

I. INTRODUCTION

Childlessness has become a common event that usually affects homes globally. Studies have revealed that it has a critical effect on spouses. Some have viewed these effects as stigmatized reproductive health morbidity as well as public problems. The psychological effect of childlessness cannot be overemphasized [1]. Some studies mentioned that the cases of infertility all over the world are around 9%. High significance is placed on children and childbearing; this is a source of pride as well as economic support to the family [2]. Childlessness has also become a sociocultural problem which mainly affect women, making them lose their self-esteem [3]. In the same way, it affects male spouses who are unable to impregnant a woman, such a man is known to be unfit which further increase the burden of childlessness. In fact, the burden of childlessness as well as the trauma experienced by women is likened to the suffer from cancer [4]. The American Childlessness Association views childlessness as having a significant impact on marriages, placing a greater burden on couples than many other life situations. [5]. For some studies, it was mentioned that it is accompanied by depression, guilt, social isolations, anxiety and reduced self-esteem for both genders [6-8]. It was problematized that parenthood remains a natural aspect of life, while childbearing represents a significant biological process, which prevents society from being wiped out [9]. The inability to give birth to children reduces the self-esteem of spouses [10]. Childlessness has negative impact on society since healthy homes bring healthy environments, thus, people that are not balanced in any way cannot bring any meaningful progress [11-12]. It results in social stigma which may bring about different negative outcomes and hampers the sanity and quality of life of those involved [13-14]. Childlessness becomes unbearable due to the lack of adequate support in poor places especially Nigeria [15]. However, in developed countries for instance, they have adequate groups, which supply expert knowledge, social support and the therapy for childless couples [16]. Thus, the services help to restore their potential for social functioning and

become integrated easily into society [17-19]. Africa does not have established support systems to aid the social and psychological effects of childlessness and infertility on affected couples [20]. This is one reason why the continent is considered to have low development despite its high population and high infertility rates. [21]. While medical interventions offer support, their high costs can exacerbate the emotional burden, anxiety, and grief of infertile couples, resulting in helplessness and hopelessness, particularly in countries such as Nigeria. [22-26]. The medical treatment of infertility has several side effects on couples [27]. It is essential to assess the psychological impact of childlessness within clinical settings, with the aim of creating an environment that supports affected couples and promotes their social integration. [28]. Childlessness may be attributed to underlying organic factors, even in the absence of observable physical symptoms. Psychological burden could also result. Mental pressure or stress sends signal to the body implying that the body is not available for pregnancy [29-30]. This may lead individuals to perceive themselves as personally responsible for their inability to conceive, potentially fostering self-doubt in both men and women [31-32].

II. PSYCHOLOGICAL BURDEN OF CHILDLESSNESS

The inability to conceive by women has been regarded as a stressful situation among couples in the global environment. The impact is quite heavy, which includes societal challenges as well as personal suffering. Development in assisted reproductive technologies like IVF can provide hope for couples where treatment is needed. However, there are existing barriers when it comes to medical aspect and its affordability [33]. Studies have shown that there is emerging relationship between stress of fertility treatment and both patient dropout rates and pregnancy outcomes. Psychological solutions, especially those that emphasize stress management and the method of coping have been established to have some advantages for couples experiencing infertility [34].

Several couples experience emotional burden due to inability to conceive, infertility is typically diagnosed after one year of focused attempts to conceive for women under 35 years of age, after six months for women aged 35 or older, or in cases with a repeated history of miscarriages. For some couples, the inability is recognized to be an inherent problem in the female spouse [35]. These notions are derived from stories and mythologies that have been passed down over millennia.

Therefore, demand for infertility treatment is on the increase worldwide. For instance, in the US, about 1.3 million spouses receive medical counsel or treatment for infertility annually. Out of this group seeking infertility services, 85 to 95% of the cases of infertility are treated using conventional infertility methods like medication or surgery. Only about 3% receive invasive procedures like IVF. Also, 50% of the couple seeking this treatment bears children, the other 50% have different failed results that could lead to critical conditions. In general, the main information and available support to couples are medical and technical solutions in terms of consultation and treatment [36]. Stigma is perceived to be a psychological burden of childlessness, which is experienced by about 5 million United States spouses [37]. Current technological solutions have brought different medical solutions for those that are infertile and can financially afford them. For those who are infertile especially the women, the intervention changes the infertility from private pain to the public, which could be a prolonged issue. Therefore, the study explored 25 US women that sought medical solutions for infertility and understand their perception of stigma that are related to infertility or childlessness.

In a particular region in India, parenthood, especially the birth of sons comes with emotional, economic and social advantages. However, daughters offer limited advantages to parents when it comes to economic and instrumental support because of practices like patrilocal exogamy, the system of dowry and reduced rates of female workforce participation. Thus, those that are childless usually face stigma and receive support from intergeneration. Based on this context, the insufficiency of research on how childlessness and the composition of gender

affect the wellbeing in later life has not been fully established [38].

Therefore, deploying data from about 59,070 men and women from the national representatives longitudinal ageing research in India and using the life course perspective, the study examined the relationship between childlessness and the composition of gender in terms of children having depressive symptoms, dissatisfaction of life and self-rated health. The outcome shows that childlessness is related to higher depression with symptoms among men and women in mid and late adulthood. Also, not having male children was linked to higher symptoms of depression and dissatisfaction of life among women in mid and later adulthood and to poorer self-rated health in later life for both genders.

Having daughters involve dowry expenses which may result in fertility expectations not met, this can lead to strain in household resources and increase parental burden. In some regions, daughters can maintain strong ties and furnish emotional support. However, in some qualitative research from the same region, daughter aversion is due to demand in dowry compared to the son's preference which drives the skew ratios. Status of employment also mediates the relationship. Parents that do not have family economy may be compelled to be economically stable to maintain financial autonomy which can increase against the stress of reduced kin-based support. Also, expected financial strain coming from childlessness support networks can increase depressive symptoms and lower life satisfaction. These route shows how relational and material dimensions link family composition to subjective wellbeing across gender life course in India [39-40].

Reproductive challenges frequently lead to emotional burden, social exclusion and suicidal thoughts. While suicide is connected to infertility, impotence accounts for a small fraction of total suicides. They represent critical and under recognized cause of death. Therefore, a study focused on conceptual and policy related articles which adopt interdisciplinary patterns that integrate psychological theories, policy analysis and demographic pattern examination. It focused on data from the accidental deaths and suicides in India which was reported between 2014 to 2022 by the national crime record that focused mainly on suicides in which infertility and impotence are known to be contributing factors [41].

The outcome of the analyses revealed that suicides are connected to infertility and impotence, however, few numerically, it remained consistent across the years and has not been addressed adequately. Young women between the ages of 18 and 29 years are vulnerable because of early reproductive expectation while men between the ages of 30 to 44 experienced delay psychological burden connected to masculine identity and that of reproductive failure. Rural areas, cast identity and limited access to mental health treatment increased the suffering. Therefore, infertility related suicides call for the attention of the public, thus, there is a need to advocate for gender sensitivity, culturally informed mental health service that is integrated within the reproductive healthcare system and a call for stigma reduction. Policy reforms as well as inclusive reproductive rights structure to be established in India.

Recently, more studies revealed that the psychological burden of childlessness is enormous and there is failure on the part of the health care system to recognize and handle this burden. For example, it was established that analyses which includes the sexual and reproductive healthcare involving qualitative research of about 503 women, involve three fundamental themes identified; this involve a sense of reproductive trauma personally and it is associated with infertility and with invitro fertilization, infertility impact on relationship, and the perception of being failed by the health care system and the society. Furthermore, the infertility as well as the IVF process resulted in conflict in relationship or enabled the couple to grow stronger. In the same vein, relationships with people and family members were strained because of isolation and feeling stigmatized as well as not understood. Also, the healthcare system as well as the healthcare providers do not have adequate support, care and the women felt dehumanized and failed by the healthcare systems [42].

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III. ARTIFICIAL INTELLIGENCE–DRIVEN DECISION SUPPORT SYSTEMS FOR MANAGING THE PSYCHOLOGICAL BURDEN OF CHILDLESSNESS IN CLINICAL SETTINGS

Artificial intelligence powered decision support system is currently emerging as a significant tool in the clinical environment and specifically in managing the psychological burden, emotional distress and trauma related with infertility and involuntary childness. Through the analyses of complex data, multimodal data that includes the history of the patient, mental health evaluations and treatment, these artificial intelligences help clinicians in providing personalized care, reduction of cognitive stress as well the provision of full mental health support to patients, especially in high stressed clinical environment [43].

Bulleti et al. [43] deployed a systematic review approach to identify clinical decision support algorithms suitable for assisted reproductive technology as well as evaluating their effectiveness in the improvement of the assisted reproductive cycles at every stage against the conventional approach. Thus, providing an evidence-based guideline for their application in practice. Literature search was based on the articles published in PubMed and Embase between January 1, 2013, and January 31, 2024. It was revealed that 116 articles met the selected criteria out of 1746 articles that were screened. These articles were further categorized into three groups, which include patient counselling, clinical management and the assessment of the embryo. 11 decision support algorithms were identified after the screening, and these were recommended to be valuable in clinical management and practices in the laboratory. Also, findings revealed that automated decisions help to enhance outcome of in-vitro fertilization. However, standardization was established to be the main limitation of the study, especially in the validation of the approach in different studies. Figure 1 showed the flow chart deployed in the study using PRISMA instructions. In the same vein, Figure 2 depicts the guidelines for managing the infertile couple for which the clinical decision supports algorithms have developed and recommended based on the study's findings.

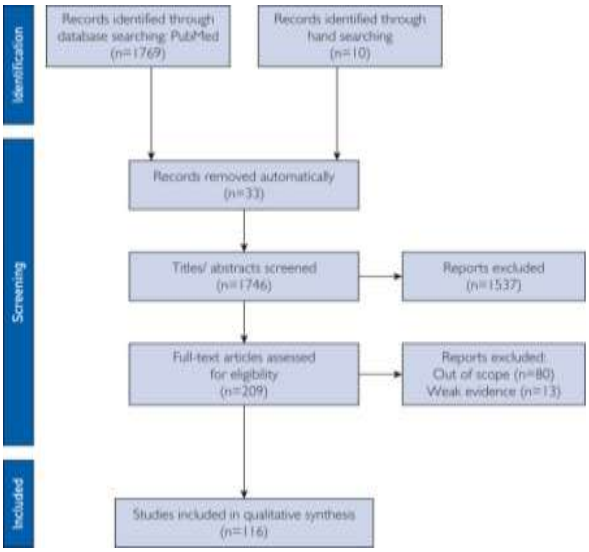

Figure 1: Flowchart based on PRISMA guidelines [43]

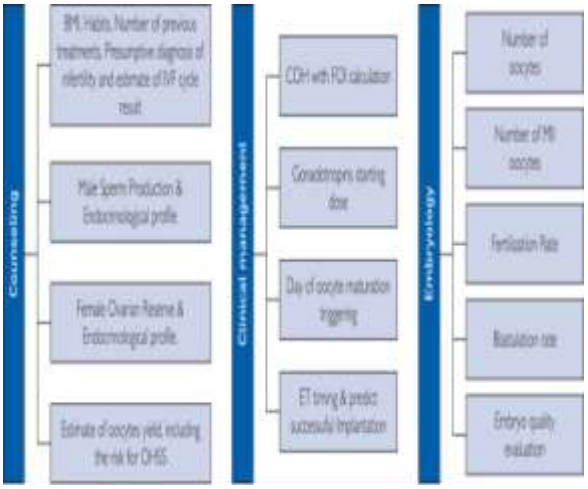

Figure 2: Recommended clinical decision support algorithm [43]

Similarly, Sajjadi et al. [44] identified about 16,310 articles and 10 were chosen after the removal of duplicates by using both inclusion and exclusion criteria. The second step about 71 systems were searched for and identified using search engines, 58 were removed and 13 were later analyzed. Also, the third step involved the use of researcher designed questionnaire which was given to about 32 experts which gave 94% agreement rate for monitoring and follow up, 94%, 90% and 82.5% were used for sperm

analyses data, abortion data and infertility information obtained using health magazines. The requirement was further classified into four main traits involving 10 elements, patient information being 19, fertility prediction data being 16 elements and secondary features 3 elements. The overall agreement of the model was 85%. Figure 3 depicts the PRISMA flowchart of the review process. Figure 4 also illustrates the conceptual framework for the decision support system for managing infertility.

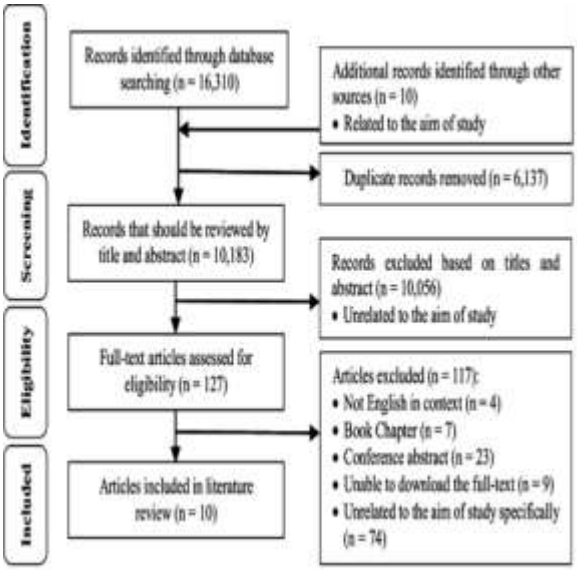

Figure 3: PRISMA flowchart of the review process [44]

The study discovered that many factors in modelling in terms of recommendation and predictions of treatment of infertility as well as the axes of the cases were found in the model. It was also mentioned that a score was assigned to each trait, and data was specified for the decision support system in infertility, however, data mining and statistical evaluations determined the most significant factors that affect fertility. In the case of this study, thyroid stimulating hormones, body mass index and other factors were significant in fertility, and they are quite consistent with items particularly in the presented model.

Figure 4: Conceptual framework for decision support system for managing infertility [44]

Luftiani et al. [45] introduced a multimodal artificial intelligence system that combines natural language processing, sentiment analyses and voice introduction to provide personalized psychological support for spouses and individuals experiencing infertility. Randomized control trial was carried out using 200 participants and the artificial intelligence intervention group was compared to a control group that is receiving standard care. The artificial intelligence system shows a reduction in anxiety and depression levels as well as improvement in emotional wellbeing. 85% improvement was recorded for the intervention group and engagement with participants using system of an average of four times a week.

The artificial intelligence system was also established to provide empathy, real time emotional support for the users. Although, these results came with challenges like cultural sensitivity and voice interactions accuracy noted. Thus, the study underscores the potential of artificial intelligence in mental health, especially in handling the frequently overlooked psychological needs of people facing infertility. Thus, it suggested that artificial intelligence driven solutions can help in bridging the gaps in psychological care through the provision of scalable, cost effective and accessible supports. Lin et

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DOI: https://doi.org/10.64388/IREV9I12-1719055

al. [46] identified and synthesized artificial intelligence augmented clinical decision support system in pregnancy care, its functionality, methodologies as well as its implementation and a systematic review was reported using empirical literature which examined the cases of artificial intelligence augmented clinical decision support system in pregnancy care.

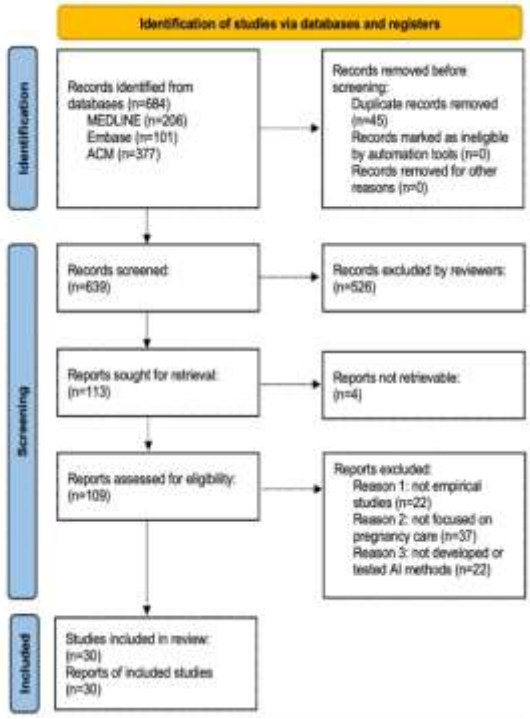

Figure 5: Artificial Intelligence PRISMA process [46]

IV. RECOMMENDATION AND CONCLUSION

Current AI-driven decision support systems show promise in identifying psychological distress associated with childlessness, yet several refinements could enhance their clinical utility and patient outcomes. Existing models would benefit from greater data granularity and personalization. Incorporating multimodal inputs, such as standardized psychometric instruments such as FertiQoL, alongside electronic health record data and patient narratives, may yield a more comprehensive representation of psychological burden. Secondly, clinical actionability remains limited in many systems. Translating model outputs into stratified risk categories with corresponding management pathways would improve implementation. For example, linking severity scores to tiered interventions ranging from psychoeducational resources to expedited mental health referrals addresses the gap between prediction and practice. AI-based models have the capacity to modify beyond the standard care model through the capturing of trends of anxiety, depression, grief as well as social isolation, which are not recognized easily in the couples that experience childlessness. Therefore, contributing to empathy, precise and adequate psychological care, however, it is necessary to establish that the success of its implementation of the AI decision support systems requires adequate and careful considerations such as clinical factors, ethical and contextual ones. Issues connected to data privacy, bias in algorithms, interpretability and trust between the clinician and the patient must be given due attention and augmented to ensure that human judgements are not replaced.

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