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Review

Concordance and Discordance of Opinions on the Impact of SDG3 on Infertility among Nigerian Women: A Perspective Review

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Abstract

Several studies have explored the frequency of infertility in underdeveloped and developing countries, such as Nigeria, and its potential impacts on the mental and physical well-being of affected individuals. This study aimed to sample the different opinions on the impact of sustainable development goals 3 (SDG3) on infertility among Nigerian women using different perspectives. Current literatures from different databases including Scopus, Web of Science, JSTOR, MEDLINE, PubMed, EMBASE, CINAHL, Google Scholar, etc. on the topic were searched online and reviewed. This perspective review revealed various factors contributing to the burden of infertility among Nigerian women, encompassing medical conditions, modifiable risk factors, environmental influences, physical and psychological stressors, and policy-related considerations. Socio-economic factors were also implicated in infertility within this population. As there were concordance and discordance in the sampled opinions on the impact of SDG3 on infertility among Nigerian women, addressing the burden of infertility among Nigerian women requires a multi-faceted approach including interventions aligned with SDG3.

Keywords: Concordance, Discordance, Impact, Infertility, Nigeria, Women, Opinions, Perspective Review, SDG3, Sustainable Development Goals 3

INTRODUCTION

Sustainable development goals 3 (SDG3) comprises thirteen targets and twenty-eight indicators to monitor progress. These targets focus on reducing maternal and child mortality, combating diseases, enhancing psychological well-being, deterring substance misuse, diminishing road-related accidents, and granting widespread entry to medical care and birth control. SDG3 additionally strives to attain comprehensive health protection and impartial entry to medical care for all sexes, which endeavors to guarantee communal availability of family planning as well as sexual and reproductive health amenities (United Nations, 2017). The United Nations implemented Quality Health and Wellness as one of the 17 Sustainable Development Goals in 2015, intending to guarantee robust livelihoods and advocate wellness for all, regardless of age (United Nations, 2015). Sustainable Development Targets emphasize living a healthy lifestyle, with indicators tracking progress across countries (Ritchie, 2018).

The holistic management of female infertility has been systematically reviewed (Armah, 2021). Therapies such as "comprehensive body-mind-spirit initiatives, mentally-centered therapy / intervention, psychotherapy, educational approaches, acceptance and commitment therapy, cognitive behavioral treatment, and spiritual therapies" were used to support infertile women (Armah, 2021). Most of these reviews highlight research outside of Africa and exhibit bias toward specific methods of investigation, including randomized controlled trials, statistical surveys, and meta-analyses. In these evaluations, there are few studies from Africa where healthcare systems are commonly used. This means that to fully understand the volume and caliber of information pertinent to the treatment of infertility in females in Nigerian medical institutions, an overview focused on Nigerian research is necessary.

Using a review methodology can provide a more thorough summary of the corpus of research on female infertility prevention and management (Munn, 2018) which will make clear how doctors perceive and manage

infertility in women. Understanding the idea and treatment of female infertility will assist in changing policy and practice. This study therefore aimed to summarize the current opinions on the impact of SDG3 on infertility among Nigerian women using different perspectives.

METHODS

Study Design

This study is a perspective review.

Study Methodology

Current literatures from different databases including Scopus, Web of Science, JSTOR, MEDLINE, PubMed, EMBASE, CINAHL, Google Scholar, etc. on the topic were searched online and reviewed.

Study Selection

Inclusion Criteria

Credible publications (which included every type of study, which involves both initial and subsequent research), demographic accounts (which included females seeking mental and physical care from infertility), and concept reports (which included indicators of infertility and conception prevention and treatment through the impact of SDG3) were included in this study. The search was limited to research that was accessible in the English language.

Exclusion Criteria

Literatures which did not undergo peer review due to concerns about the source's reliability were excluded from this scoping review. Bias may be introduced by including data from unpublished studies and thus unpublished studies were excluded. Literatures that would be difficult to translate due to linguistic quirks can also add bias to this perspective review and were excluded.

DISCUSSION

Since infertility impacts the entirety of one's life experience both qualitatively and quantitatively, public health and Sustainable Development Goal 3 have recently emphasized the necessity for an intimate social link between an individual and the environment. It is a societal problem that affects individuals as well as 10% of the people who are of reproductive age experiencing infertility in one way or the other (Evens, 2004).

Female Infertility and Associated Factors

Gametes are ova and sperm cells which are haploid and have one copy of each type of chromosome i.e. 1–22 X or 1–22 Y (Ikwuka, 2023a). Certain factors are necessary for a woman to conceive. These include hormonal balance, functioning of the ovarian system at peak efficiency, vaginal sex or *in-vitro* fertilization must occur around the ovulation period.

Issues with fallopian tubes and uteruses, or issues with egg release, are the leading causes of infertility in women. It is possible for malformations, infections like chlamydia, scar tissue, or blockages of the fallopian tube to result in infertility. For instance, endometriosis can result in infertility due to the development of endometrial tissue around the ovaries and in the fallopian tubes. Primary infertility refers to the inability to conceive or start the development of a child. One significant factor contributing to secondary infertility is infections of the reproductive tract (Kaufman, 1999), which are more prevalent than primary infertility (Starrs, 2018) and describes the inability to become pregnant even after previous attempts (Bowa, 2012).

A woman's incapacity to ovulate could be a significant contributing factor to her infertility. Conception may be made more difficult by egg malformations. For instance, an overabundance of male hormones and only partial egg development in the ovary known as polycystic ovarian syndrome which is the failure of a woman's ovaries to develop and release eggs can result to infertility. Since fertility in women decreases from age thirty and above, a woman's age as well as her weight can also have impact her chances of getting pregnant.

Autoimmune antibodies produced by the female partner against sperm cells from the male partner have been implicated as a cause of female infertility. Other immune reactions include antibodies to clotting factors, which result in both thrombosis and hemorrhage; and hemolytic reactions during transfusion of blood products (Ikwuka, 2023e).

Infertility poses a prevalent reproductive health issue in Nigeria, bearing significant socio-emotional consequences. A notable emphasis is on the importance of assisted reproductive technologies (ARTs) alongside preventive healthcare interventions. Successful adoption of new reproductive technologies in low-income countries hinges on meeting specific socio-cultural and economic prerequisites and securing government endorsement for their implementation. Coordinating with the appropriate authorities is necessary to talk about improving infertility services, which mainly entails integrating maternal health, contraception, and infertility services into public healthcare systems. Beyond this, the ability to maximize

these techniques' accessibility, cost, and efficacy will significantly influence the viability and longevity of ART in contexts with limited resources. To prevent situations where infertile couples would have to give up all that they could borrow for subpar, unsuccessful IVF, there is need to give governments, healthcare professionals, and couples with fertility issues accurate data (Zegers-Hochschild, 2008).

Endometriosis

There is a greater danger of female endometriosis in the mid-20s of age and beyond, especially if they have put off having children (Lessey, 2000). The gynecological condition known as endometriosis affects women who menstruate and refers to the stroma and endometrial glands that have been ectopically implanted outside of the uterus. These implants in the endometrium could react to cyclic hormones like a natural endometrium, which could result in pain and bleeding. There is evidence to show that endometriosis may develop in response to endocrine-disrupting chemicals (EDCs). In addition, endometriosis appears to indirectly impact female fertility through sperm or egg destruction (Lamaran, 2016).

Polycystic ovarian syndrome (PCOS)

PCOS is a collection of gynecological conditions linked to problems with hormone secretion. These illnesses can affect reproduction and cause additional health issues for women, including obesity, acne, and abnormal facial or body hair development. PCOS causes female infertility frequently and is one of the primary factors why women who experience anovulatory infertility seek treatment in fertility clinics. High levels of androgen are one of its main characteristics. The process by which eggs develop, expand, and release during ovulation is impeded in women with elevated androgen levels. Cysts, or sacs filled with fluid, may form in the ovaries as a result (Kaur, 2018).

In addition, diabetes mellitus and heart disease are risks for women with PCOS. PCOS frequently results in complications like insulin resistance, ovarian cyst formation, and irregular menstruation. An essential part of female sexual function is played by natural killer cells. Inductive failures have been linked to these cells. Gene expression and miscarriage or infertility is brought about by natural killer cell cytotoxicity (Kaur, 2018).

Hormonal Disorders

An irregular menstrual cycle, heavy or light bleeding, cramping in the pelvis and abdomen, no menstruation or a protracted menstrual cycle, and abnormal weight increase or decrease are all indicators of hormonal issues. Ovulation abnormalities in the pituitary, hypothalamus, and thyroid glands cause hormonal irregularities. These glands produce sex hormones. These glands are impacted by stress, hypothyroidism, and birth control medications (Neog, 2018).

Hormonal disorder e.g. diabetes mellitus and arterial hypertension remain two of the most common diseases in the world. Today, diabetes mellitus (DM) ranks third in the overall structure of morbidity and mortality after cardiovascular diseases and oncological diseases (Virstyuk, 2021a). In addition, the nexus, role and effects of metabolic syndrome diseases on female fertility are still being investigated. Metabolic disorders, e.g. Hypertension, Adiposity, Diabetes mellitus and Dyslipidemia, collectively known as Metabolic Syndrome Diseases (MSDs) are interrelated diseases (Ikwuka, 2015; Ikwuka, 2017a; Ikwuka, 2017c; Ikwuka, 2023c; Ikwuka, 2023f; Ikwuka, 2024; Virstyuk, 2016).

Different studies have shown that MSDs are associated with asymptomatic hyperuricemia, systemic immune inflammatory processes, and fibrogenesis all of which can lead to kidney damage (Ikwuka, 2017d; Ikwuka, 2017e; Ikwuka, 2018c; Ikwuka, 2018d; Ikwuka, 2019a; Ikwuka, 2019c; Ikwuka, 2022; Ikwuka, 2023d; Virstyuk, 2017a; Virstyuk, 2018a; Virstyuk, 2019; Virstyuk, 2021a; Virstyuk, 2021b). The influence and effects of hormonal imbalance in females leading to infertility in such females have also been reported in different studies (Aliu-Ayo, 2023a; Aliu-Ayo, 2023b).

Fallopian Tubes

Female infertility may result from damaged or obstructed fallopian tubes. Tubal infertility is another term for it. This obstructs the entry of the fertilized egg into the uterus or stops the male sperm cells from reaching the egg for fertilization (Kaur, 2018). The fallopian tube can become damaged or obstructed due to various reasons such as pelvic inflammatory disease, uterine infection, chlamydia, gonorrhea, or other sexually transmitted diseases (STDs), previous abdominal or pelvic surgery, such as for ectopic pregnancy (Neog, 2018).

Sexually transmitted diseases (STDs)

Diseases like gonorrhea and chlamydia might cause fallopian tube damage. HIV can result in vaginitis and vulvodynia, painful sexual activity, pelvic discomfort, and pelvic diseases. STDs occur typically when the causative agent appears in the uterus, fallopian tubes, or ovaries after spreading from the vagina. Unprotected sexual contact with different partners increases the risk of STDs (Balen, 2006).

Psychological Factors

Some studies have reported an interconnection between stress and the likelihood of becoming pregnant (Kaur, 2018). Oxidative stress has been associated with infertility. Linked to the induction of oxidative stress are major free radicals. Among these major free radicals, superoxide anions, hydroxyl radicals, and hydroperoxyl radicals are of physiological significance. A non-radical of physiological significance is hydrogen peroxide (Ama, 2023; Baysah, 2023; Ekechi, 2023a; Ikwuka, 2023b).

Increased stress has also been linked to α-amylase, an enzyme found in saliva. Research indicates that women with greater α-amylase levels had a reduced probability of becoming pregnant. Research has also indicated that infertility is significantly influenced by both sadness and anxiety. Many psychological issues, including anxiety, sadness, stress, and irritability have been linked to some fertility drugs e.g. leuprolide, clomiphene, and gonadotropins (Lamaran, 2016; Kaur, 2018).

Societal Factors

The inability to conceive children substantially correlates with caste, domicile, education level, occupation, family size, and socio-economic status. Urban dwellers are more susceptible to infertility than those who reside in rural areas due to automobiles, manufacturing facilities, and electric power plants that pollute the air, as well as the widespread use of plastics in addition to regular use of cosmetics, detergents, and insecticides (Lamaran, 2016).

Reproductive and Sexual Health

The WHO defines sexual wellness "as a condition of overall well-being encompassing social, mental, emotional, and physical aspects of sexuality; it goes beyond simply being free from illness, dysfunction, or disability". Positivity and respect for sexuality and relationships, as well as the ability to engage in safe, pleasurable, and violent-free sexual activities, are essential for maintaining optimal sexual health. Every person's sexual right must be recognized, upheld, and fulfilled to promote and maintain mental health (WHO, 2020).

Studies on wellness and psychological health within reproductive health and sexuality systems explore the complexities of human anatomy and sexual wellness across various life stages. This encompasses a broad spectrum of social activities, medical interventions, and scientific inquiry. In contemporary discourse, the concept of sexual and reproductive rights has gained prominence, acknowledging individuals' autonomy in making decisions regarding their sexual and reproductive lives. As the World Health Organization (WHO) states, a holistic understanding of health extends beyond the mere absence of illness or impairment to encompass mental, social, and physical well-being (Sladden, 2021).

Figure 1 below illustrates the consequences of infertility.

INDIVIDUAL FINDINGS

Psychological Distress

Infertile couples in Sub-Saharan African endure significant levels of stress connected to infertility, depressive symptoms, loneliness, suicidal thoughts, and a general decrease in quality of life as a result of the increasing pressure to procreate (Ciu, 2010; Asiimwe, 2022, Whitehouse, 2014, Adofo, 2021). Identified factors include psychological torment, ongoing bereavement, marital instability, recurrent themes in the lives of women experiencing infertility, feeling like they are unable to conceive, and financial restrictions, have been reported in a qualitative study (Asiimwe, 2022). In particular, these ladies endured persistent humiliation, psychological maltreatment, taunting and were held responsible for their infertility. Women told stories of unstable relationships disintegrating, often leaving victims grieving and experiencing painful feelings such as stress, worry, depression, and hopelessness (Asiimwe, 2022).

Infertile women in Nigeria have talked about how they no longer enjoyed having sex and felt that their counterparts who were fertile had a higher quality of life. The participants specifically linked these feelings to the psychological anguish associated with infertility (Aduloju, 2018; Omoaregba, 2011; Ndubuisi, 2021). Although they are not as likely to be the targets of stigma, infertile males also reported feeling stressed and alone. In Nigeria, childless women who are both less educated and from lower-class backgrounds have a higher risk of being abused by intimate partners (Iliyasu, 2013).

Concerns regarding infertility stemming from contraceptive usage

Studies conducted across Africa have consistently indicated that individuals, couples, and communities perceive infertility as a significant potential consequence of using modern contraception (Bornstein, 2020; Chipeta, 2010; Ackerson, 2019; Kibira, 2020; Schrumpf, 2020; Bell, 2023). Correlation between beliefs about modern contraception and various infertility outcomes, including semi-permanent, temporary, and permanent infertility, have been identified thus corroborating these findings in a scoping study conducted across Africa (Boivin, 2020; Blackstone, 2017). In Africa, adolescent girls, women,

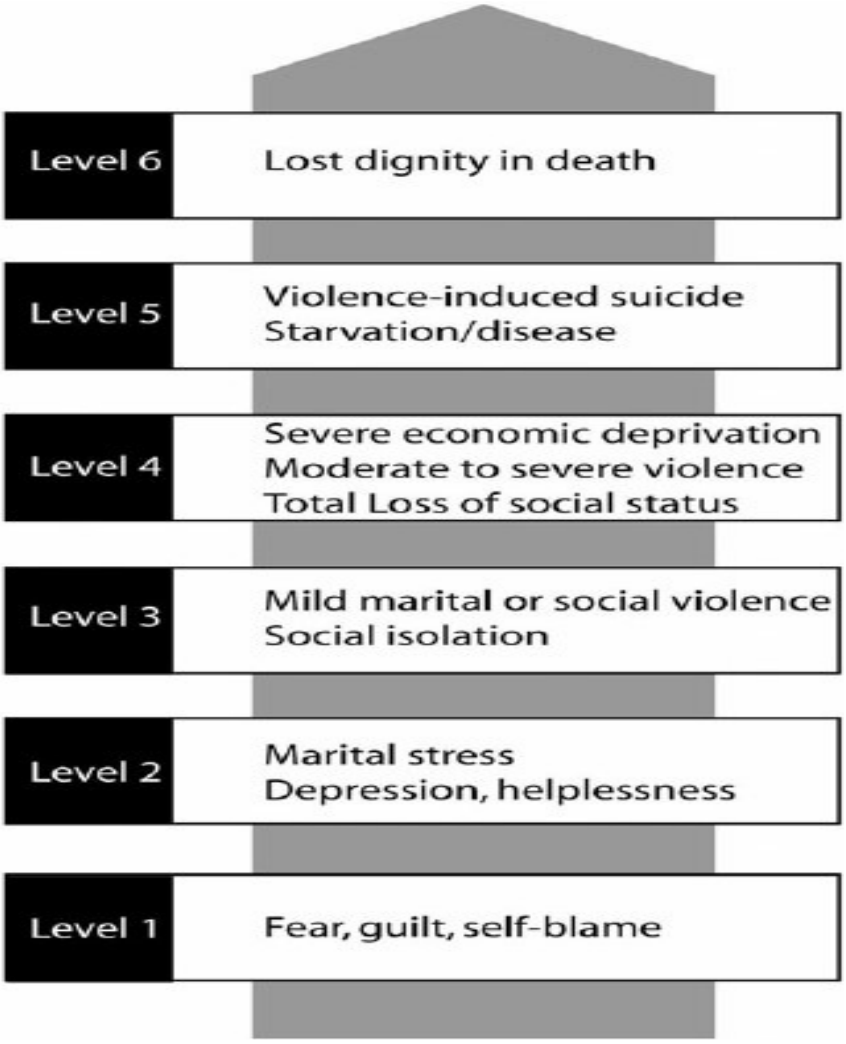

Figure 1: Consequences of infertility (McCurdy, 2015)

and couples opt not to begin or continue utilizing effective contraceptive techniques due to the well-documented belief that contraceptive use and infertility are directly associated (Bornstein, 2020; Chipeta, 2010; Sedlander, 2021; Teye, 2013).

During their assessment of female infertility across Africa, two categories of fears which are fear that a specific form of contraception can end in infertility and secondly, fear that infertility would have significant social repercussions in the future have been reported (Boivin, 2020). The concern about infertility significantly influences contraceptive method selection (Boivin, 2020). Family planning methods are thought to influence reproductive ability by inducing internal buildup and obstruction (such as menstrual fluid), structural injury (such as impaired ovules), and internal relocation of contraceptive substances. More specifically, oral contraceptives were meant to build up and "block" the reproductive system, causing either excessive or insufficient bleeding which would reduce fertility. It also applied to the notion that intrauterine devices, self-injection of contraceptives, and the use of contraceptives in general could harm the female reproductive tract physically and structurally. Studies in Senegal, Ethiopia, Kenya, and Nigeria have shown that these societies generally believe that contemporary contraceptives are harmful to women's health and womb health (Sedlander, 2021; Gueye, 2015).

INTERPERSONAL FINDINGS

Marital Instability or Dissolution

The prevalence of divorce, separation, adultery, and polygamy is higher among infertile individuals in Sub-Saharan Africa (Inhorn, 2015; Cui, 2010; Hess, 2020). In Nigeria, where having kids is viewed as essential to a

marriage's stability (Dierickx, 2019; Anokye, 2017), infertility is frequently used as an excuse for men to have multiple partners. As a result, couples experiencing infertility experience marital instability (Cui, 2010; Inhorn, 2002).

The belief that procreation is the responsibility of women leads to matrimonial issues in Nigeria, such as divorce and polygamy, which are caused by infertility. Infertility is often blamed on women and is viewed negatively when a relationship or marriage fails to produce children (Ikimalo, 2012; Cui, 2010; Tabong, 2013). A woman is seen to have failed in her marital function if she is unable to bear children for her spouse. Numerous studies have shown that women are routinely made fun of, blamed for, and exploited as scapegoats even when men are diagnosed as infertile, particularly in situations where the infertile pair is still married (Dierickx, 2021).

Polygamy and divorce were frequent outcomes in Ghanaian studies involving cases where the suspected use of contraceptives was considered the reason for secondary infertility (Tabong, 2013), and the inability to conceive led to divorce or separation in Nigeria, Mali, The Gambia, and Senegal, when couples, primarily men, looked for new marriages to get pregnant. These nations showed comparable results of infertility-related marital strife (Hess, 2018; Dierickx, 2019; Whitehouse, 2014; Larsen, 2000).

Marital infidelity as an outcome or remedy for infertility

Correlations between infertility and higher rates of extramarital affairs and polygamy, along with a rising prevalence of sexually transmitted diseases have been reported (Tabong, 2013). Likewise, infertile married females in Ghana encountered coercion from their relatives, especially from their maternal figures, to "change partners and seek fertility with another man" (Ofosu-Budu, 2020). According to studies conducted in Nigeria and The Gambia, males are under pressure from family members to look for other women to satisfy their desire for pregnancy, even though they may not wish to have an extramarital affair (Dierickx, 2019; Ofosu-Budu, 2020).

SOCIETAL FINDINGS

Cultural views on the origins of infertility

Although there are proven medical and clinical explanations for infertility, there are also widely held, socially constructed alternate views about the causes. These ideas encompass voodoo, paranormal explanations, curses from gods or ancestors, witchcraft and evil spirits, abortion, masturbation, promiscuous conduct, and careless actions during pregnancy or earlier births (Bornstein, 2020; Dierickx, 2021; Parrott, 2014). Although most of Sub-Saharan Africa still adheres to these cultural views, the importance of these elements varies throughout nations and regions.

In Nigeria, the ancestors believed that if a couple violated the codes of marriage (i.e., behaved outside of social norms in their marriage), they would be condemned to infertility (Tabong, 2013). Infertility was also thought to be the result of evil spirits; it was either one's destiny or it involved dark magic and other worldly forces (Dierickx, 2021; Okafor, 2017). Individuals living with infertility in Nigeria are often thought to have had one or more abortions and are therefore seen as promiscuous and of low moral character (Dierickx, 2018; Tabong, 2013; Ofosu-Budu, 2020). Abortion was considered a last resort for promiscuous and careless women, who were thought to be infertile (Bornstein, 2020). Social narratives in Nigeria propagated the idea that masturbation and abortion are the primary causes of infertility (Iliyasu, 2013).

Stigma and social norms linked to infertility

Matrimony and unions are generally expected to produce children carrying on the family line in Sub-Saharan Africa (Cui, 2010; Tabong, 2013; Kane, 2019). There is a persistent desire for larger family sizes. It implies that having children is highly regarded throughout the region (Dimka, 2013; Ahinkorah, 2020). Notoriety, retirement security, and replacement in the event of a child's passing have been linked to the desire for prominent families (Atake, 2019). A few other advantages of having a large family include that they can help with work, comply with religious doctrines that support having a large number of children, and bring happiness and social status to African communities (Kane, 2019; Tabong, 2013).

In Nigeria, children are also viewed as elder relatives' friends, a symbol of family success, and a means of giving parents a dignified funeral (because burial customs differ for those without children). Childlessness is not only greatly stigmatized but also strongly engendered. It has been reported that infertile couples experience severe stigma throughout Sub-Saharan Africa (Cui, 2010). One common excuse given by couples for not seeking assistance in preventing pregnancy or conceiving is fear of infertility and the stigma associated with it. Childbearing has a high social value and thus, people are frequently under pressure to demonstrate their fertility at a young age.

It is not unusual for couples to be assumed to have made poor decisions and, as a result, to have "deserved" infertility due to widely held ideas regarding the causes

of infertility in Nigeria (Iliyasu, 2013). These ideas heighten the stigma associated with infertility, psychologically pressuring infertile couples to look for answers, and they typically resort to religious authorities and conventional/spiritual healers for assistance. According to studies conducted in Ghana, Nigeria, Senegal, and The Gambia, the more extensive the social networks of individuals and couples facing infertility in West Africa, such as husbands, families, neighbors, in-laws, and co-wives, the more severe the stigmatization (Dierickx, 2019; Tabong, 2013; Whitehouse, 2014; Dimka, 2013; Ofosu-Budu, 2020).

Gender-based stigma associated with infertility

The perception of women in Sub-Saharan Africa is that they control fertility and, by extension, to preserve the family line and thus benefit from the social and family advantages that come with having children. However, men and women experience infertility equally (Dimka, 2013; Ikimalo, 2012). It is typical in Nigeria to blame women for infertility, even in cases where medical data suggests that the male partner bears responsibility. In several African nations, son preference exacerbates gender-based stigma against women. In many societies, not having a male child is equated with infertility. This idea was instilled in young people at a young age, and they expressed that having no male child meant having no children at all.

The cultural preference for male children in Nigeria and Malawi has also been used as an excuse for men to marry multiple women to have more male children because men want to continue the family line (Inhorn, 2015; Okafor, 2017). These results underscore the tremendous shame associated with childlessness and the widespread gender roles that remain unequal throughout Sub-Saharan Africa.

According to reports from Senegal, Ghana, and Nigeria, gender-based violence (GBV) includes verbal, mental, emotional, and physical abuse directed at infertile women. GBV is a manifestation of unequal gender roles and the blame placed on infertility. However, husbands were the most frequent aggressors of psychological or physical abuse directed towards infertile women. Women who are infertile in Sub-Saharan Africa use several coping mechanisms to get through stigma as well as the difficulties they encounter. Other coping mechanisms mentioned by women in Sub-Saharan Africa who are facing infertility include seeking treatment through SDG3, regularly attending support groups, working to achieve financial independence, taking on the role of foster parent to a relative's child, and avoiding difficult or sensitive situations or conversations (Dierickx, 2019; Anokye, 2017).

Female genital mutilation (FGM)

Women's genital alteration and incision include a range of non-clinical interventions performed on girls' genitalia at various points in their lives. Depending on socio-cultural and religious beliefs, these procedures may involve the removal of all or part of the female genital organs or other harm to the external genitalia of women (Shakirat, 2020). Several false beliefs link infertility in Sub-Saharan Africa to female genital mutilation. In many regions of Nigeria, FGM is a common cultural practice. Perceived benefits include protecting virginity, increasing fertility, keeping oneself clean, acting as a rite of passage, improving men's sex experiences, and increasing fertility (Nour, 2015).

Contradictory beliefs were found in focus groups (and some key informant interviews) conducted in Northern Nigeria with couples who varied in their fertility status. Some were concerned that FGM results in infertility, while others believed that the operation may treat infertility, the latter opinion was mainly due to the excision of the clitoris (Tabong, 2013). The apparent benefits of FGM are acknowledged by the groups who engage in it, but it is against human rights and causes a host of adverse effects in women, including diminished sexual function, anxiety, depression, and post-traumatic stress disorders (PTSDs), monthly menstrual problems, scarring and keloid formation, infertility, and obstetric complications during pregnancy and labor (Nour, 2015).

STRUCTURAL FINDINGS

Availability of medications for infertility

There is inadequate evidence to indicate that the funding or public health strategy for sexual and reproductive health services in Africa encompasses provisions for treating biological infertility (Inhorn, 2015; WHO, 2023; Chiware, 2012). Similar to other sectors, a diverse range of individuals, including the elderly, single individuals, and individuals with specific health ailments such as particular HIV serodiscordant couples and cancer survivors might necessitate infertility intervention and reproductive healthcare services (WHO, 2023). Numerous individuals and couples have been able to overcome obstacles like tubal blockage with the aid of enhanced diagnostic technology and assisted reproductive technologies, which include fertility drugs, gametes or egg freezing, and *in-vitro* fertilization (IVF). Over five million babies have been born worldwide due to these technologies. Although infertility treatment interventions are primarily found in affluent nations, they remain unavailable principally, inaccessible, and prohibitively expensive in Nigeria (Inhorn, 2015).

Metabolic syndrome diseases (MSDs) are interrelated diseases with very high economic costs, morbidity, and mortality rates, thus requiring the search for new and effective treatment options (Ikwuka, 2024). Treatment optimization in MSD patients using a combination of HMG-CoA and SGLT-2 inhibitors, and A2RB (AT1) has resultant clinical effectiveness as indicated by marked improvements in metabolic functions of the heart, liver, pancreas, and kidney (Ikwuka, 2017b; Ikwuka, 2018a; Ikwuka, 2018b; Ikwuka, 2021; Virstyuk, 2017b; Virstyuk, 2018b; Virstyuk, 2018c; Ikwuka, 2024). In addition, Glucagon-like Peptide 1 Receptor Agonists (GLP-1 RAs) e.g. Liraglutide have been found to improve the efficacy of treatment and clinical course of type 2 diabetes mellitus and hypertension in patients with such comorbidities (Ikwuka, 2019b). It has also been reported that coconut water has hepatorenal protective functions against alloxan-induced type 1 diabetes mellitus (Ekechi, 2023b).

Difficulties include exorbitant treatment costs, a lack of technology and equipment, infertility treatment service locations, insufficient staff training, and unregulated, subpar service delivery (Ombelet, 2014). This effectively removes access to scientific treatments for infertility and places the onus of paying for private infertility therapy on individuals and couples (Afferri, 2022). Although not universally accessible, ART treatments are primarily given in metropolitan settings across several Sub-Saharan African nations. As stated in a 2019 study, one consequence arising from the goals for sustainable development (SDG3) is that ART and counseling are only available in metropolitan regions of Sub-Saharan African countries, primarily concentrated in South Africa (Ombelet, 2014).

Socio-economic hardship

People who are infertile, both individually and as a pair, may have financial difficulties as a result of their condition. It is typically brought on by the need for costly reproductive treatments, marital breakdown, and problems transferring property to future generations. The spouses of infertile married women in Mali reported that they ceased providing for them financially, citing their childlessness as the reason. At the same time, the wives confirmed the discontinuation of financial support from their husbands. Even when these infertile women went looking for outside employment to support themselves, they claimed that because a woman's job was to provide for her children, others would make fun of them for doing so (Hess, 2018).

Due to patrineal views in the community, women of Nigeria's Ijaw community suffered financial losses as a result of not being able to inherit property (Whitehouse, 2014). When expensive infertility treatments proved ineffective, the majority of Ijaw women returned to their fathers' homes following divorce (Larsen, 2000).

The scarcity of technology and few service providers, along with high costs, private sector provision, and consequent out-of-pocket expenses, make biomedical treatments for infertility, such as IVF, mainly unavailable. While some nations, like South Africa and Nigeria, have recently launched affordable ART programs, many other countries, like Ghana, The Gambia, and Kenya, still lack access to these treatments and charge a hefty fee of about US$4,000 for each cycle of IVF, in addition to other related expenses (Dierickx, 2019; Anaman-Torgbor, 2021).

Policy perspectives on prioritizing infertility within sexual and reproductive health frameworks

There is not a single peer-reviewed study or other piece of literature that analyzes the Sub-Saharan region's present national abortion policies. In 2020, the World Health Organization released a statement outlining the reasons behind fertility issues, the need to treat them, and the challenges in doing so in most countries (finance, infrastructure, and resource scarcity). Preventing infertility (and thereby reducing the need for expensive treatment) is the first step in the WHO's advocacy of government measures to reduce unequal access to safe and efficient fertility care.

Despite the optimism behind these WHO recommendations, the expense of care and other pressing health issues are preventing many Sub-Saharan African policymakers from pushing for infertility coverage, including fervent convictions that population growth is a more pressing concern. Despite mounting evidence of the socio-economic and psychological effects of infertility, infertility has yet to be given priority or attention in Sub-Saharan African sexual and reproductive right (SRH) policies and programs (Kudesia, 2018).

Gender equality, reproductive health, and empowerment were recognized as essential components of sustainable development. At a conference that brought together governments from around the world, UN agencies, corporations, women's organizations, and youth networks, one of the largest gatherings of SRH, experts took place to discuss and decide on actions to advance the implementation of several programs of action. The conference's main objective was to slow the rapid population growth in emerging countries rather than explicitly addressing infertility (Butler, 2019).

A national study conducted in The Gambia, for example, discovered that critical stakeholders (medical professionals, governmental and non-governmental organizations) varied in their interest in and participation in initiatives to address infertility. Some individuals were highly focused on assisting women facing infertility challenges, while others prioritized efforts to prevent

Table 1. Implemented or planned SBC interventions aimed at addressing infertility in Sub-Saharan Africa

Country	Program Name	Project Aim	Socio Ecological Level	Overview of Intervention Activities	Evaluation Conducted
The Gambia	--	To improve access to biomedical treatment and decrease stigma	**Community**	Community-wide marches; radio jingles; social media campaign	--
The Gambia	Dimbayaa for Fertility *(Organization)*	Infertility awareness, counselling, testing, diagnosis, treatment and future planning	**Individual Interpersonal Societal**	Organization runs several activities. Of note, they work with *Kanyaleng* social groups to build social capital, social networks, and spread awareness and reduce stigmatization	--
Ghana	Oh Happy Day Classes (OHDCs)	To treat depression in African American adults experiencing infertility (adapted for Ghana)	**Individual**	Uses combination of cognitive behavior therapy framework, psycho-education, and a support group format over 12 weeks to unpack thinking patterns and teach coping skills	Yes. Findings indicate psycho-educational counseling can reduce infertility-induced depression and stress.
Nigeria	Reducing anxiety and depression in infertility among Nigerian women: an exploratory psycho-educational intervention trial (RADIANT)	To conduct an evaluation of eHealth intervention to support coping skills for infertility	**Individual** (activities conducted in clinic settings)	Psychosocial support, psychoeducational programming by use of locally informed and designed IEC materials (e.g. videos, stories, film)	--
Nigeria	The Fertility Life Counselling Aid (FELICIA)	To manage the psychological morbidity associated with infertility using cognitive behavioral therapy (CBT) based strategies.	**Individual Structural** (designed to be used in group settings or by health providers)	6-week-long counselling program for individual experiencing infertility; addressing coping skills, emotional and mental health, financial impact, infertility treatment and resilience	Pilot underway; evaluation planned.
Nigeria, The	BeiBei haven, Safe Haven Foundation,	To convene groups of peers experiencing	**Individual Interpersonal**	--	--

perceived biological causes of infertility. In addition, some disregarded the issue altogether, citing the high fertility rates in the region (Dierickx, 2019). Research demonstrates that even without treatment, a diagnosis can lessen a person's or a couple's suffering, which is also true in Nigeria. It implies that before offering treatment, education, counseling, and diagnostic testing would be necessary (Kudesia, 2018).

Sustainable development interventions that increase knowledge about infertility and lessen its adverse effects on the individual, the body, the mind, and society can close a significant knowledge gap in areas where investments in healthcare, health policy, and the health system are behind. It is essential to look into ways to reduce stigma, increase awareness, and give couples the resources they need to address their infertility difficulties because infertility is not given enough attention in Nigeria. The World Health Organization has recommended various policies and programs aimed at promoting reproductive awareness, mitigating risky sexual behaviors, early identification, prevention, and treatment of sexually transmitted diseases (STDs), averting complications from unsafe abortion and childbirth, implementing laws and regulations to support

and oversee assisted reproductive technology services, ongoing surveillance of ART services, enhancing healthcare provision, delivery, and implementing Sustainable Development Goals 3 (SDG 3) (WHO, 2023).

Much potential exists for combating infertility in Nigeria through SDG 3 by utilizing the lessons learned from other methods that have been executed and assessed, such as fertility awareness and norms-modifying strategies, even though there are not so many Social and Behavioral Change (SBC) programs that address it at the moment (Ombelet, 2020).

Table 1 above shows the implemented or planned social and behavioral change (SBC) interventions aimed at addressing infertility in Sub-Saharan Africa.

Preventable causes of infertility include the aftermath of poorly handled or untreated infections, physical and psychological impacts, exposure to specific environments, and lifestyle choices (Kroes, 2019). To achieve the United Nations' sustainable development goals by 2030, a conscious effort in infertility identification, avoidance, therapy, and its aftermath is required (Kroes, 2019). These objectives cannot be fulfilled if infertility is not given more attention as a crucial component of services related to reproductive wellness and contraception. The importance of infertility in guaranteeing human rights and sustainable development is becoming more widely acknowledged, even though it has historically been overlooked in sexual reproductive and global health agendas (Starrs, 2018). Gender differences could be reduced by raising men's and women's comprehension of infertility, offering solutions to those who want to get through it, and empowering women by giving them access to infertility therapies, and reducing the stigma attached to it (Inhorn, 2015).

Table 2 below illustrates the priority areas for the development of a national action plan to address infertility.

RECOMMENDATIONS

- A psychosocial and educational intervention that lessens the symptoms of depressive and anxiety disorders that infertile women experience is the goal of a study that is soon to be carried out in Nigeria and is titled "Reducing Anxiety and Depression in Infertility Among Nigerian Women (RADIANT): a trial investigating an exploratory psycho-educational intervention (Zegers-Hochschild, 2017).
- Raising awareness of the effects of infertility across the country and incorporating the intervention into routine medical settings and educational initiatives (Bello, 2021).
- Using data from related studies, researchers at the University of Liverpool developed the Fertility Life Counseling Aid (FELICIA). Using mindfulness practices and the ability to identify and alter harmful thought patterns, infertile people can live more satisfying lives by using this form of cognitive behavioral therapy (Aiyenigba, 2019).
- An organization led by women in The Gambia supported infertile individuals using three different methods in the absence of outside assistance and marching in communities first to raise awareness and second, promoting infertility on the public agenda, opposing the stigma associated with it, and disseminating information about infertility treatment through informative radio jingles that are aired in several languages. Thirdly, social media platforms should be employed to propagate information regarding reproductive health, medical explanations and treatments of fertility issues, awareness-raising campaigns, and internationally effective strategies (Diericksx, 2019).
- The United States of America developed Oh, Happy Day Classes (OHDCs), which offer cognitive behavioral treatment to infertile people in Ghana. Psychologists conducting the trainings facilitated talks on various subjects, including therapies for men and women, threat issues, forms, frequency, and perspectives on health (Adofo, 2021).
- Professionals from The Gambia's Imbalance of Reproductive Rights in Medicine gathered to raise awareness of infertility and reproductive issues in the country and outside West Africa. Apart from offering medical care, they also work with Kanyaleng, a customary organization that unites women dealing with infertility and child loss. These groups enable women to build and sustain social and health-improving support systems and significantly contribute to societal cohesion (Dierickx, 2021).
- Peer support groups have been found as a means of offering a safe space for individuals with infertility to share and offer comfort to one another. The following organizations were founded throughout Sub-Saharan Africa: the Footsteps to Fertility in Kenya, the Association of Childless Couples of Ghana (ACCOG), the Safe Haven Foundation in The Gambia, BeiBei Haven in Nigeria (Dierickx, 2018). For some groups, peer-to-peer networks were modeled, while for others, linkages to online or physical clinics were established (Dierickx, 2019).

The opinions from the research of different authors published in English language on the impact of SDG3 on infertility among Nigerian women were reviewed in this present study. One of the strengths of this present perspective review includes the fact that works from grey literatures were excluded. The primary limitation of this present perspective review is the small number of publications which addressed the specific research topic, according to an initial analysis. Since publications in other languages were not included, the focus of this present perspective review was restricted to studies published in English language. In addition, it required some time to find papers that precisely tackled the topic of the research to provide a perspective review since many

Table 2. Priority areas for the development of a National Action Plan (NAP) to address infertility

Priority Areas	Stakeholder Engagement	Education and Training	Advocacy and Implementation
Infertility Prevention Programs	• Engage with stakeholders in public health programs that directly address causes of infertility (e.g., HIV/STIs, safe abortion and delivery) or risk factors (e.g., environmental health, smoking cessation, obesity prevention) and identify linkages across sectors. • Engage researchers in understanding causes and risk factors for infertility.	• Integrate topics related to infertility within comprehensive sexual education programs. • Provide educational resources on fertility awareness (e.g., menstrual cycles, fertility windows, lifestyle and environmental chemicals that affect fertility) and identifying irregularities and abnormalities that may necessitate further medical support. • Provide educational resources on normal changes with hormonal contraception use and prevent misconceptions around fertility and contraception. • Educate health care providers on the causes and risk factors for infertility	• Expand existing public health programs and services that directly address causes of infertility (e.g., HIV/STIs, safe abortion and delivery) or risk factors (e.g., environmental health, smoking cessation, obesity prevention). • Incorporate and implement prevention strategies identified by stakeholders. • Advocate for coverage of prevention services and fertility care under a universal health coverage benefits package
Quality Fertility Care, Treatment, and Psychosocial Support Programs	• Convene the advisory group to identify unmet needs in quality fertility care and treatment, including o barriers to accessing infertility services o approaches for equitable access to care, including psychosocial needs. o gaps in service coverage for men o emerging needs or issues (e.g., oncofertility) • Engage traditional or non-Western treatments into infertility management approaches • Encourage engagement of men in fertility care and treatment • Research the efficacy, safety, and cost-efficiency of different infertility methods within country contexts	• Expand local gynaecologic services and train health care workers on fertility care • Identify local fertility care and services and inform clinicians of these referral resources • Provide in-country training and education to support specialised fertility specialists (doctors, embryologists, nurses and counsellors) • Develop training for primary care and other providers on fertility care (examination, diagnosis, treatment) and psychosocial support services • Ensure training is culturally-competent and person-centered • Educate the public on effective treatments and avoidance of supposed	• Provide equipment and supplies to expand local fertility care, psychosocial and peer support services • Establish locally-relevant treatment protocols, ethical guidelines, and regulatory frameworks that are equitable (e.g., clear language that is not exclusionary) • Identify (and evaluate) locally relevant approaches to prevent infertility or provide infertility services, including affordable ART or IUI and primary prevention strategies. • Provide public financing or public sector support for affordable [basic] infertility services and psychosocial support • Organize new or empower existing advocacy and peer support groups on infertility • Advocate for the inclusion of fertility care and treatment in national insurance schemes

Priority Areas	Stakeholder Engagement	Education and Training	Advocacy and Implementation
		fertility care practices that could harm health • Provide education, training, and services in local languages	• Provide information on other options for family formation (e.g., adoption) or ways of life that do not include being a parent (e.g., women's education and empowerment) • Ensure access to services is accessible to all
Research and Public Health Infrastructure and Regulation	• Identify research and public health stakeholders that can address priority areas • Coordinate with researchers and public health stakeholders to identify critical issues and topics on infertility	• Incorporate infertility topics into public health training and research	• Scale-up existing infrastructure that can support infertility prevention and management across multiple sectors. • Establish a regulatory body, to develop policies and regulations around the provision fertility services • Ensure systems, policies, and regulations are monitored and quality of services continually improved. • Invest in new research and public health initiatives that can address gaps in knowledge and service • Examine both short and long-term outcomes, including unintended consequences, related to infertility and related programs.

studies tried to determine the causes of female infertility with various abilities. For example, many studies concentrated on prevalence rather than causes and risk factors.

CONCLUSION

The impact of interventions that support women who are infertile, like SDG3, can be significant. Interventions that enhance fertility (and infertility knowledge) can be implemented on an individual and societal level. Fertility awareness treatments, for instance, help people and couples identify the fertile window and debunk myths regarding the use of contraceptives. Moreover, interventions may locate and attempt to change societal norms to lessen stigma, mainly directed toward infertile women. At the service level, intervention models can assist individuals and couples who are attempting to conceive by providing psychosocial support in place of, or alongside treatments for infertility e.g. assisted reproductive technologies (ARTs). There are concordance and discordance of opinions on the impact of SDG3 on infertility among Nigerian women.

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Authors' Contributions

All authors contributed to different aspects of the research.

Conflict of Interest

All the authors hereby declare that they do not have any possible conflicts of interest.

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