Available online on 15.07.2025 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Open Access Full Text Article

Review Article

Global national and rational burdens of female fertility via exposure to different alcohols

Trilochan Satapathy *, Kamaksha Tiwari, Nikita Patel, Laxmi Sahu, Pratibha Dhiwar

Columbia Institute of Pharmacy, Village Tekari, Near Vidhansabha, Raipur-493111, C.G., India

Article Info:

Article History:

Received 17 April 2025
Reviewed 30 May 2025
Accepted 24 June 2025
Published 15 July 2025

Cite this article as:

Satapathy T, Tiwari K, Patel N, Sahu L, Dhiwar P, Global national and rational burdens of female fertility via exposure to different alcohols, Journal of Drug Delivery and Therapeutics. 2025; 15(7):150-162 *DOI: http://dx.doi.org/10.22270/jddt.v15i7.7277*

*Address for Correspondence:

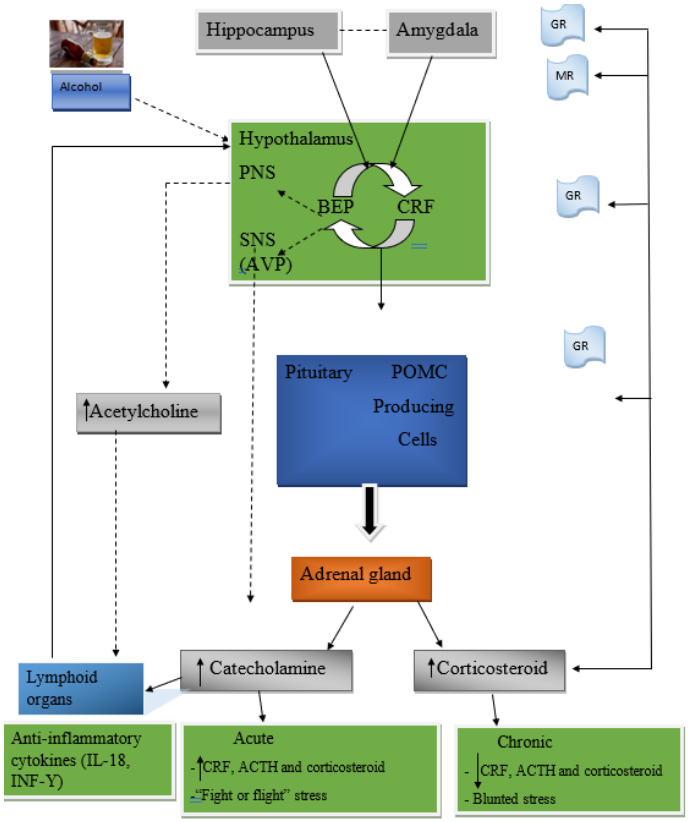
Trilochan Satapathy, Columbia Institute of Pharmacy, Village Tekari, Near Vidhansabha, Raipur-493111, C.G., India

Abstract

Alcohol intake is a key lifestyle component and a major public health concern that affects reproductive health around the world. According to the World Health Organization (WHO), alcohol causes infertility by altering hormonal balance, ovulation, and implantation. The prevalence of alcohol-related infertility varies by region, with higher rates found in nations with significant alcohol consumption, such as Europe and the Americas. Previous research has revealed that both chronic and acute alcohol consumption can disrupt reproductive hormones, decrease ovulatory function, and deplete ovarian reserve, resulting in diminished fertility potential. Alcohol causes infertility through changes in the hypothalamic-pituitary-ovarian axis, oxidative stress, and DNA damage in oocytes. Furthermore, heavy alcohol use has been related to an increased risk of monthly abnormalities, miscarriage, and ART failure. Moderate alcohol consumption is still debatable. Evidence suggests that even low to moderate consumption may have a deleterious impact on reproductive outcomes. Addressing challenges of female infertility caused by alcohol consumption necessitates targeted legislation, public health initiatives, and enhanced knowledge in order to lessen the impact on reproductive health and overall societal well-being. We believe that more study is needed to establish better dose-response correlations and to investigate the potential reversibility of alcohol-induced reproductive abnormalities

Keywords: Alcohol, female infertility, global burden, oxidative stress miscarriage, menstrual irregularities

Graphical abstract



1. Introduction

Alcohol consumption significantly increases the severity of diseases and reduces the effectiveness of treatments, and it is the main cause of the progression of many chronic diseases[1]. Alcohol consumption has numerous detrimental effects on a person's psychological and social well-being, in addition to its effects on the physiological system. Additionally, the propensity to drink leads to significant economic issues[2]. Failure to conceive after a year of consistent, unprotected sexual activity (or six months for women over 35) is known as infertility. This may have been caused by problems with one or both partners. Primary infertility, in which a person has never been able to conceive, and secondary infertility, in which problems develop following a prior successful pregnancy, are the two categories of infertility[3]. Sometimes, infertility is unexplained, which means that even after a complete medical evaluation, no discernible explanation can be identified. Female infertility is a complex medical issue involving hormone imbalances, structural abnormalities, genetic illnesses, lifestyle choices, and underlying medical conditions[4]. Issues with the uterus, fallopian tubes, and ovaries can lead to irregular or missing ovulation, obstructed fallopian tubes, and decreased chances of pregnancy. Age, smoking, alcohol consumption, stress, obesity, and pollutants also affect fertility. Treatment options include surgery, assisted reproductive technology (ART), fertility drugs, and lifestyle changes[5]. Advancements in medical research have made it possible for many women to overcome these obstacles and successfully become pregnant. around 17.5% of adults worldwide roughly 1 in 6 people will at some point in their lives become infertile, according to a 2023 WHO report. Infertility is a major global health concern, as seen by its similar occurrence in high-, middle-, and low-income nations[6]. Although the study provides the prevalence of infertility generally, there is little information specifically about female infertility throughout the previous 20 years. A global study referenced in the NCBI Bookshelf showed that female infertility was the cause of infertility in 37% of couples, male factor infertility was the cause of infertility in 8% of couples, and both male and female factors were found in 35% of couples[7]. The most prevalent causes of infertility in women are endometriosis (15%), pelvic adhesions (12%), tubal obstruction (11%), other tubal/uterine abnormalities (11%), ovulatory disorders (25%), and hyperprolactinemia (7%). Approximately 25% of the female infertility cases worldwide are caused by ovulatory disorders. Hormonal imbalances and conditions such as polycystic ovarian syndrome (PCOS) can interfere with normal ovulation[8].

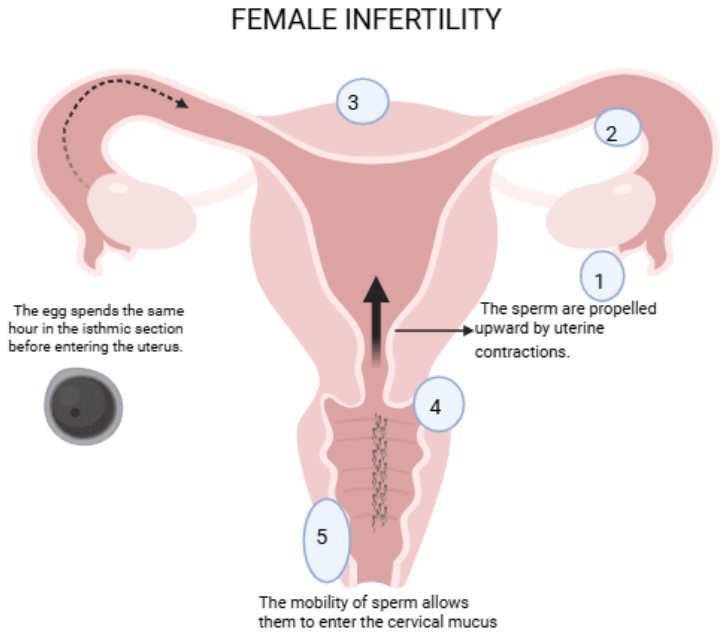


Figure 1: Alcohol induced female fertility

2. Alcohol and the fertility of women

Alcohol misuse poses a risk to human health since it raises the possibility of numerous dangerous situations, including accidents, violent crimes, poisoning, and serious chronic illnesses[9]. It can take the form of either acute episodes of binge drinking or consistent drinking, which is meant to be everyday chronic alcoholism. Furthermore, there are well-established negative effects of alcohol consumption and abuse during pregnancy on the foetus, such as fetal alcohol spectrum disorders, stillbirth, and miscarriage. Alcohol abuse puts people's health at risk since it increases the likelihood of many harmful events, such as violent crimes, accidents, poisoning, and severe chronic illnesses. Acute episodes of binge drinking or regular drinking, which is intended to be everyday chronic alcoholism, are two possible manifestations. Additionally, there are proven harms to

the foetus from alcohol use and abuse during pregnancy, including miscarriage, stillbirth, and fetal alcohol spectrum disorders[10]. and consistent drinking, or handled hangovers, which may be important if heavy alcohol use occurs during the menstrual cycle's fertile period. Finally, as chronic liver illness in general has an impact on female reproductive function, the implications of drinking on fertility should be carefully evaluated[11].

3. The female cycle

The hypothalamus, a region of the brain, is primarily responsible for controlling the four hormones that regulate the normal female cycle, which is about 28 days long and includes a 5-day bleed every 28 days[12]. The hypothalamus acts on the pituitary gland to release FSH and LH, the sex hormones that stimulate the ovary and cause ovulation. The ovary produces estrogen when FSH and LH are present. During the first 14 days of the cycle, the uterine lining grows as a result of the estrogen's powerful action on the uterus[13]. Progesterone becomes the key hormone following ovulation. Maintaining the endometrium allows the fertilized egg to implant, which is its primary function. If it does, pregnancy results, if not the bleed will occur[14].

3.1 Gender Differences in Alcohol-Related Deaths: An Examination of Women's Risk:

According to research, women are increasingly abusing alcohol, as evidenced by Despite the fact that excessive alcohol use is bad for everyone's health, alcohol-related issues disproportionately affect women[15]. Women should be aware of these health risks related to alcohol consumption in addition to the 2020–2025 Dietary Guidelines for Americans so that they can make educated decisions about their use. Adult women of legal drinking age may decide to limit their alcohol consumption to no more than one drink per day or to fully abstain from it[16]. This sum is meant to be a daily cap rather than an average. Although it won't totally eliminate the risks, reducing alcohol consumption can reduce them[17]. Some people, like those who are pregnant or may become pregnant, should never drink alcohol at all. The study highlights a significant gap in our present knowledge of the causal association between alcohol intake and health outcomes and stresses the urgent need for future research to establish causation through longitudinal and epidemiological investigations[18]. The majority of research is still correlational, despite the fact that there is substantial evidence linking long-term alcohol consumption to a number of health problems, including liver damage and female infertility. Observing the direct effects of alcohol on health requires longitudinal studies, which follow people over time[19]. In a similar vein, epidemiological research can highlight causal trends within populations, elucidating the ways in which long-term alcohol use leads to particular medical disorders. Furthermore, although the study mentions gender differences in alcohol-related health consequences in passing, more research is required to fully understand the precise processes that connect alcohol use to female infertility[20]. This further research is essential for creating focused treatments and successful public health plans to lessen the effects of alcohol-related illnesses[21].

Table 1: Tabular representation of various types of alcohol, their typical alcohol doses, and the mechanism of action on infertility, particularly how alcohol affects fertility in women

S. No.	Name of Alcohol	Typical Alcohol Dose	Mechanism of Action on Infertility
1	**Beer**	12 oz (355 mL) (1 standard drink)	Beer may disrupt hormone regulation by influencing levels of estrogen and progesterone. Long-term consumption can interfere with the menstrual cycle, hinder ovulation, and reduce ovarian reserve. It may also result in weight increase, which is another aspect affecting fertility[22].
2	**Wine**	5 oz (148 mL) (1 standard drink)	Wine, similar to beer, can affect hormonal equilibrium, especially estrogen levels, which are vital for ovulation. Excessive or regular intake may diminish fertility by affecting the performance of the ovaries and fallopian tubes. It can also result in a situation known as anovulation (absence of ovulation)[23].
3	**Vodka**	1.5 oz (44 mL) (1 standard drink)	Vodka and other distilled beverages have a comparable impact on the body, as excessive intake interferes with hormone production, particularly in the hypothalamus and pituitary gland. This can result in irregular ovulation and lower probabilities of getting pregnant. Extended alcohol consumption may result in liver harm, which can further disrupt the regulation of reproductive hormones[24].
4	**Whiskey**	1.5 oz (44 mL) (1 standard drink)	Whiskey shares effects with vodka and other liquors on fertility, especially by lowering the release of crucial reproductive hormones. It could also harm the ovaries and fallopian tubes. Long-term alcohol consumption is linked to an increased chance of miscarriage[25].
5	**Rum**	1.5 oz (44 mL) (1	Similar to whiskey and vodka, rum influences estrogen and progesterone levels, interfering with the menstrual cycle and resulting in fertility problems. Long-

		standard drink)	term intake may lead to a reduced ovarian reserve and compromised egg quality[26].
6	**Tequila**	1.5 oz (44 mL) (1 standard drink)	The impact of tequila on fertility resembles that of other alcoholic beverages. It can diminish ovarian activity, hinder ovulation, and disturb the equilibrium of reproductive hormones, complicating the process of conception[27].
7	**Champagne /Prosecco**	4 oz (118 mL) (1 standard drink)	Like wine, both champagne and prosecco can affect estrogen levels. Although moderate intake might not greatly affect the body, high consumption can interfere with menstrual cycles and result in anovulation[28].
8	**Cider**	12 oz (355 mL) (1 standard drink)	Cider may affect hormonal equilibrium, especially estrogen levels, leading to irregular menstrual cycles or anovulation. The elevated sugar levels might contribute to insulin resistance, which can adversely affect fertility[29].

4. Worldwide epidemiology of infertility

It has been estimated that one in seven couples in the west and one in four couples in underdeveloped nations are infertile among women of reproductive age[30]. In some regions, infertility rates may reach 30% worldwide, including in South Asia, certain sub-Saharan African nations, the Middle East and North Africa, Central and Eastern Europe, and Central Asia. Although they account for 50% of cases overall, males are found to be exclusively responsible for 20–30% of infertility cases[31]. These numbers, however, do not fairly reflect all parts of the globe. Male infertility rates were highest in Africa and Central/Eastern Europe, according to a study, whereas rates in North America, Australia, and Central and Eastern Europe ranged from 4.5–6%, 9%, and 8–12%, respectively[32]. In conclusion, it is estimated that 8–12% of couples in the reproductive age range globally experience infertility[33]. The most prevalent type of female infertility worldwide is secondary infertility, which is more prevalent in areas with high rates of unsafe abortion and inadequate maternity care, which can result in postpartum and post-abortive infections[34].

Table 2: Tabular representation with information about states (countries), alcohol types, percent of female alcohol use, and the impact on female health

S.No.	Country/State	Type of Alcohol	Percent of Women Using Alcohol	Impact on Female Health
1	United States	Beer, Wine, Spirits (vodka, whiskey)	55% (general), 30% binge drinking	Hormonal Imbalance Disrupts menstrual cycle and ovulation. Decreased Egg Quality Lower fertility. Increased Miscarriage Risk Alcohol increases pregnancy complications[35].
2	United Kingdom	Beer, Cider, Wine, Spirits	63% (general), high binge drinking	Menstrual Irregularities: Hormonal disturbances affecting fertility. Reduced Ovulation Decreases chances of conception. Higher Miscarriage Risk: Even moderate drinking increases risk[36].
3	Australia	Wine, Beer, Spirits	70-79%	Egg Quality Alcohol affects egg quality, leading to difficulty conceiving. Ovulation Issues: Chronic use disrupts ovulation. - Increased Risk of Preterm Birth: In early pregnancy[37].
4	Russia	Vodka, Beer, Wine	50-60%	Hormonal Imbalances Alcohol disrupts ovarian function. Infertility Linked to chronic alcohol consumption. Increased Miscarriage Risk Drinking during pregnancy significantly raises risk[38].
5	Japan	Sake, Beer, Shochu	40-50%	Egg Quality Chronic drinking lowers egg quality. Hormonal Disruption Affects fertility. Pregnancy Complications Increases risk of miscarriage[39].
6	Brazil	Beer, Cachaça, Wine	45-50%	Irregular Menstrual Cycles: Linked to alcohol consumption. Increased Risk of Miscarriage Alcohol-related risk. Infertility Chronic alcohol use reduces fertility[40].

7	Middle East	Limited Alcohol Consumption (mainly spirits in expatriate communities)	<10% (general)	Hormonal Disruption Effects seen in expatriate communities where alcohol is consumed. Infertility Similar impact as other regions when alcohol is consumed[41].
8	Scandinavian Countries (e.g., Sweden, Finland, Norway)	Beer, Spirits (vodka, aquavit), Wine	40-50%	Ovulation Issues Affects hormonal regulation and fertility. Increased Miscarriage Risk Heavy drinking linked to pregnancy loss. Reduced ART Success: Alcohol affects ART outcomes[42].

5. Fertility and Pregnancy

Drinking alcohol during pregnancy may have negative effects on the fetus's development, such as the onset of fetal alcohol syndrome[43]. Women in the reproductive age group have unique considerations and possible consequences when it comes to alcohol intake. It is unknown what the ideal alcohol intake is for women who are pregnant or may become pregnant[44]. Children who are exposed to alcohol during pregnancy may experience behavioural, cognitive, and physical issues that could eventually lead to fetal alcohol spectrum disorders[45]. Furthermore, drinking alcohol while pregnant may increase the risk of premature labour . In fetal subjects exposed to alcohol, Jones and Smith (1973) reported a condition that included facial dysmorphology, central nervous system dysfunction, and growth retardation. It is concerning that 10% of pregnant women continue to drink alcohol on a monthly basis despite continuing decreases in alcohol use during pregnancy[46]. According to recent estimates, one to five percent of American babies are affected with fetal alcohol spectrum disease (FASD).Even when alcohol intake was limited to an average of one drink per day (about 14 grams of alcohol), a prospective study including nearly 31,000 mothers revealed that kids' birth weight was lower[47]. Children as young as eight years old who consume at least 3.5 standard U.S. servings (14 grams each) of alcohol per week had lower IQ scores, especially if they have one of four genetic variations in the genes responsible for alcohol metabolism. Even moderate to low levels of alcohol use have been linked to developmental, motor, and cognitive delays, while the negative effects of alcohol exposure seem to be most noticeable during the first trimester. Recent research suggests that the father's alcohol consumption prior to conception may affect the fetus's development and subsequent alcohol consumption[48].

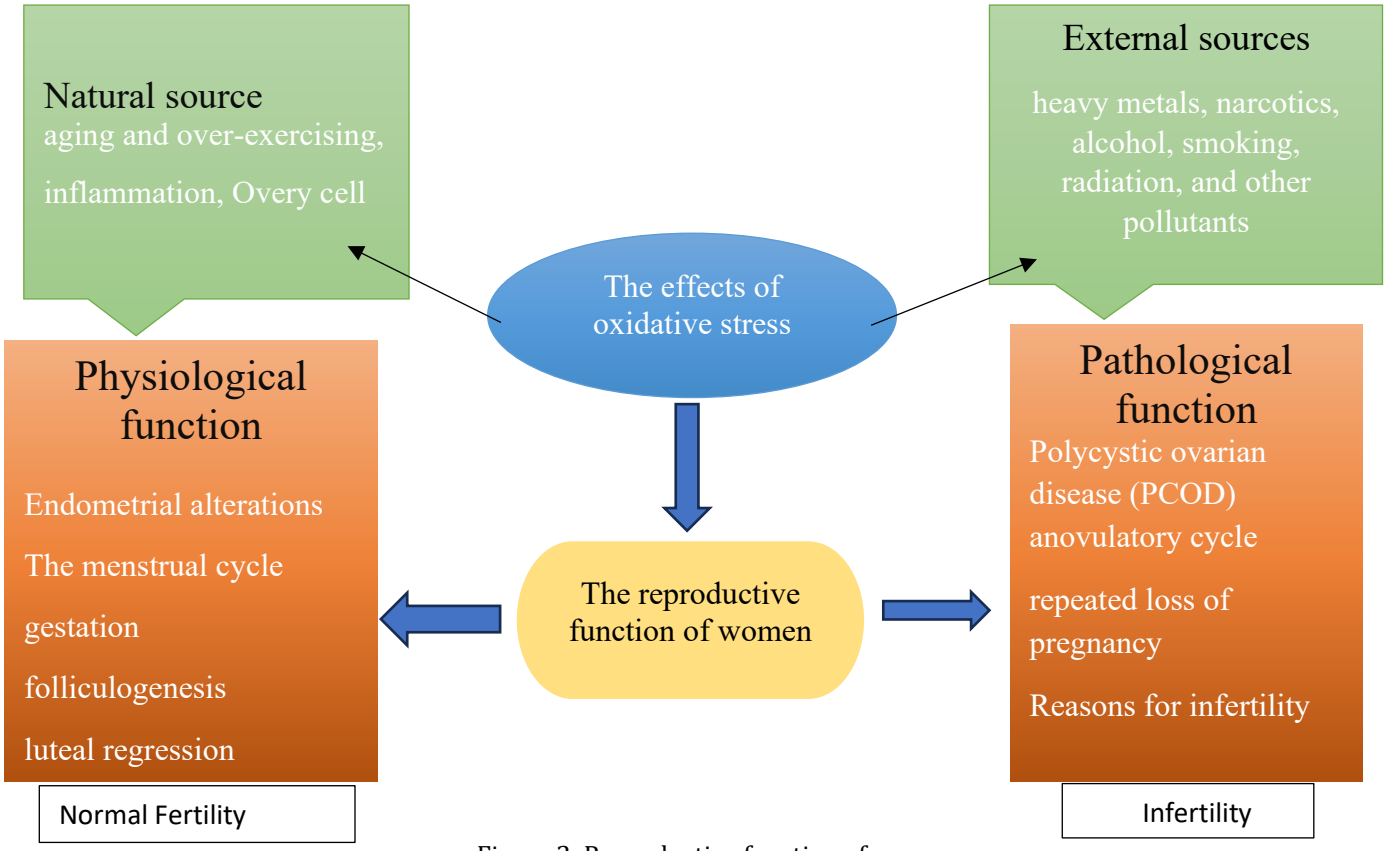


Figure 2: Reproductive function of women

6. Molecular mechanism of alcohol induced female infertility:

Through a variety of biological pathways, including the hypothalamic-pituitary-ovarian (HPO) axis, oocyte quality, oxidative stress levels, and epigenetic alterations, alcohol consumption impairs female fertility[49].

6.1 A disturbance of the HPO (Hypothalamus-Pituitary-Ovarian axis) -Alcohol changes hypothalamus function, lowering the secretion of gonadotropin-releasing hormone (GnRH), which in turn lowers levels of luteinizing hormone (LH) and follicle-stimulating hormone (FSH). Both ovulation and follicular development depend on these substances[50]. Elevated Cortisol Levels Stress brought on by alcohol raises cortisol levels, which further reduces levels of reproductive hormones by preventing the release of GnRH. Changed Estrogen and Progesterone Levels: Alcohol can cause anovulation and irregular menstrual periods by interfering with the liver's metabolism of estrogen. On the other hand, it lowers progesterone, which is necessary to get the uterus ready for implantation[51].

6.2 Stress from Oxidation and Mitochondrial Dysfunction - Reactive oxygen species (ROS), which are produced during alcohol metabolism, put ovarian cells under oxidative stress[52]. ROS harm the mitochondria of oocytes, which reduces ATP synthesis and lowers oocyte quality. Defective follicular development results from oxidative stress's effects on granulosa cells, which facilitate oocyte maturation and hormone synthesis[53]. Additionally, too much ROS causes ovarian cells to undergo apoptosis, or cell death, which lowers ovarian reserve and fertility[54].

6.3. DNA damage and epigenetic modifications - Oocyte Epigenetic Alterations Telomere Shortening Chronic alcohol exposure speeds up telomere shortening in ovarian cells, causing premature ovarian aging; Histone Modification Alcohol changes histone acetylation and methylation in reproductive cells, affecting gene expression essential for fertility; and Alcohol disturbs methylation patterns in developing oocytes, impairing embryonic development and raising the risk of miscarriage[55].

6.4. Premature ovarian failure (POF) and impaired follicle development - Reduced Anti-Müllerian Hormone (AMH) Levels AMH is a marker of ovarian reserve, and alcohol consumption lowers AMH, indicating diminished ovarian function[56]. Increased Follicular Atresia Alcohol promotes apoptosis in follicles, leading to reduced ovarian reserve and premature ovarian failure[57].

6.5. Uterine Receptivity and Implantation Failure - Endometrial Receptivity Disrupted Alcohol decreases uterine receptivity to embryos by interfering with progesterone receptor signalling[58]. Dysfunction of the Vascular System Alcohol harms the blood arteries in the uterus, which impairs placental development and raises the risk of miscarriage[59].

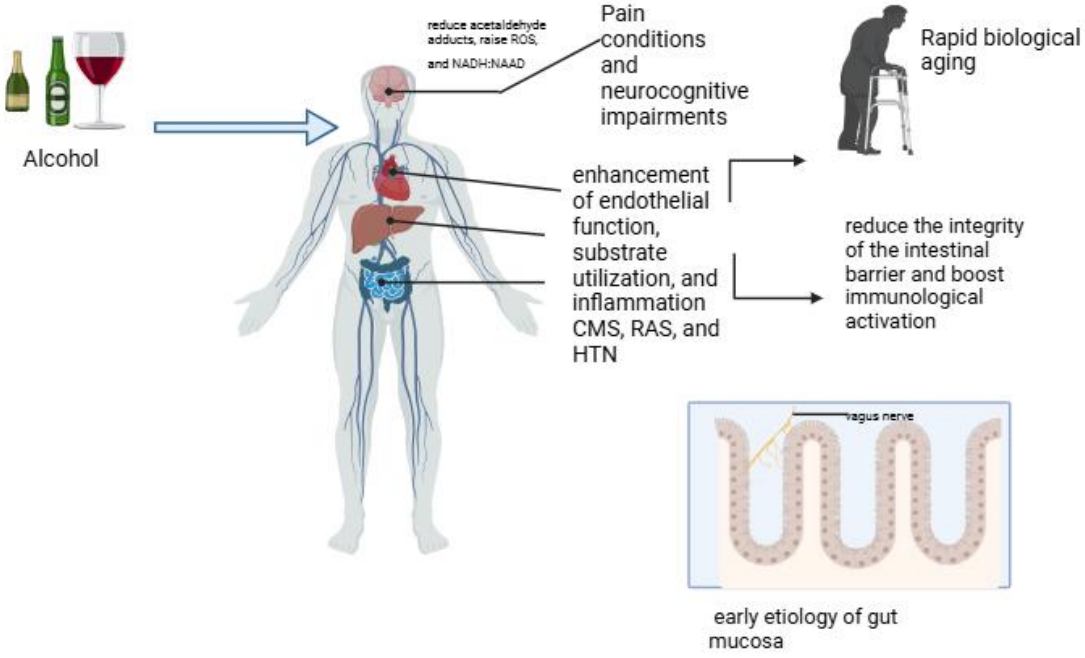


Figure 3: Alcohol interaction

7. Impact of alcohol on Sertoli cells:

The ability of Sertoli cells to preserve the blood-testis barrier and control the milieu required for sperm maturation can be hampered by oxidative stress, inflammation, and structural damage brought on by prolonged alcohol exposure[60]. Sertoli cell function is further compromised by alcohol-induced disturbances in hormonal balance, namely decreases in testosterone and follicle-stimulating hormone (FSH) levels, which results in lower sperm production and quality[61]. Male infertility can also be made worse by alcohol-related toxicity, which can cause Sertoli cells to undergo apoptosis, or cell death. There is a higher chance of long-term reproductive dysfunction with chronic heavy alcohol consumption, and these negative effects are frequently dose-dependent[62].

8. Impact of alcohol on hypothalamus pitutary gonadal axis:

Alcohol suppresses gonadotropin-releasing hormone (GnRH) secretion at the hypothalamus level by interfering with kisspeptin neurons, which are necessary for triggering GnRH pulses[63]. Alcohol also raises β-endorphins and cortisol, which further inhibit the production of GnRH. Ovarian function is disrupted as a result of the pituitary gland secreting less luteinizing hormone (LH) and follicle-stimulating hormone (FSH)[64]. A slowed LH surge limits ovulation, while lowered FSH levels impede follicular growth, resulting to irregular menstrual cycles and infertility[65]. By changing the activity of the aromatase enzyme, alcohol disrupts the ovary's ability to produce estrogen and progesterone, leading to hormonal imbalances[66]. While low progesterone levels interfere with implantation and raise the chance of early pregnancy loss, chronic alcohol consumption can result in excess estrogen, which can cause anovulation. Additionally, oxidative stress brought on by alcohol causes follicular atresia, or cell death, which lowers ovarian reserve and raises the risk of premature ovarian failure (POF)[67].

9. Impact of alcohol on oogenesis:

Chronic alcohol consumption can change the secretion of important reproductive hormones like follicle-stimulating hormone (FSH) and luteinizing hormone (LH), resulting in irregular ovulation or anovulation; alcohol-induced oxidative stress can reduce the quality and viability of oocytes (egg cells) at various stages of development, increasing the risk of chromosomal abnormalities, which can lead to infertility, miscarriages, or developmental defects in offspring; and long-term alcohol exposure has also been linked to premature ovarian failure and a decline in ovarian reserve, further reducing reproductive potential[68]. The length of time and amount of alcohol consumed determine how severe these effects are; long-term heavy drinking poses the greatest risk to female fertility[69].

10. Alcohol's effects on prenatal development and harm:

alcohol readily crosses the placenta, the fetus is exposed to its harmful effects, which may disrupt normal development and growth. Fetal alcohol syndrome (FAS), which is marked by growth limitations, neurodevelopmental impairments, and facial deformities, is one of the most severe consequences [70]. By causing oxidative stress, preventing neuronal cell migration, and changing neurotransmitter systems, alcohol interferes with brain development and causes cognitive deficiencies, learning disabilities, and behavioral issues[71]. Alcohol consumption can also result in organ deformities, skeletal abnormalities, and congenital heart problems[72]. Even tiny doses of alcohol can have negative effects since the fetal liver is immature and cannot process it effectively[73]. The amount, frequency, and timing of alcohol exposure all affect how severe fetal harm is; binge drinking is the most dangerous. Complete abstinence is advised to avoid fetal injury because there is now no established safe threshold of alcohol use during pregnancy[74].

11. Impact of alcohol on spontaneous abortion :

Women who consume more than two drinks per day are more likely to experience spontaneous abortion and stillbirth, which are frequently caused by placental abruption[75]. Although these studies do not sufficiently account for the higher gravidity seen among heavy drinkers, retrospective surveys of women from the general population and obstetric populations in the United States have also revealed this link. Retrospective designs, low power, or the use of subpar alcohol consumption measurements may have hampered studies that have failed to show a link between high alcohol use and spontaneous abortion. Ethnicity and beverage type may also have an impact on the risks of spontaneous abortion associated with alcohol[76].

12. Alcohol's effects on gynecological cancers:

gynecological cancers, such as endometrial, ovarian, and breast cancers. Because alcohol raises estrogen levels, it can encourage the unchecked growth of hormone-sensitive tissues, especially in malignancies of the breast and endometrium[77]. Additionally, it contributes to DNA damage, oxidative stress, and compromised immunological function—all of which can promote the development of cancer[78]. Acetaldehyde, a poisonous substance that disrupts DNA repair processes and raises mutation rates, is also produced during the metabolism of alcohol, increasing the risk of cancer[79]. Chronic alcohol use is also linked to lifestyle choices including smoking, obesity, and poor food, all of which increase the risk of gynecological cancers[80]. Drinking more alcohol over an extended period of time increases the risk of developing cancer, and the risk is dose-dependent[81]. Limiting or abstaining from alcohol can help lower the risk of certain cancers and promote general reproductive health, even though moderate alcohol use may still contribute to the development of cancer[82].

13. Health Burden and Societal Effects

Alcohol-related female infertility represents a significant health challenge by disturbing hormonal equilibrium, hindering ovulation, and heightening the likelihood of reproductive issues like polycystic ovarian syndrome (PCOS), early ovarian failure, and menstrual

abnormalities[83]. These biological impacts frequently result in emotional suffering, such as depression, anxiety, and sensations of loneliness. The impacts on society are especially evident in cultures where a woman's social status and identity are tightly connected to her fertility. Women dealing with infertility can encounter stigma, relationship issues, or even domestic abuse[84]. From an economic standpoint, the expenses associated with infertility diagnosis and treatment—particularly in low-resource environments—impose a significant financial burden on families and healthcare systems[85]. Furthermore, the lack of unified care models that merge reproductive health with addiction support services intensifies the issue. In general, infertility caused by alcohol impacts not only personal well-being but also adds to larger societal issues concerning gender disparity, healthcare availability, and public health costs[86].

13.1 Socioeconomic Impacts

Alcohol-related female infertility carries significant socioeconomic repercussions that go beyond personal health, profoundly impacting families, communities, and national economies[87]. Infertility can result in significant personal costs for diagnosis and treatment, encompassing hormonal therapies, assisted reproductive technologies (ART), and mental health support—all of which are frequently unavailable to women in low-income or rural areas. The financial strain is even more significant in nations lacking universal health coverage or government-assisted fertility services[88]. A decline in fertility may also impact a woman's job opportunities, particularly in industries where motherhood or reproductive ability is culturally esteemed or necessary[89]. In conventional societies, infertility can result in social ostracism or separation, reducing a woman's financial stability and exposing her to the dangers of poverty or reliance. At the community level, the pressure on healthcare systems from escalating infertility cases leads to higher public health expenditures, diverting funds from other essential sectors[90]. On a national scale, decreasing fertility rates—partially driven by alcohol use and reproductive issues—can affect trends in population growth, sustainability of the workforce, and productivity of the economy. Moreover, in areas with excessive alcohol consumption and low awareness, the cycle of poverty and inadequate reproductive health continues through generations[91]. These socioeconomic effects highlight the critical requirement for policy investments in education on reproductive health, prevention of alcohol misuse, and accessible infertility treatment services to alleviate the strain on individuals and society overall[92].

13.2 Pressure on Medical Care Systems

Female infertility caused by alcohol is increasingly straining healthcare systems, especially in nations already facing limited medical resources and escalating reproductive health challenges[93]. With an increasing number of women facing fertility issues associated with alcohol consumption, there is a growing need for specialized services like gynecological consultations, hormonal treatments, assisted reproductive technologies (ART), diagnostic imaging, and lab testing. This heightened demand frequently burdens reproductive health clinics, particularly in public hospitals, resulting in extended waiting times, diminished quality of care, and unequal access[94]. Moreover, numerous health systems do not offer integrated care models that merge addiction treatment with reproductive health services, leading to disjointed and ineffective management of patients impacted. Mental health services encounter increased demands, as women experiencing infertility frequently need psychological counseling and emotional assistance to manage anxiety, depression, and societal stigma[95]. In rural and low-income areas, the burden grows even heavier due to a lack of trained personnel, equipment, and medications, where healthcare infrastructure is already weak. The combined impact not only increases healthcare expenses but also redirects essential resources away from preventive and primary care. To ease this burden, system-level reforms are necessary, which include enhancing capacity, providing cross-disciplinary training, implementing early intervention strategies, and integrating policies that connect substance abuse prevention with women's reproductive health services[96].

13.3 Lack of Awareness and Educational Gaps

One of the most critical barriers to addressing alcohol-induced female infertility is the widespread lack of awareness and persistent educational gaps among women, families, and even healthcare providers[97]. In many communities, the connection between alcohol consumption and impaired reproductive health is poorly understood or entirely overlooked[98]. Women of reproductive age often consume alcohol socially or habitually without recognizing its potential to disrupt hormonal balance, damage ovarian function, or reduce fertility. This lack of knowledge is compounded by cultural taboos and misinformation surrounding both infertility and alcohol use, especially in conservative or rural settings[99]. Educational institutions and public health campaigns rarely emphasize the reproductive consequences of alcohol as part of broader health education. Even within healthcare systems, many general practitioners and gynecologists do not consistently screen for alcohol use or provide counseling on its fertility-related risks[100]. As a result, opportunities for early intervention and prevention are frequently missed. Furthermore, the absence of tailored educational materials—especially in local languages or for low-literacy populations—limits outreach and engagement[101]. This educational gap extends to men and families, who often influence reproductive choices and alcohol use patterns. To address these shortcomings, it is essential to implement comprehensive, culturally sensitive awareness programs, integrate alcohol education into reproductive health curricula, and train healthcare providers to routinely assess and address alcohol-related fertility risk[102].

14. Policies at the National Level and Worldwide Guidelines -

14.1 Organizational Standards and Global Protocols:

Numerous prominent global and regional health organizations have established guidelines and protocols to tackle the effects of alcohol on reproductive health, especially regarding female fertility[103]. The World Health Organization (WHO) establishes the worldwide standard with its Global Strategy to Mitigate the Harmful Use of Alcohol, highlighting women of reproductive age as a key demographic and encouraging nations to adopt alcohol regulation policies, educational initiatives, and health system incorporation. The WHO works together with the United Nations Population Fund (UNFPA) and World Bank to integrate alcohol risk evaluation into reproductive and maternal health services[104]. The Centers for Disease Control and Prevention (CDC) in the U.S. advises regular alcohol screening for women of childbearing age during primary care and reproductive health evaluations. Likewise, the European Public Health Association (EUPHA) supports the inclusion of alcohol consumption history in preconception advice and fertility therapies[105]. At the clinical level, organizations such as the American Society for Reproductive Medicine (ASRM) and the Royal College of Obstetricians and Gynaecologists (RCOG) have published guidelines advising against alcohol consumption in women attempting to conceive and suggest behavioral strategies for patients at risk[106]. These standards advance a preventive, evidence-driven strategy by incorporating alcohol-related reproductive risk evaluations into gynecological appointments, fertility centers, and public health initiatives. Nonetheless, in spite of these protocols being accessible, implementation varies greatly across regions, especially in areas with limited resources. Numerous countries do not possess the institutional capability or training structures to effectively implement these international standards. Going forward, a more cohesive and enforceable framework of worldwide reproductive health guidelines is required—one that acknowledges the biological dangers of alcohol exposure on fertility while also addressing the socioeconomic and cultural factors that affect alcohol consumption among women[107].

14.2 Interventions Tailored to Specific Countries

Acknowledging the varied cultural, economic, and social factors impacting alcohol use and reproductive health, numerous nations have introduced specific interventions to tackle the issue of alcohol-related female infertility[108]. In India, government programs like the National Health Mission (NHM) and the Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+A) framework include alcohol awareness as part of wider maternal health education, particularly in rural and tribal regions where customary alcohol consumption is prevalent[109]. Nonetheless, these initiatives frequently emphasize fetal alcohol syndrome over female infertility, highlighting a necessity for specialized fertility-oriented components. In the United States, the Fetal Alcohol Spectrum Disorders (FASD) prevention initiatives by the CDC incorporate preconception counseling and substance abuse evaluations in women's health services, particularly targeting underserved populations[110]. Simultaneously, Australia's National Alcohol Strategy incorporates culturally relevant initiatives created in partnership with Indigenous communities, addressing issues of reproductive harm and intergenerational impacts. South Africa, grappling with significant levels of alcohol abuse and infertility, has incorporated alcohol cessation assistance into HIV and reproductive health clinics, acknowledging the shared risks among women of childbearing age[111]. In Norway and Sweden, alcohol prevention initiatives are incorporated into national sexual and reproductive health education programs starting in adolescence, alongside state-funded fertility services that track alcohol consumption. These countries also have centralized health databases that assist in monitoring alcohol's effects on reproductive results[112]. Even with these tailored strategies for each country, disparities continue in low- and middle-income countries (LMICs), where interventions frequently face challenges due to insufficient resources, stigma associated with infertility, and a shortage of gender-focused addiction services. Thus, expanding successful interventions necessitates localized studies, community involvement, and the incorporation of alcohol-related fertility assistance into current healthcare systems[113].

Discussion And Conclusion

Research from international and domestic sources, backed by experimental and clinical findings, unmistakably demonstrates that exposure to alcohol—especially ethanol and similar substances—represents a major risk to women's reproductive health. In various populations and regions, alcohol interferes with the normal operation of the hypothalamic-pituitary-ovarian axis, changes hormone levels, and triggers oxidative stress, all of which hinder ovulation and endometrial receptiveness. This biological effect is amplified in nations where alcohol consumption is rising among women due to changing cultural standards, urban development, and lack of understanding. The challenge is especially significant in low- and middle-income countries (LMICs), where reproductive care access is restricted and there is almost no educational outreach on the effects of alcohol on reproduction. At the national level, although a few high-income countries have included alcohol screening in reproductive health guidelines, the majority of nations do not have cohesive policies or specific interventions that tackle the connection between alcohol consumption and female fertility. Simultaneously, the logical burden highlighting the preventable aspect of alcohol-related infertility points to a significant gap: this largely preventable public health concern continues to exist because of inadequate education, lax policy enforcement, and insufficient healthcare infrastructure. Alcohol exposure is a significant but often overlooked factor contributing to female infertility globally. Its influence is intricately connected to biological, social, economic, and cultural elements, resulting in a complex burden. There is a pressing requirement for cohesive strategies that merge public health education, clinical screening, and policy enforcement on both global and national levels. Logically, decreasing alcohol intake in women of reproductive age is a practical and economical measure that can markedly enhance fertility results. Tackling this concern demands collaboration across sectors, culturally aware

engagement, and robust political commitment to prioritize reproductive health within alcohol regulation policies. Future studies should focus on long-term, population-centered research to enhance causal understanding and inform evidence-based recommendations. In the end, safeguarding women's fertility from alcohol-related damage is both a medical necessity and a social and moral obligation.

Conflict of interest: The authors declare that they have no conflict of interest.

Acknowledgement: The authors are thankful to the management and principal, Columbia Institute of Pharmacy, Raipur (C.G.) for providing the necessary facilities to complete this review article.

Funding: We do not receive any funding from any source for this review article.

Author's Contribution:

Trilochan Satapathy: Review and proofreading.

Kamaksha Tiwari: Conceptualization, Writing – original draft preparation

Pratibha Dhiwar: Visualization

Nikita Patel: Grammar Correction

Laxmi Sahu: Tables and Figures

References

1. Zhou Y, Zheng J, Li S, Zhou T, Zhang P, Li HB. Alcoholic beverage consumption and chronic diseases. International journal of environmental research and public health. 2016 Jun;13(6):522. https://doi.org/10.3390/ijerph13060522

2. De Goeij MC, Suhrcke M, Toffolutti V, van de Mheen D, Schoenmakers TM, Kunst AE. How economic crises affect alcohol consumption and alcohol-related health problems: a realist systematic review. Social science & medicine. 2015 Apr 1;131:131-46. https://doi.org/10.1016/j.socscimed.2015.02.025

3. Ghaffari F, Arabipoor A. The role of conception type in the definition of primary and secondary infertility. International journal of reproductive biomedicine. 2018 May;16(5):355. https://doi.org/10.29252/ijrm.16.5.355

4. Bala R, Singh V, Rajender S, Singh K. Environment, lifestyle, and female infertility. Reproductive sciences. 2021 Mar;28(3):617-38. https://doi.org/10.1007/s43032-020-00279-3

5. Zeinab H, Zohreh S, Gelehkolaee KS. Lifestyle and outcomes of assisted reproductive techniques: a narrative review. Global journal of health science. 2015 Feb 24;7(5):11. https://doi.org/10.5539/gjhs.v7n5p11

6. Inhorn MC, Patrizio P. Infertility around the globe: new thinking on gender, reproductive technologies and global movements in the 21st century. Human reproduction update. 2015 Jul 1;21(4):411-26. https://doi.org/10.1093/humupd/dmv016

7. Obeagu EI, Njar VE, Obeagu GU. Infertility: Prevalence and consequences. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(7):43-50. https://doi.org/10.22270/ijmspr.v10i4.123

8. Tanbo T, Mellembakken J, Bjercke S, Ring E, Åbyholm T, Fedorcsak P. Ovulation induction in polycystic ovary syndrome. Acta obstetricia et gynecologica Scandinavica. 2018 Oct;97(10):1162-7. https://doi.org/10.1111/aogs.13395

9. Chikritzhs T, Livingston M. Alcohol and the Risk of Injury. Nutrients. 2021 Aug 13;13(8):2777. https://doi.org/10.3390/nu13082777

10. Popova S, Charness ME, Burd L, Crawford A, Hoyme HE, Mukherjee RA, Riley EP, Elliott EJ. Fetal alcohol spectrum disorders. Nature reviews Disease primers. 2023 Feb 23;9(1):11. https://doi.org/10.1038/s41572-023-00420-x

11. Sarkar M, Brady CW, Fleckenstein J, Forde KA, Khungar V, Molleston JP, Afshar Y, Terrault NA. Reproductive health and liver disease: practice guidance by the American Association for the Study of Liver Diseases. Hepatology. 2021 Jan;73(1):318-65. https://doi.org/10.1002/hep.31559

12. Das PK, Mukherjee J, Banerjee D. Female reproductive physiology. InTextbook of veterinary physiology 2023 Sep 1 (pp. 513-568). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-9410-4_22

13. BAZER FW, ROBERTS RM, THATCHER WW. Actions of hormones on the uterus and effect on conceptus development. Journal of animal science. 1979 Jan 1;49(suppl_II):35-45. https://doi.org/10.1093/ansci/49.Supplement_II.35

14. Nagy B, Szekeres-Barthó J, Kovács GL, Sulyok E, Farkas B, Várnagy Á, Vértes V, Kovács K, Bódis J. Key to life: physiological role and clinical implications of progesterone. International journal of molecular sciences. 2021 Oct 13;22(20):11039. https://doi.org/10.3390/ijms222011039

15. Mulia N, Bensley KM. Alcohol-related disparities among women: Evidence and potential explanations. Alcohol Research: Current Reviews. 2020 Sep 3;40(2):09. https://doi.org/10.35946/arcr.v40.2.09

16. McCartt AT, Hellinga LA, Kirley BB. The effects of minimum legal drinking age 21 laws on alcohol-related driving in the United States. Journal of Safety Research. 2010 Apr 1;41(2):173-81. https://doi.org/10.1016/j.jsr.2010.01.002

17. Bartram A, Eliott J, Crabb S. 'Why can't I just not drink?'A qualitative study of adults' social experiences of stopping or reducing alcohol consumption. Drug and Alcohol Review. 2017 Jul;36(4):449-55. https://doi.org/10.1111/dar.12461

18. Visontay R, Sunderland M, Slade T, Wilson J, Mewton L. Are there non-linear relationships between alcohol consumption and long-term health?: a systematic review of observational studies employing approaches to improve causal inference. BMC medical research methodology. 2022 Dec;22:1-28. https://doi.org/10.1186/s12874-021-01486-5

19. Bell S, Britton A. An exploration of the dynamic longitudinal relationship between mental health and alcohol consumption: a prospective cohort study. BMC medicine. 2014 Dec;12:1-3. https://doi.org/10.1186/1741-7015-12-91

20. Lubau NS, Chengebroyen N, Subramaniyan V. Investigation of Uncovering Molecular Mechanisms of Alcohol-Induced Female Infertility-A Rational Approach. Reproductive Sciences. 2024 Nov 1:1-3. https://doi.org/10.1007/s43032-024-01692-8

21. Room R, Babor T, Rehm J. Alcohol and public health. The lancet. 2005 Feb 5;365(9458):519-30. https://doi.org/10.1016/S0140-6736(05)17870-2

22. Schliep KC, Zarek SM, Schisterman EF, Wactawski-Wende J, Trevisan M, Sjaarda LA, Perkins NJ, Mumford SL. Alcohol intake, reproductive hormones, and menstrual cycle function: a prospective cohort study. The American Journal of Clinical Nutrition. 2015 Oct 1;102(4):933-42. https://doi.org/10.3945/ajcn.114.102160

23. Gavaler JS. Alcoholic beverages as a source of estrogens. Alcohol Health and Research World. 1998;22(3):220.

24. Rachdaoui N, Sarkar DK. Pathophysiology of the effects of alcohol abuse on the endocrine system. Alcohol research: current reviews. 2017;38(2):255.

25. Drescher-Burke KM. Alcohol, substance use, and birth control. University of California, Berkeley; 2008.

26. Tobias ME. Effects of chronic alcohol consumption and folate supplementation on the mouse mammary gland. State University of New York at Buffalo; 2009.

27. Chavarro JE, Rich-Edwards JW, Rosner BA, Willett WC. Caffeinated and alcoholic beverage intake in relation to ovulatory disorder

infertility. Epidemiology. 2009 May 1;20(3):374-81. https://doi.org/10.1097/EDE.0b013e31819d68cc

28. Dasgupta A. Alcohol and its biomarkers: clinical aspects and laboratory determination. Elsevier; 2015 Feb 18.

29. Danduga RC, Kurapati AS, Shaik RA, Kola PK, Konidala SK, Varada HB. Synergistic Amelioration of Letrozole-induced Polycystic Ovary Syndrome in Rats: A Therapeutic Approach with Apple Cider Vinegar and Metformin Combination. Reproductive Sciences. 2024 Sep;31(9):2861-76. https://doi.org/10.1007/s43032-024-01545-4

30. Araoye MO. Epidemiology of infertility: social problems of the infertile couples. West African journal of medicine. 2003;22(2):190-6. https://doi.org/10.4314/wajm.v22i2.27946

31. Pourreza A, Sadeghi A, Amini-Rarani M, Khodayari-Zarnaq R, Jafari H. Contributing factors to the total fertility rate declining trend in the Middle East and North Africa: a systemic review. Journal of Health, Population and Nutrition. 2021 Dec;40:1-7. https://doi.org/10.1186/s41043-021-00239-w

32. Mascarenhas MN, Flaxman SR, Boerma T, Vanderpoel S, Stevens GA. National, regional, and global trends in infertility prevalence since 1990: a systematic analysis of 277 health surveys. PLoS medicine. 2012 Dec 18;9(12):e1001356. https://doi.org/10.1371/journal.pmed.1001356

33. World Health Organization. Infertility prevalence estimates, 1990-2021. World Health Organization; 2023 Apr 4.

34. Abebe MS, Afework M, Abaynew Y. Primary and secondary infertility in Africa: systematic review with meta-analysis. Fertility research and Practice. 2020 Dec;6:1-1 https://doi.org/10.1186/s40738-020-00090-3

35. Jabeen F, Khadija S, Daud S. Prevalence of primary and secondary infertility. Saudi Journal of Medicine. 2022;7(1):22-8. https://doi.org/10.36348/sjm.2022.v07i01.004

36. Small CM, Manatunga AK, Klein M, Feigelson HS, Dominguez CE, McChesney R, Marcus M. Menstrual cycle characteristics: associations with fertility and spontaneous abortion. Epidemiology. 2006 Jan 1;17(1):52-60. https://doi.org/10.1097/01.ede.0000190540.95748.e6

37. Nasri H, van Den Brand H, Najjar T, Bouzouaia M. Egg storage and breeder age impact on egg quality and embryo development. Journal of Animal Physiology and Animal Nutrition. 2020 Jan;104(1):257-68. https://doi.org/10.1111/jpn.13240

38. Bhardwaj JK, Paliwal A, Saraf P. Effects of heavy metals on reproduction owing to infertility. Journal of Biochemical and Molecular Toxicology. 2021 Aug;35(8):e22823. https://doi.org/10.1002/jbt.22823

39. Chang Y, Li J, Li X, Liu HE, Liang X. Egg quality and pregnancy outcome in young infertile women with diminished ovarian reserve. Medical science monitor: international medical journal of experimental and clinical research. 2018 Oct 12;24:7279. https://doi.org/10.12659/MSM.910410

40. Saxov KR. Average alcohol consumption and binge drinking during pregnancy-characteristics of the women who drink and the association with miscarriage and fertility.

41. Sadeu JC, Hughes CL, Agarwal S, Foster WG. Alcohol, drugs, caffeine, tobacco, and environmental contaminant exposure: reproductive health consequences and clinical implications. Critical reviews in toxicology. 2010 Aug 1;40(7):633-52. https://doi.org/10.3109/10408444.2010.493552

42. Agenor A, Bhattacharya S. Infertility and miscarriage: common pathways in manifestation and management. Women's health. 2015 Jul;11(4):527-41. https://doi.org/10.2217/WHE.15.19

43. Ornoy A, Ergaz Z. Alcohol abuse in pregnant women: effects on the fetus and newborn, mode of action and maternal treatment. International journal of environmental research and public health. 2010 Feb;7(2):364-79. https://doi.org/10.3390/ijerph7020364

44. Raymond N, Beer C, Glazebrook C, Sayal K. Pregnant women's attitudes towards alcohol consumption. BMC public health. 2009 Dec;9:1-8. https://doi.org/10.1186/1471-2458-9-175

45. Riley EP, McGee CL. Fetal alcohol spectrum disorders: an overview with emphasis on changes in brain and behavior. Experimental biology and medicine. 2005 Jun;230(6):357-65. https://doi.org/10.1177/15353702-0323006-03

46. Ethen MK, Ramadhani TA, Scheuerle AE, Canfield MA, Wyszynski DF, Druschel CM, Romitti PA, National Birth Defects Prevention Study. Alcohol consumption by women before and during pregnancy. Maternal and child health journal. 2009 Mar;13:274-85. https://doi.org/10.1007/s10995-008-0328-2

47. May PA, Chambers CD, Kalberg WO, Zellner J, Feldman H, Buckley D, Kopald D, Hasken JM, Xu R, Honerkamp-Smith G, Taras H. Prevalence of fetal alcohol spectrum disorders in 4 US communities. Jama. 2018 Feb 6;319(5):474-82. https://doi.org/10.1001/jama.2017.21896

48. McBride N, Johnson S. Fathers' role in alcohol-exposed pregnancies: systematic review of human studies. American journal of preventive medicine. 2016 Aug 1;51(2):240-8. https://doi.org/10.1016/j.amepre.2016.02.009

49. Bala R, Singh V, Rajender S, Singh K. Environment, lifestyle, and female infertility. Reproductive sciences. 2021 Mar;28(3):617-38. https://doi.org/10.1007/s43032-020-00279-3

50. Rachdaoui N, Sarkar DK. Pathophysiology of the effects of alcohol abuse on the endocrine system. Alcohol research: current reviews. 2017;38(2):255.

51. Song Y, Li R. Effects of environment and lifestyle factors on anovulatory disorder. Environment and female reproductive health. 2021:113-36. https://doi.org/10.1007/978-981-33-4187-6_5

52. Devine PJ, Perreault SD, Luderer U. Roles of reactive oxygen species and antioxidants in ovarian toxicity. Biology of reproduction. 2012 Feb 1;86(2):27-1. https://doi.org/10.1095/biolreprod.111.095224

53. Wang L, Tang J, Wang L, Tan F, Song H, Zhou J, Li F. Oxidative stress in oocyte aging and female reproduction. Journal of cellular physiology. 2021 Dec;236(12):7966-83. https://doi.org/10.1002/jcp.30468

54. Yan F, Zhao Q, Li Y, Zheng Z, Kong X, Shu C, Liu Y, Shi Y. The role of oxidative stress in ovarian aging: a review. Journal of ovarian research. 2022 Sep 1;15(1):100. https://doi.org/10.1186/s13048-022-01032-x

55. Zhu Z, Xu W, Liu L. Ovarian aging: mechanisms and intervention strategies. Medical Review. 2023 Feb 10;2(6):590-610. https://doi.org/10.1515/mr-2022-0031

56. Moolhuijsen LM, Visser JA. Anti-Müllerian hormone and ovarian reserve: update on assessing ovarian function. The Journal of Clinical Endocrinology & Metabolism. 2020 Nov;105(11):3361-73. https://doi.org/10.1210/clinem/dgaa513

57. Hsueh AJ, Billig H, Tsafriri A. Ovarian follicle atresia: a hormonally controlled apoptotic process. Endocrine reviews. 1994 Dec 1;15(6):707-24. https://doi.org/10.1210/edrv-15-6-707

58. Ye Q, Zeng X, Cai S, Qiao S, Zeng X. Mechanisms of lipid metabolism in uterine receptivity and embryo development. Trends in Endocrinology & Metabolism. 2021 Dec 1;32(12):1015-30. https://doi.org/10.1016/j.tem.2021.09.002

59. D'Angelo A, Peracchini M, Agostini A, Di Matteo C, Fiore M, Ceccanti M, Vitali M, Messina MP. the impact of oxidative stress on pregnancy. The Neglected role of alcohol misuse. La Clinica Terapeutica. 2024 Feb 18;175(1).

60. Dutta S, Sengupta P, Slama P, Roychoudhury S. Oxidative stress, testicular inflammatory pathways, and male reproduction. International journal of molecular sciences. 2021 Sep 17;22(18):10043. https://doi.org/10.3390/ijms221810043

61. Finelli R, Mottola F, Agarwal A. Impact of alcohol consumption on male fertility potential: a narrative review. International journal of environmental research and public health. 2021 Dec 29;19(1):328. https://doi.org/10.3390/ijerph19010328

62. Condorelli RA, Calogero AE, Vicari E, La Vignera S. Chronic consumption of alcohol and sperm parameters: our experience

and the main evidences. Andrologia. 2015 May;47(4):368-79. https://doi.org/10.1111/and.12284

63. Prashar V, Arora T, Singh R, Sharma A, Parkash J. Hypothalamic kisspeptin neurons: integral elements of the GnRH system. Reproductive Sciences. 2023 Mar;30(3):802-22. https://doi.org/10.1007/s43032-022-01027-5

64. Ilie IR. Neurotransmitter, neuropeptide and gut peptide profile in PCOS-pathways contributing to the pathophysiology, food intake and psychiatric manifestations of PCOS. Advances in Clinical Chemistry. 2020 Jan 1;96:85-135. https://doi.org/10.1016/bs.acc.2019.11.004

65. Kumar P, Sait SF. Luteinizing hormone and its dilemma in ovulation induction. Journal of human reproductive sciences. 2011 Jan 1;4(1):2-7. https://doi.org/10.4103/0974-1208.82351

66. Purohit V. Can alcohol promote aromatization of androgens to estrogens? A review. Alcohol. 2000 Nov 1;22(3):123-7. https://doi.org/10.1016/S0741-8329(00)00124-5

67. Shi YQ, Zhu XT, Zhang SN, Ma YF, Han YH, Jiang Y, Zhang YH. Premature ovarian insufficiency: a review on the role of oxidative stress and the application of antioxidants. Frontiers in Endocrinology. 2023 Aug 1;14:1172481. https://doi.org/10.3389/fendo.2023.1172481

68. Song Y, Li R. Effects of environment and lifestyle factors on anovulatory disorder. Environment and female reproductive health. 2021:113-36. https://doi.org/10.1007/978-981-33-4187-6_5

69. Bala R, Singh V, Rajender S, Singh K. Environment, lifestyle, and female infertility. Reproductive sciences. 2021 Mar;28(3):617-38. https://doi.org/10.1007/s43032-020-00279-3

70. Scott-Goodwin AC, Puerto M, Moreno I. Toxic effects of prenatal exposure to alcohol, tobacco and other drugs. Reproductive Toxicology. 2016 Jun 1;61:120-30. https://doi.org/10.1016/j.reprotox.2016.03.043

71. Pervin Z, Stephen JM. Effect of alcohol on the central nervous system to develop neurological disorder: pathophysiological and lifestyle modulation can be potential therapeutic options for alcohol-induced neurotoxication. AIMS neuroscience. 2021 Apr 9;8(3):390. https://doi.org/10.3934/Neuroscience.2021021

72. Baumann P, Schild C, Hume RF, Sokol RJ. Alcohol abuse-a persistent preventable risk for congenital anomalies. International Journal of Gynecology & Obstetrics. 2006 Oct 1;95(1):66-72. https://doi.org/10.1016/j.ijgo.2006.05.033

73. Chaudhuri JD. Alcohol and the developing fetus-a review. Medical Science Monitor. 2000 Sep 1;6(5):1031-41.

74. O'LEARY CM, Bower C. Guidelines for pregnancy: what's an acceptable risk, and how is the evidence (finally) shaping up?. Drug and alcohol review. 2012 Mar;31(2):170-83. https://doi.org/10.1111/j.1465-3362.2011.00331.x

75. Tikkanen M. Placental abruption: epidemiology, risk factors and consequences. Acta obstetricia et gynecologica Scandinavica. 2011 Feb;90(2):140-9. https://doi.org/10.1111/j.1600-0412.2010.01030.x

76. Kline J, Stein Z, Shrout P, Susser M, Warburton D. Drinking during pregnancy and spontaneous abortion. The Lancet. 1980 Jul 26;316(8187):176-80. https://doi.org/10.1016/S0140-6736(80)90062-8

77. Micallef Fava A. The role of biochemical markers and genetic susceptibility in the pathogenesis of hormone dependent malignancies.

78. Jelic MD, Mandic AD, Maricic SM, Srdjenovic BU. Oxidative stress and its role in cancer. Journal of cancer research and therapeutics. 2021 Jan 1;17(1):22-8. https://doi.org/10.4103/jcrt.JCRT_862_16

79. Brooks PJ, Zakhari S. Acetaldehyde and the genome: beyond nuclear DNA adducts and carcinogenesis. Environmental and molecular mutagenesis. 2014 Mar;55(2):77-91. https://doi.org/10.1002/em.21824

80. Rieck G, Fiander A. The effect of lifestyle factors on gynaecological cancer. Best practice & research Clinical obstetrics & gynaecology. 2006 Apr 1;20(2):227-51. https://doi.org/10.1016/j.bpobgyn.2005.10.010

81. Lieber CS, Garro A, Leo MA, Mak KM, Worner T. Alcohol and cancer. Hepatology. 1986 Sep 1;6(5):1005-19. https://doi.org/10.1002/hep.1840060533

82. Anderson BO, Berdzuli N, Ilbawi A, Kestel D, Kluge HP, Krech R, Mikkelsen B, Neufeld M, Poznyak V, Rekve D, Slama S. Health and cancer risks associated with low levels of alcohol consumption. The Lancet Public Health. 2023 Jan 1;8(1):e6 https://doi.org/10.1016/S2468-2667(22)00317-6

83. Lubau NS, Chengebroyen N, Subramaniyan V. Investigation of Uncovering Molecular Mechanisms of Alcohol-Induced Female Infertility-A Rational Approach. Reproductive Sciences. 2024 Nov 1:1-3. https://doi.org/10.1007/s43032-024-01692-8

84. Whiteford LM, Gonzalez L. Stigma: the hidden burden of infertility. Social science & medicine. 1995 Jan 1;40(1):27-36. https://doi.org/10.1016/0277-9536(94)00124-C

85. Njagi P, Groot W, Arsenijevic J, Dyer S, Mburu G, Kiarie J. Economic costs of infertility care for patients in low-income and middle-income countries: a systematic review protocol. BMJ open. 2020 Nov 1;10(11):e042951. https://doi.org/10.1136/bmjopen-2020-042951

86. Thoma M, Fledderjohann J, Cox C, Adageba RK. Biological and social aspects of human infertility: a global perspective. InOxford research encyclopedia of global public health 2021 Mar 25. https://doi.org/10.1093/acrefore/9780190632366.013.184

87. Saxov KR. Average alcohol consumption and binge drinking during pregnancy-characteristics of the women who drink and the association with miscarriage and fertility.

88. Khanlou N, Haque N, Skinner A, Mantini A, Kurtz Landy C. Scoping review on maternal health among immigrant and refugee women in Canada: prenatal, intrapartum, and postnatal care. Journal of pregnancy. 2017;2017(1):8783294. https://doi.org/10.1155/2017/8783294

89. Brewster KL, Rindfuss RR. Fertility and women's employment in industrialized nations. Annual review of sociology. 2000 Jan 1:271-96. https://doi.org/10.1146/annurev.soc.26.1.271

90. Ombelet W, Cooke I, Dyer S, Serour G, Devroey P. Infertility and the provision of infertility medical services in developing countries. Human reproduction update. 2008 Nov 1;14(6):605-21. https://doi.org/10.1093/humupd/dmn042

91. Greene ME, Merrick T. Poverty reduction: Does reproductive health matter?. World Bank, Washington, DC; 2005 Jul 1. https://doi.org/10.1596/13722

92. Sesay SM. Gender Dynamics and the Socioeconomic Implications of Infertility in Sierra Leone: A Study on Health, Social Stigmatization, and Economic Impact. World Journal of Public Health. 2024 Oct;9(4):313-21. https://doi.org/10.11648/j.wjph.20240904.11

93. Barrera N, Omolaoye TS, Du Plessis SS. A contemporary view on global fertility, infertility, and assisted reproductive techniques. InFertility, Pregnancy, and Wellness 2022 Jan 1 (pp. 93-120). Elsevier. https://doi.org/10.1016/B978-0-12-818309-0.00009-5

94. Elmusharaf K, Byrne E, O'Donovan D. Strategies to increase demand for maternal health services in resource-limited settings: challenges to be addressed. BMC public health. 2015 Dec;15:1-0. https://doi.org/10.1186/s12889-015-2222-3

95. Hamid OA, Alrawaili ND, Alrawaili BD, Alanazi WS, Alanazi FS. Female Infertility Associated Depression and Anxiety: A Comprehensive Review. Metallurgical and Materials Engineering. 2024 Dec 14;30(4):370-80.

96. Shi L. The impact of primary care: a focused review. Scientifica. 2012;2012(1):432892. https://doi.org/10.6064/2012/432892

97. Hadley R. The impact of male involuntary childlessness on men's health across the life course: implications for individuals, healthcare providers and practitioners. InJournal of Men's Health:

Abstracts of the Proceedings of the Men's Health World Congress 2023 2023 Dec 30 (Vol. 19, No. 12, pp. 129-130). MRE Press.

98. Glasier A, Gülmezoglu AM, Schmid GP, Moreno CG, Van Look PF. Sexual and reproductive health: a matter of life and death. The Lancet. 2006 Nov 4;368(9547):1595-607. https://doi.org/10.1016/S0140-6736(06)69478-6

99. Tohit NF, Haque M. Forbidden conversations: A comprehensive exploration of taboos in sexual and reproductive health. Cureus. 2024 Aug 12;16(8).

100. Trawick E, Pecoriello J, Quinn G, Goldman KN. Guidelines informing counseling on female age-related fertility decline: a systematic review. Journal of Assisted Reproduction and Genetics. 2021 Jan;38:41-53. https://doi.org/10.1007/s10815-020-01967-4

101. Keifer MC, Reyes I, Liebman AK, Juarez-Carrillo P. The use of audience response system technology with limited-english-proficiency, low-literacy, and vulnerable populations. Journal of agromedicine. 2014 Jan 2;19(1):44-52. https://doi.org/10.1080/1059924X.2013.827998

102. Sommer M, Mmari K. Addressing structural and environmental factors for adolescent sexual and reproductive health in low-and middle-income countries. American journal of public health. 2015 Oct;105(10):1973-81. https://doi.org/10.2105/AJPH.2015.302740

103. World Health Organization. Global status report on alcohol and health 2018. World Health Organization; 2019 Feb 14.

104. Canton H. United Nations Population Fund-UNFPA. InThe Europa Directory of International Organizations 2021 2021 Jul 28 (pp. 283-285). Routledge. https://doi.org/10.4324/9781003179900-36

105. Shawe J, Delbaere I, Ekstrand M, Hegaard HK, Larsson M, Mastroiacovo P, Stern J, Steegers E, Stephenson J, Tydén T. Preconception care policy, guidelines, recommendations and services across six European countries: Belgium (Flanders), Denmark, Italy, the Netherlands, Sweden and the United Kingdom. The European Journal of Contraception & Reproductive Health Care. 2015 Mar 4;20(2):77-87. https://doi.org/10.3109/13625187.2014.990088

106. Baker PN, McEwan AS, Arulkumaran S, Datta ST, Mahmood TA, Reid F, Shafi MI, Aiken C, editors. Gynaecology: Prepare for the MRCOG E-book: Key articles from the Obstetrics, Gynaecology & Reproductive Medicine journal. Elsevier Health Sciences; 2015 Oct 12.

107. Emokpae MA, Brown SI. Effects of lifestyle factors on fertility: practical recommendations for modification. Reproduction and Fertility. 2021 Jan 8;2(1):R13-26. https://doi.org/10.1530/RAF-20-0046

108. Lim AW, Van Schalkwyk MC, Maani Hessari N, Petticrew MP. Pregnancy, fertility, breastfeeding, and alcohol consumption: an analysis of framing and completeness of information disseminated by alcohol industry-funded organizations. Journal of studies on alcohol and drugs. 2019 Sep;80(5):524-33. https://doi.org/10.15288/jsad.2019.80.524

109. Pati S, Chauhan AS, Mahapatra P, Hansdah D, Sahoo KC, Pati S. Weaved into the cultural fabric: A qualitative exploration of alcohol consumption during pregnancy among tribal women in Odisha, India. Substance abuse treatment, prevention, and policy. 2018 Dec;13:1-9. https://doi.org/10.1186/s13011-018-0146-5

110. Chico-Jarillo TM. Prevention of Alcohol Exposed Pregnancies and Fetal Alcohol Spectrum Disorders and Conceptualizing the Adaptation Process for Health Promotion Programs in Urban American Indian/Alaska Native Communities (Doctoral dissertation, The University of Arizona).

111. Zietsman L. Exploring the value of mentorship programmes as a preventative strategy for prenatal alcohol use for at risk women in the South Africa (Doctoral dissertation, Stellenbosch: Stellenbosch University).

112. Poznyak V, Fleischmann A, Rekve D, Rylett M, Rehm J, Gmel G. The World Health Organization's global monitoring system on alcohol and health. Alcohol research: current reviews. 2014;35(2):244.

113. Schmitz HP. The global health network on alcohol control: successes and limits of evidence-based advocacy. Health policy and planning. 2016 Apr 1;31(suppl_1):i87-97. https://doi.org/10.1093/heapol/czu064