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Review Article

Tobacco addiction and infertility in India: an overview

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ABSTRACT

Tobacco addiction is one of the oldest known addictions with annual death toll of three million. And India is the second largest consumer of tobacco in the world because of easy availability of variety of smoking and smokeless tobacco products in the market. This has made the situating very complex in India, as the same tobacco generating billions of revenues for India is also a financial burden over the health care sector. Tobacco is a risk factor for approximately 50 serious health care diseases including infertility. But it is surprising that only 22% of the general population are familiar with the reproductive risks associated with smoking. This shear ignorance has led to increase in smoking among women too. Tobacco use not only decrease fecundity and reproductive potential of the individual, but also causes relationship disharmony among the already emotional wrecked infertile couple. Though this stress might be the contributory factor towards tobacco abuse but ironically this tobacco use further escalates the financial 'stress' in these couples. Multiple attempts may be required during the process of quitting and the likelihood of success increases with each attempt. The ultimate key is counselling, education, and encouragement at each clinical visit.

Keywords: Smoking, Tobacco, Infertility

INTRODUCTION

Smoking, one of the oldest known addictions is the new rage. The attribution of smoking to health can be estimated from annual death toll of three million due to smoking, which is forecasted to rise upto ten millions within coming three to four decades.[1] Apart from contributing to increased mortality, smoking also causes premature death in approximately 50%.[1]

Despite being a well-known global killer, it is probably the glamour associated with smoking that has camouflaged its' adverse effects. With its peak in the 1980's, the culture of tobacco consumption seems to be re-normalized by advertisements, entertainment media and pop culture. The on-screen puffing fascinates the youth, idealizing it to be the real representation of life. Compared to women, smoking is more rampant in men of all age groups, with prevalence of 21.9% in 25-44 years age category paralleled to 20.7% in females in the same age cohort.[2]

Smoking is a modifiable risk factor associated with an array of diseases and increases the risk for more than 50 serious health conditions. 7 out of 10 smoking individuals might develop carcinoma lung besides other cancers like oral, nasopharynx, larynx, bowel, bladder, kidney, liver and pancreas.[3]

In pregnant females, smoking increases the likelihood of several complications including preterm delivery, intrauterine growth restriction, placental abruption, placenta previa, preterm premature rupture of membranes, and perinatal mortality. Due to ignorance amongst the general population, the harmful effects of cigarette smoke on fecundity and reproduction are often overlooked. Only 22% of the females are familiar with the reproductive risks associated with smoking.[4]

The prevalence of infertility has been increasing globally with total burden being 48.5 million in 2010.[5] According to the ISAR (Indian Society of Assisted Reproduction),

infertility currently affects about 10 to 14 percent of the Indian population, with higher rates in urban areas where one out of six couples is affected. Nearly 27.5 million couples actively trying to conceive suffer from infertility in India.[6] While the true prevalence and geographical afflictions of infertility in India is largely unknown in view of the massive heterogenous landmass, 39.3% of females in urban areas of central India, suffering with infertility are between 25-29 years age group.[7]

INDIA AND TOBACCO USE

India is the second largest consumer of tobacco in the world after China. Approximately 266.8 million Indian population currently use tobacco in any one of the forms and bypasses China in terms of smokeless tobacco users.[8,9]

The availability of variety of smoking and smokeless tobacco products and a number of combinations makes the situation in India far more complex than any other country in the world. Smokeless forms of tobacco include khaini, gutkha, betel quid with tobacco and zarda whereas bidi, cigarette and hookah constitute smoking forms of tobacco.[10]

The global adult tobacco survey (GATS) shows the average age of initiating tobacco was 17.8 years, with higher usage among males (19% vs 2% in females).[9] Majority of these encompass smokeless tobacco users (199.4 million). The real nuisance is the smoking form of tobacco because it also exposes the surrounding 38.7% people to second hand smoke.[9]

Despite propagating that no form of tobacco is safe, market is flooded with various forms of tobacco products and their substitutes. Tobacco products, like e-cigarettes, hookahs, edibles, heat-not-burn cigarettes, and smokeless tobacco, contain over 7000 chemicals as regular combustible cigarettes and therefore are not the safer forms as usually perceived.[11]

The fad of smoking 'light', 'mild', 'hand rolled', 'natural', and 'herbal' cigarettes is just a substitute for regular cigarette and no better. Besides physical effects of tobacco on health, its use also exerts economic loss. In the year 2002-2003, it has been reported that India had spent approximately Rs. 300 billion (US$ 6.2 billion) in public and private spending on the treatment of tobacco-related diseases.[12]

Another study reported that the direct cost of treating four major tobacco-related noncommunicable diseases amounted to Rs. 54 billion (US$ 1.2 billion) in 2004, or 4.7% of India's national health care expenditure that year.[13] This estimate rose to Rs. 104,500 crores in the year 2011, of which 16% was related to direct costs and 84% was related to indirect costs.[13] Despite such consequences, tobacco economics appears to be the prime reason that government is not banning tobacco use in India. The revenue generated in 2019 from cigarettes across India was approximately 348 billion rupees.[14]

EFFECT OF TOBACCO USE ON THE COUPLE

Male and female factors contribute to one-third causes of infertility independently whereas the causes remain unexplained in the rest of the cases. Active smoking delays the conception by 6-12 months duration. Interestingly, despite increased awareness regarding the untoward effects of smoking, knowledge regarding risk of infertility is only confined to 22% of the general public.[15] Though association seen between smoking and decreased fecundity is generally consistent across studies, but true causation is yet to be established.[15] A dose dependent relationship has also been demonstrated in various studies.[16] However, in some studies the effects on fertility were seen only in women smoking more than 20 cigarettes per day, but a trend for all levels of smoking was identified.[15] Another study reported that even smoking half pack a day has been associated consistently with decreased fecundity.[17] Fortunately this decrease in fecundity was found to be reversible with cessation of tobacco usage.[18]

Relationships can also influence and exacerbate unhealthy health risk behaviour. Despite understanding the detrimental relationship of smoking and infertility, it has been demonstrated that over time individuals tend to take up partners' unhealthy behaviour. Surprisingly, it has also been observed that it is less likely for males to quit even when the female partner has become pregnant.[19] Nevertheless, it has been seen that smokers are more likely to quit if both partners quit at same time.[20] On the other hand, living with a heavy smoking spouse has been associated with a decreased likelihood of smoking cessation.[21] Also the level of relationship satisfaction might influence the tobacco use because couples are likely to quit smoking if they perceive their relationship as highly satisfying with stronger influence on female smoker than male smoker.[22]

Deemed as 'stress-buster'; this is the explanation as well as the coping mechanism that is most often used by the smokers.[23] Ironically the money spent on buying these cigarettes takes a toll on the available income and contributes to financial stress. Siahpush et al revealed that smoking households with a higher percentage of expenditure on tobacco are predisposed to increased chances of financial turmoil.[24] This financial stress is not limited to low socio-economic status, but even exists among high income households too.[24] Besides financial stress, tobacco also contributes to development and perpetuation of anxiety disorders via modulation of fear, memory and emotion processing by nicotine.[25]

The couples suffering from infertility are already overwhelmed with emotional disturbances ranging from frustration and anxiety to depression, hopelessness, guilt, and feelings of worthlessness in life.[26] Inherent higher cost of infertility treatment further adds misery to their already

strained relationship. Over the top, tobacco consumption amplifies their distress, eventually beginning a downhill journey for the couple, only to end in the whirlpool of despair, hopelessness, addiction and endless complications.

CHANGING TRENDS

Among the various forms of tobacco available, smoking is the most common form associated with infertility. Over the past couple of decades, there has been an added concern among the policy makers and implementers regarding the alarming rise in smoking prevalence among women in both developed and developing countries.[27] The National Family health survey demonstrated two fold increase in the prevalence of smoking amongst women from 1.4% to 2.9% during 2005-2010.[28] Over the same time smoking among men significantly fell from 33.4% to 24.3% ($p<0.001$), causing the ratio of smokers (males to females) to drastically fall from 23.9 to 8.4.[28] This finding resonates with Lopez et al descriptive model of the tobacco epidemic which propounds regarding rising number of female smokers in low and middle income countries. Smoking amongst the female gender falsely represents autonomy, modernity, emancipation, sophistication and sexual allure, making females easy targets to marketing gimmicks.[29]

TOBACCO USE AND FEMALE INFERTILITY

There are approximately 7000 chemicals in cigarette smoke which appear to accelerate the ovarian follicular depletion leading to loss of reproductive function. Both active and passive smoking increases the FSH levels as compared to non-smokers and impedes the urinary oestrogen excretion, possibly because constituents of tobacco smoke inhibit granulosa cell aromatase.[30-32]

AMH levels, considered gold standard to mimic ovarian reserve biochemically, declines 21% faster with every passing year in smokers in contrast to non-smokers. However, this fall was not significantly seen in reformed or passive smokers.[34] Consequent to this fall in AMH, infertility develops necessitating the need for assisted reproductive techniques. But due to exposure to tobacco toxins like cadmium, the oocytes are exposed to oxidative stress and the oocyte quality degrades.[35] Even when these females undergo *in vitro* fertilization, the mean dose of gonadotropins required increases as compared to their non-smoking counterparts.[36] Each year that the women has smoked, there is 9% increased risk of an unsuccessful IVF cycle.[37] The effect of smoking on ovary culminates into premature menopause, approximately 1-4 years earlier further predisposing the females to menopause related health hazards.[38]

TOBACCO USE AND MALE INFERTILITY

All forms of tobacco have shown dose dependent adverse effects on multiple semen parameters.[39] Tobacco chewing, even the mild chewer, had delterious impact on semen parameters like defects in sperm head and cytoplasmic residue.[40]

Azoospermia and oligoasthenozoospermia increases with increase in levels of tobacco chewing addiction.[39] Both active and passive smoking has demonstrated decrease in sperm density, motility, antioxidant activity, and a possible adverse effect even on the sperm morphology.[41] Although sperm concentration, motility, and/or morphology often are reduced compared with results observed in non-smokers, they often remain within the normal range. A study based on zona free penetration test demonstrated impaired binding of sperm to zona pellucida among smokers, highlighting physiological derangements in the sperms too apart from obvious anatomical anomalies.[42]

STOPPING TOBACCO USE: 'FOR ONCE AND ALL

Unassisted smoking cessation in India is very low, unlike in the West.[43] In India, tobacco users mostly quit only after development of some serious ailments. GATS 2 survey reported that 55.4% of the smokers wanted to quit smoking and 49.6% wanted to stop smokeless tobacco use.[9] India has initiated a national quit tobacco programme in 2015 where the person can register himself/herself with the national registry and reap benefits.[44]

Various interventions including behavioural modification, group counselling, feedback, advice, and weaning nicotine with patches and gum have proven effective. The response of infertile females to smoking cessation is far better with counselling, education, and encouragement at each clinical visit. Those under evaluation or treatment for infertility, on an average have tried three attempts to quit smoking previously and also the likelihood of achieving complete remission increases with each attempt.[45] Women should be counselled that the substantial reproductive risks associated with smoking can be reversed within a year of smoking cessation.[46]

With better understanding of nicotine pharmacology, several drugs including bupropion and varnecline have been developed and proven to be very effective to achieve de-addiction. When the behavioural therapy fails, medical adjunctive therapy like nicotine replacement therapy (NRT), bupropion and varinecline increases the chances of smoking cessation.[47]

NRT is available in various forms like gum, lozenges, and patches (available over the counter) as well as nasal sprays and inhalers (prescription only). Of note, nasal sprays and inhalers should be avoided by those seeking infertility treatment. Both varinecline and bupropion are FDA approved non-nicotine based smoking cessation agents where varinecline is approximately 60% more effective for smoking cessation.[48] Despite these pharmacological advancements, Cochrane database 2015 shows that behavioural intervention still beats pharmacotherapy hands down for smokeless tobacco cessation.[49]

CONCLUSION

The dreaded evil, namely smoking, with its easy availability, cheap price, high addictive potential and social acceptance, is rampantly infiltrating our society and has turned to become a national menace. It is the need of the hour for each individual to understand the detrimental effects of tobacco and join hands to help each other fight this peril and build a tobacco-free society.

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