Introduction

In the last three decades, India has significantly improved its population's health status and quality of life. Since 1970s, infant mortality has fallen by half and life expectancy has increased from 50 years to 65 years. In the present scenario, stabilizing population size is the national priority and the need of male participation in family welfare programs is the current topic of debate among health professionals. However, involvement of men in reproductive health services both in the field of adopting contraceptive methods as well as in evaluation of infertility in couples still remains inadequate.

Reproductive health is a state of complete physical, mental and social well being that is essential for a productive life, it is not mealy the absence of disease or infirmity. Health development and maintenance depend upon the quality of health care, which involves self-care, care by the family, the community and the health care system(s). In this wider concept, reproductive health is not merely the absence of disorder of reproductive processes, function or system among the individuals of different age groups, but it enables men to have a responsible, safe and enjoyable sex life, and provides them the right, freedom, choice, ability, desire and opportunity to regulate their fertility (WHO, 1978).

Infertility, one of the basic components of reproductive health is a world–wide problem of all communities; the cause and magnitude varying with geographical location and socio-economic status. Globally, 60-80 million couples are reported to suffer from infertility, of which 15-20 million are in India alone (WHO, 1996). In spite of such a high prevalence, infertility has been relatively neglected in South Asia for greater thrust being directed towards population control (Jejeebhoy, 1998).

Approximately, 8-10% couples in their reproductive age are infertile (WHO, 1992). The incidence of infertility in newly married couples is gradually
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increasing in industrialized countries from 8% in early 1960s to almost 20-30% today (Frick, 1996), and there has been decline in sperm count over the last 50 years (Carlsen et al, 1992). Such a high magnitude of problem has raised enough panic in the world and needs multi-dimensional diagnostic and management system, as Infertility involves couple as a unit.

Infertility is defined as the failure to conceive after two years of regular unprotected sexual cohabitation (WHO, 1991). According to American Fertility Society, if pregnancy does not occur after one year of unprotected cohabitation, the couple is considered to be infertile (Roy, 1992).

Infertility is synonymous with sub-fertility. Primary infertility applies to those who have never conceived whereas secondary infertility is attributed to those who have conceived at least once. Sterility is an intrinsic inability to achieve pregnancy. It has been estimated that in the USA, 1 in 6 couples is infertile and 1-2% of couples are involuntarily sterile (Martin, 1994).

Both partners in a relationship contribute to potential fertility, and both may be sub-fertile. In the couples presenting for infertility evaluation, 30% infertility is due to female factor, 40% is due to male factor, another 20 to 30% due to couple factor (Martin, 1994).

Among 6000 couples surveyed by WHO, it has been shown that the male factor infertility was identified in 51.1% of couples (Puri et al, 2000). Obviously, there is intensive demand to improve men’s attitude towards their intimate behavior and social relationship to attain positive sexual and reproductive outcome rather than making their female partner to feel responsible and guilty. Infertility is not fatal but it carries with it a social stigma and a sense of personal failure. It deprives a couple of personal happiness, unique relationship with children, the feeling of parenthood and inflicts a devastating trauma on the individual. Most of these couples suffer in silence.

The overall incidence of primary infertility is about 10-15%, but varies from country to country and among different population groups; whereas,
secondary infertility may be even higher (20-30% or more) particularly in rural areas among poor socio-economic groups. Many conditions of secondary infertility are preventable through hygienic health practices and early diagnosis and treatment (Roy, 1992).

The etiology of infertility in men is multi-factorial. It could be congenital, physiological, pathological, environmental, idiopathic and also due to certain lifestyle. The most common causes of male infertility could be classified as Pre-Testicular, Testicular and Post-Testicular (Sperm transport) defects (Graffin and Wilson, 1992).

**Pre-Testicular defects are** mainly due to endocrine disorders

a) Hypothalamic-Pituitary disorders - isolated gonadotropin deficiency (Kallmann's syndrome), isolated FSH deficiency.

b) Acquired gonadotropin deficiency- Cushing's syndrome, hyperprolactenemia, congenital adrenal hyperplasia, hemachromatosis induced hypogonadism (Graffin and Wilson, 1992).

**Testicular defects are**

a) Developmental and structural disorders – Chromosomal disorders (Klinefelter syndrome, XX male syndrome), germ cell aplasia, Sertoli cell–only syndrome, Cryptorchidism, Varicocele, Immotile cilia syndrome.

b) Acquired testicular disorders- Viral orchitis, trauma, radiation exposure, drugs, environmental toxins, autoimmunity and due to diseases like diabetes mellitus, hypertension and tuberculosis.

c) Defects associated with systemic and neurological diseases- Liver disease, renal failure, sickle cell disease, myotonic dystrophy and paraplegia.

d) Androgen resistance (Graffin and Wilson, 1992).
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Post testicular defects are

a) Disorders of sperm transport - Congenital or acquired obstruction of epididymis, vas deferens due to cystic fibrosis, vasectomy; and congenital absence or abnormality of ejaculatory system.

b) Disorders of sperm motility or function - Congenital defects of sperm maturation, sperm tail, immunological disorders and infections.

c) Sexual dysfunction- retrograde ejaculation, impotence and decreased libido (Graffin and Wilson, 1992).

Male fertility is declining in the western world quite rapidly due to modern lifestyle. The testicles were designed to hang free and cool. Anything which raises them up to body temperature (hot water baths, sauna baths, tight jeans & underwear, cycling, long driving and even over exercise) reduces fertility (Jejeebhoy, 1998). Even occupational exposure to heat is a significant risk factor for male infertility (Thonneau et al, 1998).

Cigarette or marijuana smoking

Intake of recreational drugs like cocaine and anabolic steroids (even infrequent consumption) and heavy alcohol consumption affect sperm count, motility and the fertilizing ability of spermatozoa (Jejeebhoy, 1998).

Sexually Transmitted Diseases (STDs) and Reproductive Tract Infections (RTIs)

An increasing proportion of infertility in developing countries is also due to STDs and reproductive tract infections . WHO study reports that in Asia, among men with demonstrable causes, about one in three is probably infertile as a result of STD experience (Jejeebhoy, 1998).
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Antioxidants

One of the possible etiologies of idiopathic male infertility is susceptibility of sperm cell membrane to oxidative stress. The controlled production of reactive oxygen species such as superoxide anions, hydrogen peroxide and nitric oxide are useful for fertilization; but disruption of their production balance causes sperm cell damage. Supplementation with antioxidants like Vitamin C, E, glutathione and selenium alone or in combination have shown remarkable improvements in sperm motility and their fertilizing ability. Vitamin B12 and folic acid are required for the synthesis of genetic material, DNA. Their deficiency causes decreased sperm motility and count (Steven, 2000).

Environmental risk factors


American Society of Reproductive Medicine has published association between aromatic solvent exposure and impaired semen parameters. Relatively poor semen parameters of painters and varnishers are also due to toxins (Tielemans et al, 1999). In addition, exposure to environmental estrogens and pesticides has been linked to alterations in spermatogenesis (De Celis et al, 1996).

Electrolytes and Trace Elements

A little variation in trace element concentrations through diet or any other source has produced dramatic improvements in fertility regulation of human subjects. Zinc is an essential trace mineral for normal functioning of male reproductive system. Numerous biochemical mechanisms are Zn dependent, including more than 200 enzymes in the body (Favier, 1993). Zinc deficiency is associated with decreased testosterone level and sperm count. An adequate Zn level ensures proper sperm motility and production. Zn levels in seminal plasma are generally lower in infertile men with diminished sperm
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count. Several studies have found that supplemental Zn may prove helpful in treating male infertility (Madding et al, 1986).

On the other hand, certain trace elements have severe toxic effects on reproductive functions. Even moderate exposure to aluminium, lead, cadmium and copper can significantly reduce the semen quality in terms of sperm density, motility, viability, and increased sperm head defects (Mur et al, 1998, Telisman et al, 2000).

Occupational exposure to manganese and electric welding fumes has been reported to have direct toxic effects on sperm production. Semen volume, sperm count and sperm viability is significantly lowered and liquefaction of semen takes longer time (Wu et al, 1996).

Although, considerable progress has been made towards understanding sperm physiology and biology of gamete interaction, yet more work is needed to achieve objectivity and standardization of andrological diagnostic methods used in the clinical setting. More information is needed to definitively establish which tests are more accurate predictors of sperm performance (Oehninger, 2001)

Unfortunately, at least 25-40% of infertile men have idiopathic infertility for which the cause has not been identified (Gopalakrishnan et al, 1996). Hopefully, more known causes will be discovered as knowledge of male reproductive physiology expands.

The physiological role of trace elements in relation to male infertility is still to be explored fully although, the studies on element content of semen had been started long back when Bertrand and Vladesco (1921) first reported high levels of Zinc in human semen (Abou–Shakra et al, 1989). The estimation of zinc, iron, magnesium, copper, cadmium, selenium and lead in semen of fertile and infertile males have been a focus of attention for the past four to five decades (Mann and Lutwak-Mann, 1981)
Only a limited number of studies have been able to look at the multi-
elemental content of human tissues and fluids related to male infertility such
as whole semen, seminal plasma and spermatozoa but their role in infertility is
yet to be established (Umeyama et al, 1986 and Abou –Shakra et al, 1989).

The present study has been designed to evaluate the semen profile
and to find a correlation between the trace element composition in serum,
seminal plasma and spermatozoa in both fertile and infertile men.

The study has been designed to evaluate a possible correlation of
fertility status of men with semen biochemistry by comparing the levels of
lactic dehydrogenase, fructose, neutral α-glucosidase and citric acid with
sperm functions. In addition, hormone profile and histopathology of testes has
also been done to rule out certain underlying causes of infertility.

An attempt has also been made to highlight the trace element profile of
people working in metal industry, welding industry and heat furnace for more
than 5 years and its effect on their fertility status.