Lifestyle and Occupation patterns with poor semen quality: A cross sectional analysis

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Research

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Abstract

Background

Infertility is a major problem persisting all around the world. According to WHO the rate of infertility is approximately 15% worldwide and it differ from geographical location, ethnicity and social status. Lifestyle habits, environmental and occupational hazards, physical parameters can be recognized as major risk factors which may affect male infertility. The objective of this study was to determine factors associated with male infertility in Sri Lanka.

Methods

A cross sectional study was conducted on 299 individuals participated for an infertility clinic in a Teaching hospital in Sri Lanka. Socio-demographic, occupational and environmental characteristics were collected using interviewer administered questionnaire. Semen samples were collected from each participant for laboratory investigations. Sperm concentration and motility, morphology and viability of sperms were measured.

Results

Out of total participants, 30.1% of participants had a sperm concentration of < 15 × 10⁶ and the sperm mortality was < 32% in 34.7% participants. Older age, tobacco smokers, individuals using tight under wears and individuals exposed to either heat or chemical hazards were identified as risk groups with low sperm concentration and low semen volume. In addition, older age, individuals using tight under wears and individuals exposed to either heat or chemical hazards were significantly associated with low or abnormal sperm mortality and morphology. Individuals having diabetes showed a significantly higher non-motility rate of sperms. Alcohol usage, betel chewing, mumps, special radiation exposure, body mass index and waist circumference were not significantly associated with semen parameters.

Conclusion

Older age, tobacco smoking, wearing tight underwear, occupational exposures, and diabetes mellitus has shown a great risk for the generation of poor semen parameters, which can lead to male infertility. Furthermore it is very important to carry out extended studies regarding this problem to establish the effect of above factors.

Introduction

Infertility is a disease unable to achieve the pregnancy after 12 months or more of regular sexual intercourse without using contraceptive methods of couples [1, 2]. At present about 30 million men around the world suffer from infertility around the world, ranging from 10–15% of couples, even up to 30% in some regions [3]. More than 90% of male infertility cases are as a result of low sperm concentration and poor semen quality [4].

Male fertility can be influenced by a variety of environmental, occupational and lifestyle factors that contribute to the weakening of semen quality [5, 6]. Working in high temperatures, exposure to radiation, electromagnetic waves and chemical substances, mumps, stress and alcoholism were reported as risk factors for male infertility [7–10]. Abnormalities of sperms can be caused by number of factors such as congenital birth defects, diseases, chemical

exposure and lifestyle habits. In addition, wearing tight underwear, tight pants for a long period of time can cause testicular heating and drugs such as cocaine, marijuana can temporally reduce the sperm quality [4]. Marijuana can alter the ability of the sperms to swim and penetrate the egg. Heavy alcohol consumption and smoking may impair the sperm quality. Obesity and emotional stress impair hormonal levels and cause serious fertility defects.

Prevalence of global infertility rates is difficult to estimate since the presence of complicating factors belongs to both genders. Sometimes it becomes more difficult to estimate the infertility since it only addresses the women and outcome of pregnancy [11]. In addition, lesser rates of primary infertility were observed in younger ages in males than higher ages [12]. According to Hewabatage et al. 2017, a total of 26.4% male factors were contributed to primary infertility in Sri Lanka and 33% out of which are due to poor semen quality [13].

The identification of risk factors precisely and measurement of the possible effects against semen parameters individually or collectively, could be very important in minimizing the levels of male infertility. In the Sri Lankan setting, the prevalence of the possible harmful factors and their effect on the people exposed to them is not thoroughly studied yet. Nevertheless, a study on environmental and occupational exposures as a cause of male infertility has been conducted [14]. An effort to detect any association between these factors and the quality of semen with the quality of semen should be very useful in the diagnosis and treatment of male infertility. Therefore, this study was designed to determine the impact of lifestyle, physical and occupational factors for the generation of poor semen parameters leads to male infertility in Sri Lanka.

Methods

Study design

A cross sectional study was conducted in infertility clinics and the Andrology laboratory at a Teaching hospital in Sri Lanka. Convenient sampling method was used to include patients to the study. All the male patients between the age group of 18–50 years old referred from the infertility clinic during the period of 1st of June to 31st of October 2017 for seminal fluid analysis were selected. A total of 299 patients diagnosed as primary infertile were selected for the study within the study period. Patients participated for this clinic from all provinces in Sri Lanka. Individuals with ongoing infertility treatment, with cancer treatments such as radiotherapy and chemotherapy, with suspected reproductive system infections / fever within one month / sexually transmitted infections (STI), drug addicts, with underlying medical conditions/ physical disabilities in the reproductive system such as varicocele, damaged or undergone testicular surgeries and hernia surgery were excluded from the study population.

Data Collection

An interviewer administrated questionnaire was used to obtain basic information relevant to the lifestyle factors was collected on the each selected individual according to four major categories; a) history of smoking: Information obtained from the smokers regarding the type of smoke, duration of use and the frequency, b) habit of chewing Betel: Information on the frequency and the duration of use was obtained, c) history of alcohol intake: Information relevant to the type of alcohol used, duration and the frequency was noted, d) other lifestyle factors: Information on using hot water for bath as a habit with frequency and duration, and the types of underwear used was obtained. Users of boxer briefs and any type of tight undergarments were defined as tight underwear users. In addition, medical history, such as information regarding chronic/prolonged medical conditions and some common diseases,

particularly on diabetes, heart diseases/high cholesterol, hypertension, asthma, arthritis, dengue, mumps etc. were collected.

Measurement Of Physical Parameters

Anthropometric measurements such as height, weight, waist circumference and hip circumference of participants were measured according to WHO guidelines [14]. All participants stood barefooted against a wall and a stediometer was used to measure height to the nearest 0.1 cm. Body weight of each participant with lightweight clothes was measured to the nearest 0.1 kg using a digital balance. All measurements were taken by two members of the research group and were calculated mean values to minimize intra personal errors. The waist circumference and the hip circumference were measured according to the guidelines given by the WHO STEPS protocol. The BMI (Body Mass Index) and the WHR (Waist to Hip Ratio) was calculated by using the above parameters. Subject posture and other factors were controlled according to WHO guidelines [15].

Specimen Collection

Participants were instructed to give a semen sample after 2–5 days of abstinence. In addition, each participant was instructed to have a clean the genital area before the sample collection. The sample was collected into a sterile wide mouth plastic container by masturbation at the laboratory premises. After allowing liquefying, the sample was examined at room temperature within one hour of collection. Semen was mechanically liquefied using 18 gauge syringe needle after one hour for highly viscous specimens [16].

Laboratory Investigations

All laboratory investigation was conducted in a well-equipped modern Teaching hospital. In the laboratory, investigations related to semen full report was investigated. They were; liquefaction time, semen volume, viscosity, reaction, sperm concentration and sperm motility. In addition, examination of pus cells, sperm vitality (viability) and sperm morphology were reported. All investigations were conducted and reported according to the instructions of WHO (16). Total sperm count per ejaculation $< 15 \times 10^{}$ per millilitre defined as abnormal and subjects with $\geq 15 \times 10^{}$ were defined as normal. In addition, percentage of motile sperms < 32% defined as abnormal and subjects with ≥ 32% were defined as normal.

Statistical Analysis

Collected data were recorded in a spread sheet and transferred to SPSS version 20 (IBM. Somers, NY). Ages of the participants were categorized into two groups; ≤ 40 and more than 40 years. Educational attainment was classified into two groups; those who were completed ordinary level or below ordinary level (11 years or low school education) and completed secondary or tertiary level education (≤ 13 years of formal education). Types of exposure were categorized in to 4 types of risks associated factors: chemicals, agrochemicals, radiation and heat. BMI was categorized according to 18.5–22.9 as normal and ≥ 23 as overweight, 25–29.9 as pre obese and > 30 was considered as obese. Individuals who smoke tobacco products as a habit were considered as smokers. Internal consistency reliability for the parameters of semen analysis was highly reliable. The Cronbach's alphas for sperm concentration and sperm motility were 0.846.

Descriptive statistics were performed on demographic data. The Independent sample t test was performed to identify the differences on total sperm count per ejaculation, percentage of motile sperms, abnormal forms and viability of sperms with socio demographic factors. One way ANOVA was performed to identify the variations of smoking pattern with total sperm count per ejaculation, percentage of motile sperms and the percentage of normal forms. In addition, chi square test was used to determine the variations of sperm concentration and mortality with socio demographic characteristics. The logistic regression model was used to identify the contributing factors for the poor semen parameters in both univariate and multivariate analyses. P value less than 0.05 was considered as significant.

Results

A total of 299 subjects diagnosed as primarily infertile by reproductive endocrinologists were participated for this study. The age range of the participants was 20–49 years (mean 33.1, SD 5.6 years old). Individuals from 8 provinces (except North province) participated in the study, with a maximum participation of 83.3%, from the western province. Majority of individuals educated up to ordinary level (51.5%). Two third of the participants had ≥ 15×10^6 total sperm count per ejaculation and ≥ 32% of motile sperms (Table 1).

Table 1
Sperm concentration and mortality in participants

Variables	Categories	No. of participants (%)
Total sperm count per ejaculation	Abnormal (< 15×10^6)	90 (30.1)
	Normal (≥ 15×10^6)	209 (69.9)
Percentage of motile sperms	Abnormal (< 32%)	104 (34.7)
	Normal (≥ 32%)	195 (65.3)

Factors And Their Relationship With Different Semen Parameters:

When considering total sperm count per ejaculation with socio demographic factors, age less than 40 years individuals showed more sperm count per ejaculation (mean sperm count 35.36 × 166/ml) than age more than 40 years males (p = 0.026). Mean BMI of the participants was 24.2 kg/m² ± 4.2 with the range of 15.9 and 44.1 kg/m². Mean of waist circumference is 86.3 ± 11 cm was obtained, with the range of 59 cm and 132 cm. Mean Waist to Hip ratio (WHR) is 0.94 with a standard deviation of ± 0.06. There were 235 (78.6%) were exposed to one or more radiation types and 64 (21.4%) individuals were not exposed (Table 2).

Table 2
Association of total sperm count per ejaculation with socio demographic characteristics

Variable	Category	No of	mean sperm count	p value
		participants (%)	(million / ml)	
Age (Years)	≤ 40	267 (89.3)	35.36	0.026
	> 40	32 (10.7)	23.79	
Education Level	Up to O/L	210 (70.2)	40.06	0.317
	A/L or above	89 (29.8)	44.45	
Smoking	Smokers	120 (40.1)	38.13	0.185
	Non smokers	179 (59.9)	43.54	
Betel chewing	Betel chewers	86 (28.8)	40.24	0.720
	Not chewer	213 (71.2)	41.82	
Alcohol usage	Alcohol users	210 (70.2)	40.03	0.303
	Not users	89 (29.8)	44.53	
Boxes/ tight brief usage	Boxer/tight brief users	111 (37.1)	36.35	0.054
	Normal underwear users	188 (62.9)	44.33	
Mumps	Yes	126 (42.1)	42.41	0.658
	No	173 (57.9)	40.61	
Diabetes	Yes	17 (5.6)	25.71	0.054
	No	282 (94.4)	42.31	
Occupation level	Staff/Executive	148 (49.5)	43.06	0.403
	Labourer	151 (50.5)	39.71	
Occupational exposure	Any Occ. Exposure	110 (36.8)	38.45	0.267
	No Exposure	189 (63.2)	43.06	
Exposed to radiation	Exposed- Sp. Radiation	235 (78.6)	42.24	0.405
	Non exposed	64 (21.4)	38.17	
BMI	High	118 (39.5)	42.13	0.760
	Normal	181 (60.5)	40.87	
WC	High	100 (33.6)	41.07	0.937
	Normal	198 (66.4)	41.41	
Independent sample t test was used to obtain p values				

Only the boxer/tight brief users showed a significant relationship with. Both, age > 40 years and boxer/tight brief users showed a significant relationship with progressive motility and normal sperm percentage. In addition, diabetes

patients had significantly low percentage of normal sperm mortality (50.5%) compared to the normal people (62.2%). Smoking, alcohol usage, betel chewing, mumps, occupational and radiation exposure were not identified as factors significant for normal sperm and mortality percentages (Table 3).

Table 3
Association of percentage of normal forms and motile sperms with socio demographic characteristics

Variable	Category	No. of	Mean percentage	p value	No. of	Mean percentage	p value
		participants (%)	of motile sperms		participants (%)	of normal forms	
Age (Years)	≤ 40	257 (89.5)	62.50	0.035	244 (89.7)	15.51	0.043
	> 40	30 (10.5)	53.17		28 (10.3)	11.71	
Smoking	Smokers	117 (40.8)	59.20	0.154	107 (39.3)	14.38	0.299
	Non smokers	170 (59.2)	63.12		165 (60.7)	15.59	
Betel chewing	Beetle chewers	81 (28.2)	61.49	0.989	76 (28.0)	14.93	0.841
	Non chewer	206 (71.8)	61.53		196 (72.0)	15.19	
Alcohol usage	Alcohol users	201 (70.0)	60.68	0.340	190 (69.8)	14.62	0.185
	Non users	86 (30.0)	63.50		82 (30.2)	16.27	
Boxes/ tight brief usage	Boxer/tight brief users	108 (37.6)	56.57	0.004	102 (37.5)	13.45	0.023
	Normal underwear users	179 (62.4)	64.51		170 (62.5)	16.12	
Diabetes	Yes	29 (5.9)	50.59	0.042	31 (6.3)	15.66	0.152
	No	270 (94.1)	62.21		268 (93.7)	14.18	
Mumps	Yes	121 (42.2)	62.12	0.709	113 (41.6)	14.39	0.281
	No	166 (57.8)	61.09		159 (58.4)	15.64	
Occupational exposure	Any Occ. Exposure	104 (36.2)	59.11	0.179	95 (34.9)	14.68	0.578
	No Exposure	183 (63.8)	62.90		177 (65.1)	15.35	
Exposed to radiation	Exposed- Sp. Radiation	227 (79.1)	62.05	0.447	216 (79.4)	15.05	0.818
	Non exposed	60 (20.8)	59.52		56 (20.6)	15.37	
Independent sample t test was used to obtain p values							

Boxer/tight brief users were significant associated with low sperm volume (2.24 ml) compared to the individuals used normal underwear. Although, smokers, alcohol users, betel chewers, diabetes and mumps patients showed low sperm volume, there were no significant difference with normal healthy people (Table 4).

Table 4
Association of semen volume (ml) with socio demographic characteristics

Variable	Category	mean value	p value
		of semen volume (ml)	
Age (Years)	≤ 40	2.36	0.995
	> 40	2.36	
Smoking	Smokers	2.30	0.376
	Non smokers	2.43	
Betel chewing	Beetle chewers	2.15	0.065
	Non chewer	2.44	
Alcohol usage	Alcohol users	2.33	0.624
	Non users	2.41	
Boxes/ tight brief usage	Boxer /tight brief users	2.24	0.032
	Normal underwear users	2.56	
Diabetes	Yes	2.34	0.227
	No	2.71	
Mumps	Yes	2.27	0.171
	No	2.47	
Independent sample t test was used to obtain p values			

When considering sperm concentration and mortality, more than one third of boxer/tight brief users showed significantly low sperm count per ejaculation (38.7%) and low percentage of motile sperms (42,5%). A considerable number of individuals exposed to either heat or chemical hazards were associated with significantly low sperm concentration and low sperm mortality (37.5% and 44.2% respectively). In addition, 37.5% of smokers had significantly low sperm count per ejaculation (Table 5).

Table 5
Association of sperm concentration and mortality with socio demographic characteristics

		Total sperm count per ejaculation			Percentage of motile sperms		
Variable	Category	$< 15 \times 10^6$ / ml	$\geq 15 \times 10^6$/ ml	p Value	< 32%	≥ 32%	p Value
		No. of participants (%)	No. of participants (%)		No. of participants (%)	No. of participants (%)	
Age (Years)	≤ 40	78 (29.2)	189 (70.8)	0.170	89 (33.3)	178 (66.7)	0.129
	> 40	12 (37.5)	20 (62.5)		15 (46.9)	17 (53.1)	
Education Level	Up to O/L	68 (32.4)	142 (67.6)	0.187	75 (35.7)	135 (64.3)	0.603
	A/L or above	22 (24.7)	67 (75.3)		29 (32.6)	60 (67.4)	
Smoking	Smokers	45 (37.5)	75 (62.5)	0.022	48 (40.0)	72 (60.0)	0.121
	Non smokers	45 (25.1)	134 (74.9)		56 (31.3)	123 (68.7)	
Betel chewing	Betel chewers	26 (30.2)	60 (69.8)	0.975	30 (34.9)	56 (65.1)	0.981
	Not chewer	64 (30.0)	149 (70.0)		74 (34.7)	139 (65.3)	
Alcohol usage	Alcohol users	68 (32.4)	142 (67.6)	0.187	77 (36.7)	133 (63.3)	0.293
	Not users	22 (24.7)	67 (75.3)		27 (30.3)	62 (69.7)	
Boxes/ tight brief usage	Boxer/tight brief users	43 (38.7)	68 (61.3)	0.012	47 (42.3)	64 (57.7)	0.035
	Normal underwear users	47 (25.0)	141 (75.0)		57 (30.3)	131 (69.7)	
Mumps	Yes	44 (34.9)	82 (65.1)	0.121	44 (34.9)	82 (65.1)	0.966
	No	46 (26.6)	127 (73.4)		60 (34.7)	113 (65.3)	
Diabetes	Yes	6 (35.3)	11 (64.7)	0.302	11 (64.7)	6 (35.3)	0.008
	No	84 (29.8)	198 (70.2)		93 (33.0)	189 (67.0)	
Occupation level	Staff/Executive	38 (25.7)	110 (74.3)	0.099	44 (29.7)	104 (70.3)	0.069
	Labourer	52 (34.4)	99 (65.6)		60 (39.7)	91 (60.3)	
Occupational exposure	Any Occ. Exposure	41 (37.3)	69 (62.7)	0.039	43 (39.1)	67 (60.9)	0.014
	No Exposure	49 (25.9)	140 (74.1)		61 (32.2)	128 (67.8)	

Chi square test was used to obtain p values

		Total sperm count per ejaculation			Percentage of motile sperms		
Occ. Exp to chemicals	Yes	39 (37.5)	65 (62.5)	0.042	46 (44.2)	58 (55.8)	0.026
& heat + Agrochemical	No	51 (26.2)	144 (73.8)		58 (29.7)	137 (70.3)	
Exposed to radiation	Exposed- Sp. Radiation	67 (28.5)	168 (71.5)	0.251	79 (33.6)	156 (66.4)	0.417
	Non exposed	23 (35.9)	41 (64.1)		25 (39.1)	39 (60.9)	
BMI	Normal	56 (47.5)	62 (52.5)	0.760	67 (56.8)	51 (43.2)	0.453
	Overweight / Obese	34 (18.8)	147 (81.2)		35 (19.3)	146 (80.7)	
Chi square test was used to obtain p values							

Analysis Of Semen Parameters With Different Types Of Smokers

Subjects were classified in to two main categories as smokers and non-smokers. They were further classified in to 4 different groups according to their current smoking pattern; Non-smoker, Occasional smoker (< 7 cigarettes/week), Light smokers (1–5 cigarettes/day) and Medium/Heavy smokers (> 5 cigarettes/day). There is a significant association between increasing smoking habits and decreased total sperm count per ejaculation (Table 6).

Table 6
Comparison of semen parameters with the smoking pattern

Smoking groups	No. of	Total sperm count per ejaculation	Non motile sperms	Progressively motile sperms	Abnormal sperm forms
	participants (%)	Mean (10^6)	Mean (%)	Mean (%)	Mean (%)
Non-smokers	179 (59.9)	43.54	36.88	47.55	84.41
Occasional smokers (< 7 cigarettes/week)	33 (11.0)	44.52	39.81	46.12	84.50
Light smokers (1–5 cigarettes/day)	66 (22.1)	41.84	36.77	49.24	85.56
Medium/Heavy smokers (> 5 cigarettes/day)	21 (7.0)	16.40	55.50	30.95	87.67
p value		0.007	0.018	0.006	0.502
Total	299	41.37	38.48	46.60	84.88
One way ANOVA was used to obtain p values					

Significant decline of total sperm count was noticed in medium/heavy smokers. They also showed a significant increase of non-motility and a significant decrease progressive motility rates compared to other smokers. Smokers

with increasing tobacco smoking showed a gradual increase of abnormal forms. However, it is statistically not significant (Table 6).

Logistic Regression Analysis:

Univariate logistic regression was applied to investigate the association between sperm concentration and each variable. It showed, smoking habit (OR = 1.83, 95% CI; 1.11–3.02) was a significant risk factor for poor semen concentration of the study population.

In multivariate logistic regression analysis, smoking habits and wearing tight under wares were identified as significant factors for sperm concentration (p = 0.045 and 0.025 respectively). In addition, Multivariate analysis identified that diabetes and wearing tight underwear were identified as significant factors for the sperm mortality (p = 0.007 and 0.021 respectively).

Discussion

Infertility is a prominent issue in reproductive health of both males and females worldwide. This study was aimed to investigate the impacts of physical condition, lifestyle and occupational factors for the development of poor semen parameters. The outcomes of the present study can be very important to diagnose and treat the male infertility in Sri Lanka.

Present study confirmed that cigarette smoking is a risk factor for decreasing sperm production and eventually leads to infertility. Individuals with heavy smoking showed a drastic decline of the sperm concentration, compared to the non-smoker. Smokers with a habit of using > 5 cigarettes per day is highly vulnerable to become oligospermic. Cigarette smoking causes elevated oxidative stress, and cell apoptosis, which lead to reduce semen quality, spermatogenesis and sperm maturation. In the present study identified that both the motility analyses (none or progressive) showed a risk of asthenospermia with increased smoking. Similarly, studies reported that smoking significant associated with low sperm concentration and mortality and semen quality [6, 17, 18]. Cigarette smoking causes DNA damage, aneuploidies, and mutations in sperm [19].

Alcohol interferes with the production of hormones associated with male reproductive system (GnRH, FSH, LH, and testosterone) and reduces the functions of Leydig and Sertoli cells (10). Therefore, development and maturation of spermatozoa gradually decline with increasing levels of alcohol intake [20, 21]. However, Alcohol consuming was not a significant factor for sperm concentration and mortality in the present study. In contrast to this study, Muthusami et al. 2005 revealed that alcohol consuming individuals had significantly decreased semen volume, sperm concentration, motility and percentage of normal sperm morphology [10].

Boxer briefs and tight underwear users showed significant relationships with low sperm concentration and motility and poor semen quality. Boxer brief and tight underwear users had significant relationships with low sperm volume, high percentage of abnormal forms, progressive motility and non-motility. Wang et al. 1997 reported that temperature increase in the scrotum in athletic supporters (0.8 °C to 1 °C) who wear tight underwear. When increasing 1 °C in testis, a total of 14% decline in the spermatogenesis [22]. Therefore, genital heat stress is a risk factor for male infertility [22]. Parazzini et al. 1995 reported that individuals wearing tight fitting underwear had a risk of 2.5 of having impaired semen quality [23]. Therefore, it is suggested that loose fitting underwear is

advantageable for high quality sperm parameters. Elevated temperatures in the scrotum lead to oxidative stress, and sperm DNA damage [24].

Males exposed to high temperature at their workplaces were more prone to infertility. Excess environmental heat increases the temperature of the scrotum, causing a negative effect on quantity of sperm production and decrease in motility and morphology of the sperms. High temperature stimulates more generation of reactive oxygen species (ROS) in cells [6]. ROS negatively effect on cell metabolism by damaging sperm plasma membrane and fragmentation of both nuclear and mitochondrial DNA [25]. Several studies reported that lower sperm production and motility and high rate of abnormal forms were significantly associated with increasing temperature of testis [26–28].

In the present study, chemical, agrochemical, heat and radiation were considered as occupational exposures. Individuals exposed to either chemical or heat exposed individuals have shown a significant association with low sperm concentration and low sperm motility. Similarly, a previous study in Sri Lanka, reported that a significant relationship between occupational exposure (Agrochemical or Industrial chemical and heavy metals) with sperm concentration and quality [14]. Sperm motility and viability were not significant relationship with the exposed group.

Poor semen parameters increase with the advancement of male ages. In the present study, low sperm concentration and high rate of non-motility, abnormal forms and progressive motility observed in > 40 years of age category. Similarly, several studies reported that low sperm concentration, volume and progressive motility of sperm was significantly associated with increasing age after 40 years old [29, 30]. A total of 0.17–0.6% of motility rate decreased with per year of age and resulting 3–12% decline in motility over 20 years [31, 32]. Although the production of spermatozoa exists until death, the quality of male germ cells is negatively associated with advanced paternal age [33]. After the age of 45, semen volume and the percentage of normal sperm morphology begins to decline [34, 35]. In addition, the age is directly related to elevation of oxidative stress and it is responsible for DNA fragmentations [36].

In the present study, no significant relationship was found between Mumps infection with semen parameters. However, a study performed by Povey et al. 2012 revealed individuals who exposed to mumps at ≥ 13 years of age have a risk of lower motile sperm concentration [37]. Mumps infections are associated with the production of anti-sperm anti bodies and inflammation. Anti-sperm antibodies adversely affect sperm quality and production and finally cause infertility.

Distress at the workplace, will decreased motivation of workers and develops psychological and physiological dysfunctions [38]. Psychological stress is associated with abnormal semen parameters affecting male infertility. Stress activates the hypothalamus–pituitary–adrenal (HPA) axis [24] and has an inhibitory effect on the hypothalamus–pituitary–gonandal (HPG) axis. The inhibition of the HPG axis reduces luteinizing hormone (LH) and testosterone pulsing, thus reducing spermatogenesis and sperm quality [39, 40]. Reduction of testosterone secretion negatively effects on spermatogenesis [41]. In the present study, sperm concentration and mortality were negatively associated with occupation exposure. Similarly, several studies reported that negative associations between stress and sperm motility, sperm concentration, percentage of morphologically normal spermatozoa and low semen quality [42, 43].

Glucose metabolism is very important to produce sperms. The present study found that sperm motility and volumes are significantly lesser in individuals with diabetes compared to non-diabetics. Many studies have reported that

diabetes associated with male infertility by reduced motility, structural defects in nuclear and mitochondrial DNA and decreased zona pellucida binding capacity of sperms [44–46].

Overweight and obese are well known characteristics with low sperm quality and a greater risk of infertility in males. The excess adipose tissue causes increased conversion of testosterone to oestrogen and affects the HPG axis to reduce the production of gonadotropin. It adversely effects on spermatogenesis [47]. Obese men were prone to be oligozoospermic or azoospermic compared to men within a normal weight range [48]. Present study did not find any significant difference between normal and high BMI group of individuals with sperm concentration. In contrast to this study, Hammoned et al. 2008 found the prevalence of oligozoospermia was increased with increasing BMI [49].

Conclusion

There is strong association low sperm concentration and low sperm mortality with lifestyle factors such as smoking and wearing boxer brief/tight underwear occupational exposure, age and diabetes. Prospective studies should be conducted to identify/assess the effect of risk factors for the generation of poor semen parameters mentioned in the study. Further studies to find out relationships of semen parameters with factors such as psychological stress, occupation categories, drugs use could be very important. Implementation of educational programs to create awareness about male infertility in society is important.

Abbreviations

STI: sexually transmitted infections; BMI: Body Mass Index; WHR: Waist to Hip Ratio; SPSS: Statistical Package of Social Sciences; HPA: hypothalamus–pituitary–adrenal; GnIH: gonadotrophin-inhibitory hormone HPG: hypothalamus–pituitary–gonandal; UK; United Kingdom; WHO: World health organization;

Declarations

Ethics approval and consent to participate

The ethical clearance was approved by the Ethical Review Committee, Faculty of Medicine, General Sir John Kotelawala Defence University, Sri Lanka. Permissions were obtained from the Director of Castle Street Teaching Hospital, Colombo, Sri Lanka to conduct the study. All individuals were informed that their participation was voluntary, and the procedure used did not pose any potential risk and their identities will be kept strictly confidential. Informed written consent forms were taken from all participants who voluntary participated. and all information was kept in confidence.

Consent to publish

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

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Author Contributions

MB and JMKBJ conceived and designed the experiments. YCPR, YLG, HOTOP and WACK performed the study. LSG, YCPR, YLG, HOTOP and WACK involved to data interpretation and statistical analysis. LSG wrote the first draft of the manuscript MB and JMKBJ critically revised the manuscript for intellectual content. All authors read and approved the final manuscript. MB, JMKBJ and LSG are guarantors of the paper.

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