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Lifestyle and Environmental Factors Affecting Fertility in Men

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Quality indicators of sperm studies have deteriorated in all industrialized countries in the world, prompting scientists to seek the reasons for these bad results. Till now lifestyle has been overlooked as a factor, but today more and more attention is paid to it as a reason for the poor results. It was impossible using the uncontested statistical data to prove which of the environmental factors and the way of the daily life of modern man affect his health and in particular the male reproductive function. But looking at the recent past and taking into account the changes that occur in the last 100 years, we cannot fail to take account of changes in way of eating, use of hormones, chemicals, antibiotics in the processing of food, lifestyle and more accurate the sedentary life compared to the time spent outdoors performing active physical activity, stress that we are subjected daily, affects human health and in particular the quality of sperm parameters.

Key words: infertility men, semen analysis, sperm morphology, lifestyle

Introduction

Investigations that follow sterility in men over a long period and comparing sperm indicators has reported deterioration in quality indicators in all industrialized countries in the world for years. Different factors have been the cause of a decrease in sperm count. In recent years, the tendency to reduce sperm concentration (> 20 mil ≥ 30% m1 WHO) has increased, another trend observed in their morphology, more than 4-14% can be defined as normozoospermia using Kruger's strict criteria [6] and WHO [16].

In the last two decades, a series of reports have been published that take into account the global decline in the quality of the ejaculate - the quantity, motility and sperm morphology [7, 12, 13]. One of Geoffroy-Siraudin's latest series of reports [3] traces a period of 20 years (1988-2007), the sperm count analyzes trends for the progressive reduction of sperm concentration (1.5% per year), the total number of sperm (1.6% per year), general mobility (0.4-5.5% per year) and normal morphology (2.2% per year). All scientific teams declare that there is no change in the methodology of work for the

reporting period, and that andrological laboratories are working in accordance with the WHO standards.

Different factors have been seen as the cause of a decrease in sperm count. The authors highlight factors such as lifestyle, smoking [4], alcohol, drug abuse, aging [10], and others. Apparently, several factors may be responsible for the condition of male sterility and it is difficult to make a meaningful assessment of their impact. Spermatogenesis started in puberty, and since it is a highly vulnerable process, all harmful actions will have adverse effects on its quality.

The aim of the present study is to relate the deteriorating sperm parameters such as concentration, motility and morphology to the lifestyle and environmental factors such as medicines, anabolic substances, drugs, alcohol, smoking and heat exposure.

Materials and Methods

This study was done in accordance with the ethical standards of the Medical University of Plovdiv/Bulgaria (resolution of the University Ethic Committee No P-1166/15.04.2016). Each patient completes a set of documents in a dossier as required - informed consent and poll. The survey was conducted among 80 men of average age 34.9 years (20-51 years) from families with long (primary or secondary) infertility from the town of Plovdiv and its region. Sperm study was obtained by masturbation, after 3-5 days sexual abstinence, in a sterile container and it was stored at room temperature 18-20 °C. Qualitative and quantitative research was carried out to determine the ejaculate volume, sperm concentration, total sperm count, assessment of mobility and morphology applying strict criteria of Kruger [6]. Concentration, motility and morphology were analyzed using the Computer Aided Sperm Analysis (CASA) to provide an objective assessment of sperm fertilization. The evaluation of the results was carried out according to the criteria of the WHO [16]. All data were processed with statistical program SPSS 19.0.

Results

Our study on infertile patients found significant deviations from the WHO standards and they are illustrated in Figs. 1 and 2. After evaluation of sperm motility, we found that 34.13% are normally motile, 8.79% are weakly motile, and 57.07% are fixed (immotile). According to WHO, the criteria for fertility recommended minimum is 40% of sperm to be progressively motile (fast and slow linear translational motions) (**Fig. 1)**.

Examining the morphology of the sperm we found 96.66 % pathological forms of which 58.89% showed head defect, 32.77% - head and neck defect, and 4.99% - neck defect. Only 3.34% are with normal morphology (**Fig. 2**).

Morphological analysis classifies sperm as normal only if the shape and size of sperm segments (head, midpiece and tail) fall within defined parameters. Strict criteria by Kruger [6], illustrated in **Fig. 3**, were applied for sperm evaluation, according to which a spermatozoon is normal if it has an oval head, 4.0-5.0 μm long and 2.5-3.5 μm wide, measured with an ocular micrometer. The length-to-width ratio should be 1.50-1.75. A normal spermatozoon has a well-defined acrosome that covers 40-70% of the head. The midpiece is thin, less than 1 μm wide, about 1.5 times longer than the head. Cytoplasmic droplets, if present, should not be larger than half of the head width. The tail is thin, uniform, uncoiled and about 45 μm long. According to this classification system, all borderline forms are considered as abnormal. In case normal forms accor-

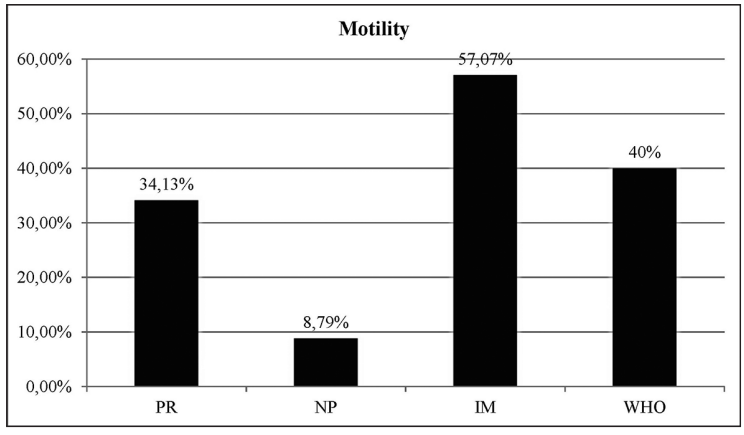

Fig. 1. Progressive (PR), non-progressive (NP), immotile (IM) and WHO

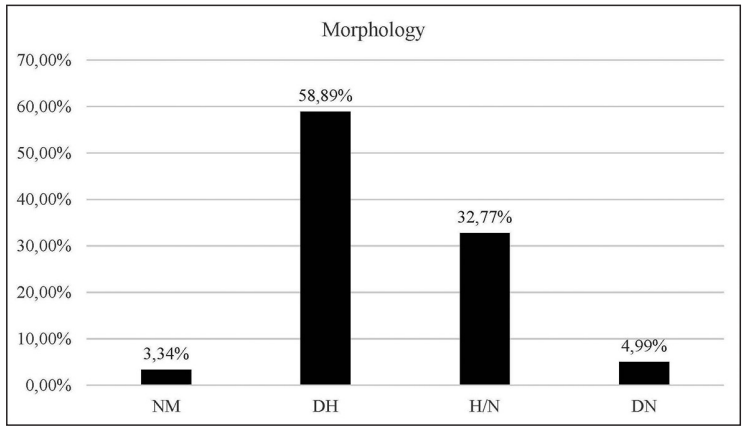

Fig. 2. Normal morphology (NM), pathological forms – defect head (DH), head and neck (HN), defect neck (DN)

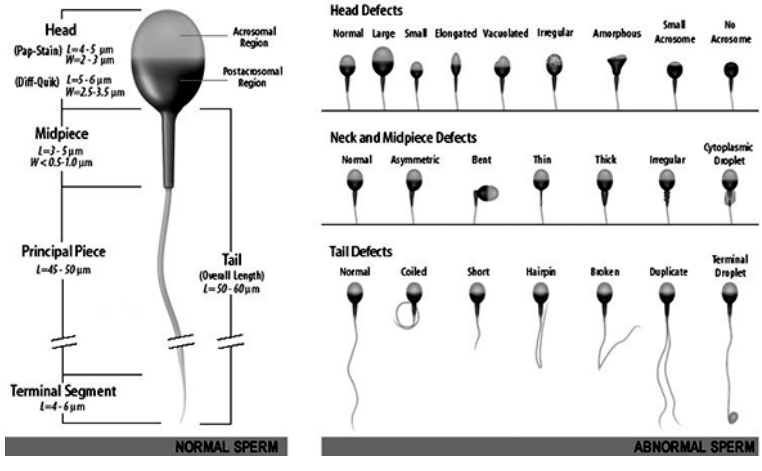

Fig. 3. Kruger's morphological criteria for evaluation of the sperms

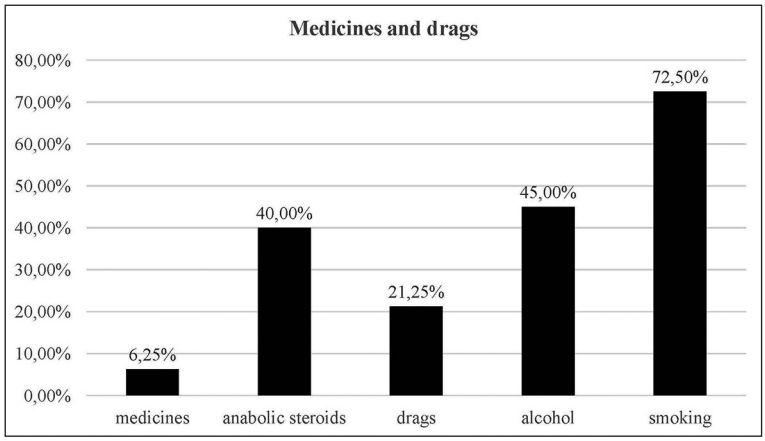

Fig. 4. Results of patient survey 1

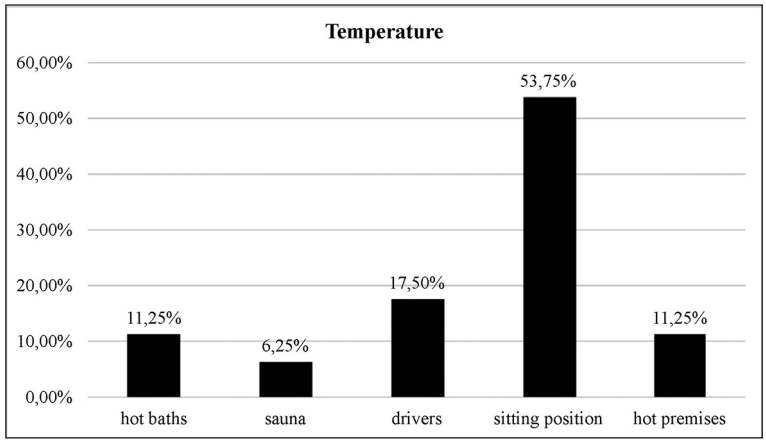

Fig. 5. Results of patient survey 2

ding to Kruger's criteria exceed 15% after counting 200 sperm the sample is considered as normal.

The increasing percentage of infertile men motivates us to make a poll among men in the town of Plovdiv and its region, in which we try to identify the causes leading to this severe problem, which raises epidemic proportions.

Figs. 4 and 5 show some of the answers to the questionnaire. On the question "Do you take medications and other chemical substances?" (**Fig. 4**), 6.25% of respondents answered that they take medications on a daily basis, 40% take anabolic substances, 21.25% take or have taken opiates, 45% drink alcohol every day, and 72.50% of them are smokers. The results obtained are more than 100% because some of the questions gave more than one answer and others were unanswered.

On the question "Causes leading to elevated temperature in the small pelvis?" (**Fig. 5**) – 11.25% of respondents answered that they like to take a continuous hot shower, 6.25% often use sauna, 17.50% are drivers, 53.75% are sitting on all working day, and 11.25% work in hotspots.

Discussion

Over the last decades, the efforts have been directed to attempts of identifying the causes leading to a steady decrease in the number and quality of human sperm. Drastic reduction in reproductive performance led to lowering of several benchmarks, determined by the WHO, most recently in 2010. Moreover, very small percentage of men managed to cover these standards and this is illustrated by the results shown in Figs. 1 and 2. Thinking of the causes of these negative effects, daily routines become more and more important, such as long-term hot showers, use of the sauna, time spent sitting, the number of smoked cigarettes, use of anabolic drugs, medicines, opiates and alcohol.

In warm-blooded animals, the evolutionary solution is to have the testes outside the body where the temperature is 3-4 °C lower than the body temperature (37.6 °C, which is harmful for spermatogenesis) [8, 11]. Another key element in providing the testicle cooling is the presence of the pampiniform plexus which cools the arterial blood entering the testis. The functioning of this plexus is of importance for normal testicular function. Therefore, occupations associated with long-standing sitting, such as drivers, programmers, clerks, workers in premises with increased temperature, etc. could cause deterioration of sperm counts and quality. The reason for these results is a slowing of blood flow in the small pelvis resulting in a rise in temperature [8, 14].

In experimental mouse models, it was found that immersion of the testes for 30 min in hot water at 42 °C for a period of 30 days induces infertility with impairment of sperm quality by 44.9% due to germ cell apoptosis, resulting in decreased fertility *in vitro* compared to controls and decreased in vivo quality of embryos [9]. It is suggested that short immersion of the testes in hot water cause thermal damage to DNA and proteins in germ cells [15]. Within the years, a gradual increase was reported in the use of anabolic substances, opiates, especially so-called mild opiates such as marijuana, and the many synthetic analogues most commonly combined with alcohol and cigarettes. In our current study these findings are clearly demonstrated.

A large study conducted in Denmark among 1221 young men aged 18-28 (in the period 2008-2012) found a decrease in the concentration, the total number and percentage of sperm with normal morphology between 33% and 59% depending on the amount of alcohol intake and combination with marijuana more than once a week [5]. Numerous studies reported an increase in the percentage of spermatozoa with morphological defects, fragmentation of the DNA and decreased viability in cases of idiopathic infertility and aging [1, 2, 4].

Conclusion

The reasons leading to disruption of fertility in men are complex. More attention is needed to the increasing etiological impact of lifestyle factors. Establishing the cause of infertility is not a simple task and requires comprehensive and multifactor analysis of all possible influences.

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