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Semen Quality and Frequency of Smoking and Alcohol Consumption — An Explorative Study

Henny J.M. Goverde, Ph.D.
Hester S. Dekker, M.Sc.
Herman J.G. Janssen, B.Sc.
Bart A. Bastiaans, Ph.D.,
Rune Rolland, M.D.
Gerhard A. Zielhuis, M.D.

Department of Gynecology & Obstetrics, and Department of Epidemiology
Catholic University
Nijmegen, The Netherlands

ABSTRACT: Objective — To study the contribution of smoking and alcohol consumption to semen quality.
Design — Retrospective analysis.
Setting — University-based fertility clinic.
Patients and Methods — Smoking and alcohol consumption were investigated in a control group (68) and in a group of 47 subjects with defined poor semen quality (PSQ). The control group was composed of subjects whose semen showed a greater than 60% morphological normality, a greater than 60% motility with a linear progression, and a density of greater than 20 million spermatozoa/mL. The group with PSQ was composed of subjects whose semen showed a less than 30% morphological normality, less than 60% motility, characterized by slow, weak motility, and a density of less than 20 million spermatozoa/mL. Medical dossiers were studied regarding the life style of the subjects.
Results — The distribution of heavy smokers and light smokers did not differ statistically between the groups. There appeared to be a higher, but statistically insignificant, proportion of heavy smokers in the PSQ group (50%) compared to the control group (32.3%; \( P < .1 \)); nor were significant differences found between cases and controls with respect to alcohol consumption pattern. In the PSQ group, a comparison of the semen characteristics of the daily drinkers with those of all the other subfertile patients showed no statistical difference concerning semen volume (4.1 ± 1.9 vs. 3.3 ± 1.3 mL; \( P > .1 \)), sperm density (10.6 ± 7.8 vs. 8.9 ± 5.8 million spermatozoa/mL; \( P > .1 \)), and percentage of motile spermatozoa (27.0 ± 15.1 vs. 25.5 ± 16.1%; \( P > .1 \)). However, a lower percentage of normal sperm morphology was observed in the daily-drinker group (17.6 ± 7.2% vs. 23.0 ± 6.5% for the other subfertile patients; \( P < .05 \)). Conclusion — Factors such as smoking and alcohol consumption may decrease further an already low percentage of sperm with normal morphology.

KEY WORDS: sperm quality, smoking, alcohol, fertility

Introduction

It was recently reported that the portion of semen samples with normal morphology of spermatozoa has decreased over the last 15 or 20 years [1-3]. Quite recently, Carlsen et al [4] reported a significant decrease in sperm count and semen volume during the past 50 years. These findings led to the suggestion that changes in life style and/or environmental factors are responsible for these phenomena. A number of exogenous and environmental factors are reportedly found to influence semen quality. Some studies deal with the effect of life style factors such as smoking [5-9],
alcohol consumption [10,11], drug (ab)use [12], and stress [13]. Occupational exposure to physical stressors such as temperature [14-18], radiation [19], and chemical pollutants [19,20] is also thought to have an impact.

Most studies compare semen characteristics in groups of subjects with different life style factors or dissimilar exposure to environmental factors. As we were interested in the contribution of such factors to poor semen quality in a clinical population, we studied the frequencies of smoking and alcohol consumption in a group of male subjects with a semen quality defined as poor and in a group of subjects with normal semen characteristics.

MATERIALS AND METHODS

Subjects

All study subjects were selected from a population of about 5,000 men who visited our clinic for semen analysis within a period of 3 years. Semen samples were obtained by masturbation after a three-day period of abstinence. Only subjects of whom a complete semen analysis and a complete medical history were available were included in the study. Subjects who had been operated upon, or who had inflammations in the urogenital region, or orchiopexy, varicocele, a disturbed descensus testiculorum, radiations, diabetes or tuberculosis were excluded for the study population. Semen analyses were performed following the WHO manual [21]. The group with poor semen quality (PSQ; n=47; mean age, 33.2 ± 3.5 years) included subjects with semen samples with a normal sperm morphology of less than 30%, with less than 60% motile spermatozoa characterized by a slow, nonlinear or weak motility (WHO Manual) and with a sperm density of less than $20 \times 10^6$ spermatozoa/mL. The control subjects (n=68; mean age, 32.5 ± 3.8 years) had semen samples with a normal morphology of greater than 60%, more than 60% motility which was characterized by a rapid and linear progressive motility, and sperm density of more than $20 \times 10^6$ spermatozoa/mL.

Exposure Information

The risk factor status of all study subjects was obtained from the medical files. Smoking was calculated according to the number of cigarettes/day. Pipe or cigar smokers were not included.

Frequency of alcohol consumption was estimated and divided into four categories: never, occasionally, only on the weekend, or daily. Furthermore, alcohol consumption was expressed as the number of consumptions/week.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Semen characteristics of poor quality and control groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Semen Quality</td>
<td>Control</td>
</tr>
<tr>
<td>(mean ± SD)</td>
<td>(mean ± SD)</td>
</tr>
<tr>
<td>Semen volume (mL)</td>
<td>3.5 ± 1.5</td>
</tr>
<tr>
<td>Sperm density (x10^6/mL)</td>
<td>9.7 ± 6.3</td>
</tr>
<tr>
<td>% Motility</td>
<td>26.6 ± 15.4</td>
</tr>
<tr>
<td>Motility quality</td>
<td>3.4 ± 0.7</td>
</tr>
<tr>
<td>% Normal morphology</td>
<td>22.1 ± 6.8</td>
</tr>
</tbody>
</table>

Statistical Analysis

Alcohol consumption and smoking pattern among cases and controls were analyzed by the Wilcoxon and chi-square tests. Means were compared using the Mann-Whitney test. Data are given as means ± standard deviation (SD).

RESULTS

Mean semen characteristics of both the control and the PSQ group are given in Table I. Table II shows frequency of smoking behavior in both groups. No significant differences between the PSQ and control groups were observed ($P > .1$). There appeared to be a higher, but statistically insignificant, proportion of heavy smokers in the PSQ group versus the control subjects ($P < .1$). We evaluated the relation between smoking and semen characteristics among the cases and the controls. In the PSQ group, no statistically significant difference was observed between the non-smokers and heavy smokers as regards semen volume ($3.6 ± 1.6$ vs. $3.6 ± 1.7$ mL; $P > .1$), normal sperm morphology ($23.8 ± 7.0$ vs. $21.4 ± 6.7%$; $P > .1$), sperm density ($8.5 \times 10^6 ± 5.9$ vs. $10.9 \times 10^6$ spermatozoa/mL).
10^6 \pm 6.6$ spermatozoa/mL, $P > .1$, or motility (31.0 ± 16.4 vs. 22.7 ± 13.8%; $P > .1$). In the control group, the mean values for non-smokers and heavy smokers were as follows: normal sperm morphology, 71.2 ± 6.1 vs. 70.6 ± 5.0% ($P > .1$); sperm density, 73.4 ± x $10^6$ ± 55.7 vs. 60.9 × $10^6$ ± 57.6 spermatozoa/mL ($P > .1$); motility, 71.8 ± 13.8 vs. 69.2 ± 11.7% ($P > .1$). Only the semen volumes tended to be different in the control group: 3.5 ± 1.7 in the non-smokers versus 2.7 ± 1.5 mL in the heavy-smokers group ($P > .1$).

The frequency of alcohol consumption is presented in Table III. No statistically significant difference in alcohol consumption pattern between the two groups was observed. After exclusion of the non-drinkers, the mean alcohol consumption in a week was calculated. Cases consumed 11 ± 5 glasses/week as compared to the controls' 13 ± 9 ($P > .1$).

When semen characteristics in the subgroup of daily drinkers in the subfertile group were compared to the combined groups of never, occasional and weekend drinkers, no significant difference was observed as regards semen volume (4.1 ± 1.9 vs. 3.3 ± 1.3 mL, $P > .1$), density (10.6 ± 7.2 vs. 8.9 ± 5.8 × $10^6$ spermatozoa/mL, $P > .1$) or the percentage of motile spermatozoa (27 ± 15 vs. 24 ± 16%, $P > .1$). However, a small, but statistically significant, difference was found when the quantity of normal spermatozoa was considered: 17.6 ± 7.2% in the daily drinkers subgroup versus 23.0 ± 6.5% ($P < .05$) for other cases together. No such difference was observed in the control group (68.0 ± 4.8% for the daily drinkers vs. 70.7 ± 5.9% for the other control subjects together, $P > .1$).

**TABLE II**

Distribution of smoking habits in both groups.

<table>
<thead>
<tr>
<th>Poor Semen Quality</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>16 (38.1)</td>
</tr>
<tr>
<td>Light smokers*</td>
<td>5 (11.9)</td>
</tr>
<tr>
<td>Heavy smokers†</td>
<td>21 (50.0)</td>
</tr>
</tbody>
</table>

* [1-10 cigarettes/day]
† [11-50 cigarettes/day]

**DISCUSSION**

The results of the present study do not show meaningful differences with respect to smoking and alcohol consumption between a group of male patients with poor semen quality and a control group (Tables II and III).

Several studies deal with the effect of smoking on semen quality, but discrepancies are reported. Some studies reported a decrease in density due to smoking [6,22], which was not observed in other studies [7, 8, 23, 24]. With regard to spermatozoal morphology, only one report [26] deals with a decrease in normal sperm due to smoking, whereas other authors did not find such a difference [6-8,23,24,26-28]. As far as the percent motility is concerned, conflicting data were found: decreases of motility in smokers [6,8] have been described, whereas other authors did not find a difference between smokers and non-smokers [7,22-26,28]. Interestingly, Saaranen et al [24] found that the motility was higher in heavy smokers, but that this motility decreased more rapidly. We found no clear statistical difference in smoking frequency between the two groups, although there tended to be more heavy smokers in the poor semen group. In the control group, heavy smoking tended to be associated with a lower semen volume. This last observation is in agreement with other studies [7,23,24] in which no other semen parameter was found to be different.

The similarity between both our groups as regard the frequency of alcohol consumption (Table III) is supported by the study of Marshburn et al [7], who could not find an effect on semen volume, sperm density, motility, or morphology either. Effects of alcohol on volume, density, and motility were
described by Brzek [11]. We found that daily alcohol consumption in the PSQ group decreases normal sperm morphology, but we did not find such data in our control group. This indicates that there may be a small, but significant, deteriorating effect of daily alcohol consumption only when the sperm quality is already poor.

In conclusion, our data do not support the hypothesis that smoking and alcohol consumption contribute much to the etiology of poor semen quality, even though high alcohol consumption may decrease further the degree of normal sperm morphology in semen of subjects with already poor semen characteristics.

REFERENCES


Address reprints requests to: H.J.M. Goverde Laboratory of Endocrinology & Reproduction Geert Grooteplein zuid 8 6525 GA, Nijmegen, The Netherlands

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