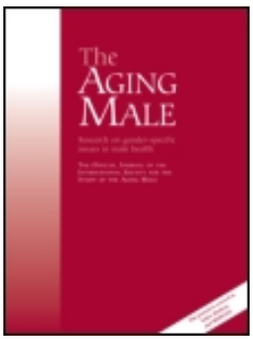

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The effects of male age on semen parameters: analysis of 1364 men attending an andrology center

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Abstract
Although the effect of maternal age on fertility is well known, it is unclear whether paternal age also affects fertility. The aim of this retrospective study was to establish an association between the age of the individuals from Medellin, Colombia with semen volume, rapid progressive motility (a), total progressive motility (a + b) and concentration. We evaluated semen volume using a graduated tube, progressive motility using light microscopy (40 ×) and sperm concentration using a Makler Chamber. Semen samples were grouped according to age into three arbitrary groups (≤ to 30 years; between 31 and 39 years; and ≥ to 40 years). The semen volume, rapid progressive motility (a) and total progressive motility (a + b), concentration and total sperm count were found to be inversely related to age ($p < 0.05$). The reduction in semen parameters of 1364 men attending an andrology center was associated with increasing age of the individuals.

Keywords: *Age, semen analysis, semen quality, spermatozoa*

Introduction

In women there is an association between advanced age and reduced fertility [1]. Abundant research has focused on female menopause, which is the reproductive period characterized by a rapid decline of estradiol and a decrease in oocyte quality. The average maternal age at first birth in women has increased during the last 50 years caused by several factors including their personal and intellectual success; unlike in women, the current knowledge about the effect of aging on male fertility is more limited [1–6].

However, knowing that: (i) the spermatogenesis process usually persists well into old age [7], although an age-related decline in androgen secretion levels may suggest impairment in sperm parameters; (ii) advanced male age has been associated with significant reductions in pregnancy rates [8]; (iii) a study demonstrating that men older than 35 years have half the chance of fathering a child within 12 months compared with men younger than 25 years of age [2]; (iv) children have been fathered by men over 90 years old [3]; (v) the same factors that increase in maternal age as personal and intellectual success also increase in paternal age, and (vi) there is some evidences about no changes in sperm parameters with age [9,10], it is important to analyze a sample population from other geographical origin to contribute to knowledge of the effect of advanced paternal age on sperm parameters or increased risk of infertility.

It is universally accepted that semen analysis is one of the most important and widely used test to evaluate the potential fertility of a man, which provides both quantitative and qualitative information, however, recent reports have suggested that the semen analysis is unreliable [11,12]. Congruent with the World Health Organization manual [13], it is necessary for each region to establish its own reference values to evaluate the sperm parameters. Sperm characteristics may differ according to the region because of several factors such as nutrition, life style and geographical location. Nevertheless, it is important to know whether advanced paternal age is associated with impaired semen quality and a higher risk of infertility. For this reason, the purpose of this study was to establish an association between the age of individuals and the semen volume, progressive motility, and concentration.

Materials and methods

Subjects

This retrospective study was based on 1364 semen analyses from the Reproduction Group data base, University of Antioquia, Medellín, Colombia, during the period from January 1997 to December 2004. All men underwent testing for fertility alterations and

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the samples were collected during routine examinations. Ethical approval from the Research Ethics Committee of the University of Antioquia was obtained.

Semen samples were grouped according to age into three arbitrary groups: ≤to 30 years (Group 1), between 31 and 39 years (Group 2) and ≥ to 40 years (Group 3) (Table I).

Semen analysis

Semen samples were obtained by masturbation after 2 to 6 days of sexual abstinence. After complete liquefaction of the sample (between 30 and 60 min), the volume was evaluated using a graduated tube (accurate to 0.2 ml), progressive motility (A: ≥25 μm/sec and B: 5 to 25 μm/sec) was determined using direct observation of an aliquot by light microscopy (40×) and the concentration was determined using a Makler chamber (Sefi-Medical Instruments, Haifa, Israel). Semen analysis was performed using World Health Organization guidelines [14]. The total sperm count per ejaculate was calculated by multiplying the sperm concentration by the volume of semen in each sample.

Statistical analysis

The results are expressed as the mean (±standard deviation), range, and 25–75% percentiles. To evaluate the effect of age on volume, rapid and total progressive motility, and concentration, ANOVA tests, Spearman correlations and linear regression were performed using the Prism 4.0® Software.

Results

Semen volume, rapid progressive motility (a) and total progressive motility (a + b), concentration and total sperm count were inversely related to age. A gradual, consistent and significant decline in sperm parameters was observed over time (Table I).

Linear regression and Spearman correlation analysis were performed to evaluate the effect of male age on volume, rapid progressive motility (a) and total progressive motility (a + b), concentration and total sperm count. Congruent with the decline in sperm parameters over time, statistically significant correlations were observed between each parameter and age (Figure 1).

Discussion

The testis serves two physiological functions: (i) spermatogenesis, the formation of mature male gametes capable of interacting with oocytes; and (ii) steroidogenesis, the production of testosterone by Leydig cells which is essential for male sexual functions [15]. Human male aging is associated with progressive decrease in serum concentration of testosterone [3] suggesting decreased Leydig cell testosterone production. Testosterone decline is associated with reduced sexual function, muscle functions, and bone density [16]. Additionally, several mechanisms have been proposed to explain how aging may affect changes in semen quality [8]. If aging alters prostate (smooth muscle atrophy, decrease in protein and water content) or epididymal functions, these alterations may explain how sperm parameters might be affected.

Table I. Demographics and semen characteristics.

	≤ to 30 years (Group 1)	31 to 40 years (Group 2)	≥ to 40 years (Group 3)	$p^\star$
Number of individuals	400	730	234	
Age (years)	26.02 ± 3.6[a]	34.77 ± 2.4	43.72 ± 4.19	
	(17–30)[b]	(31–39)[b]	(40–59)[b]	
Abstinence (days)	4.0 ± 0.98	4.0 ± 0.90	4.0 ± 0.91	>0.5
	(2–6)	(2–6)	[2–6]	
Volume, ml	3.3 ± 1.6	3.08 ± 1.4	2.77 ± 1.4	1 *vs.* 3: <0.001
	(0.5–11)	(0.2–9.0)	(0.2–8)	2 *vs.* 3: <0.05
	2.0–4.2[c]	2.0–4.0	1.8–3.5	
Rapid progressive motility (a), %	10.58 ± 12.2	8.23 ± 10.9	7.9 ± 11.20	1 *vs.* 2: <0.01
	(0–65)	(0–68)	(0–57)	1 *vs.* 3: <0.05
	0–19	0–14	0–13	
Total progressive motility (a + b), %	45.40 ± 19.47	42.77 ± 18.79	38.91 ± 18.99	1 *vs.* 2: <0.05
	(0–95)	(0–85)	(0–85)	1 *vs.* 3: <0.001
	34–59	30–57	23.35–54	
Concentration, 1×10^6 sperm/ml	76.02 ± 64.86	68.24 ± 62.09	59.72 ± 58.64	1 *vs.* 3: <0.01
	(0.001–320)	(0.1–430)	(0.5–386)	
	22–115	23.5–94	17–81.50	
Total sperm count Sperm/ejaculate	231.5 ± 216.4	199.8 ± 193.5	145.8 ± 132.7	1 *vs.* 2: <0.05
	(0.005–1400)	(0.54–1276)	(1.2–663)	1 *vs.* 3: <0.001
	64.60–330	60.80–269.4	39–223.6	2 *vs.* 3: <0.001

$^\star p > 0.05$ in comparisons not included.
Values are represented as [a]mean ± SD and [b]range in brackets and [c]25–75% percentiles.
There were no statistically significant differences in abstinence between the groups.

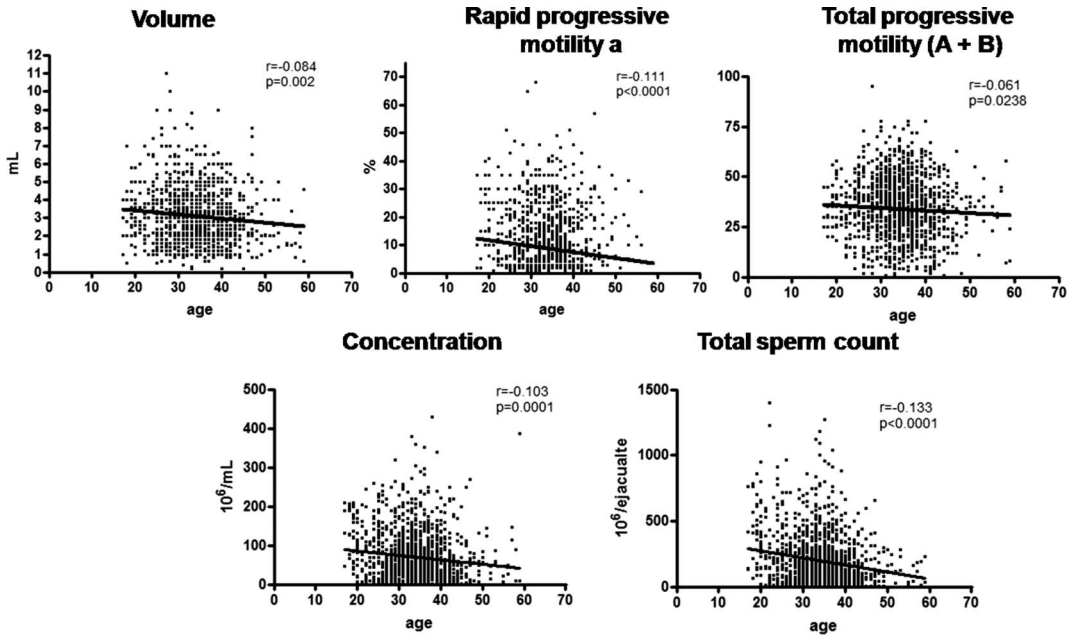

Figure 1. Correlations between sperm parameters and age. To evaluate the effect of age on sperm parameters, Spearman correlations and linear regression were performed. A negative correlation was found between sperm parameters and age in all groups.

In our study, using a large number of men ($n = 1364$) grouped according to age, without sexual abstinence as potential confounding factor ($p > 0.05$), a statistically significant decrease ($p < 0.05$) in volume, rapid progressive motility (a) and total progressive motility (a + b), concentration and total sperm count among older men ($\geq$ to 40 years) was observed compared to younger men ($\leq$ to 30 years) (Table I). Additionally, inverse correlations were found between sperm parameters and age (Figure 1). These changes may be important factors that could affect overall fertility.

This study indicates that a significant decline in volume, rapid and total progressive motility, and sperm count exists among older men compared with younger men. To our knowledge, this is one of the largest reports analyzing the effect of male age on sperm parameters in three age groups without differences in the duration of sexual abstinence. Therefore, in the present study sexual abstinence can be excluded as variable bias.

Several retrospective studies showed a relation between sperm parameters and age [3,17,18]. Jung et al., [3] established that lower progressive motility, normal morphology, and lower volume exist in older men compared to younger men. Additionally, serum testosterone levels were lower in the group of older men (3.0 ng/ml) compared to younger men (3.6 ng/ml). Eskenazi et al., [17] and Levitas et al., [18] found decreased progressive motility and volume in older men compared to younger men. In contrast, no significant relationship between age and sperm count was observed [17], although sperm count increased with advancing age [18]. On the basis of these studies, the relationship between sperm count and age is not clear. However, a decrease in volume and in progressive motility with age seems to be consistent. These previous findings were later confirmed by Ng et al., [19].

In conclusion, this study suggests that the aging male impairs the semen quality affecting negatively the reproductive capacity of men. However, more studies taking into account relationships with female age, coital frequency, life style and prostate diseases are necessary to determine more consistently if male aging has a relationship with infertility.

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