Overweight and seminal quality: a study of 794 patients

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Fertility and Sterility Vol. 94, No. 5, October 2010

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INTRODUCTION

- Diminution in male fertility (adverse trend > 20+ yrs)
  - In Patient for infertility & overall population
  - Rapid ↑ in frequency => Environment factors, esp. nutritional habits/diet composition
- Obesity → Epidemic proportions (U.S, 22% → BMI ≥ 30 kg/m2) → Associated with reduced male fertility
- Not well established:
  - BMI → Male fertility & Seminal parameters
  - Overweight or obesity → Functional activity of

- Obesity & nutritional

→ Significant disturbance → plasma hormonal milieu

  - ↓ Total / Free T levels
  - ↓ Gonadotropin levels
  - ↓ Binding capacity of sex hormone–binding globulin
  - Hyperestrogenemia

→ Affect male reproductive system & gamete quality

Objectives

- Evaluate semen from patients grouped by their BMI:

[1] **Sperm quality parameters** such as volume, concentration, motility, morphology, viability, membrane integrity, functionality, and nuclear maturity

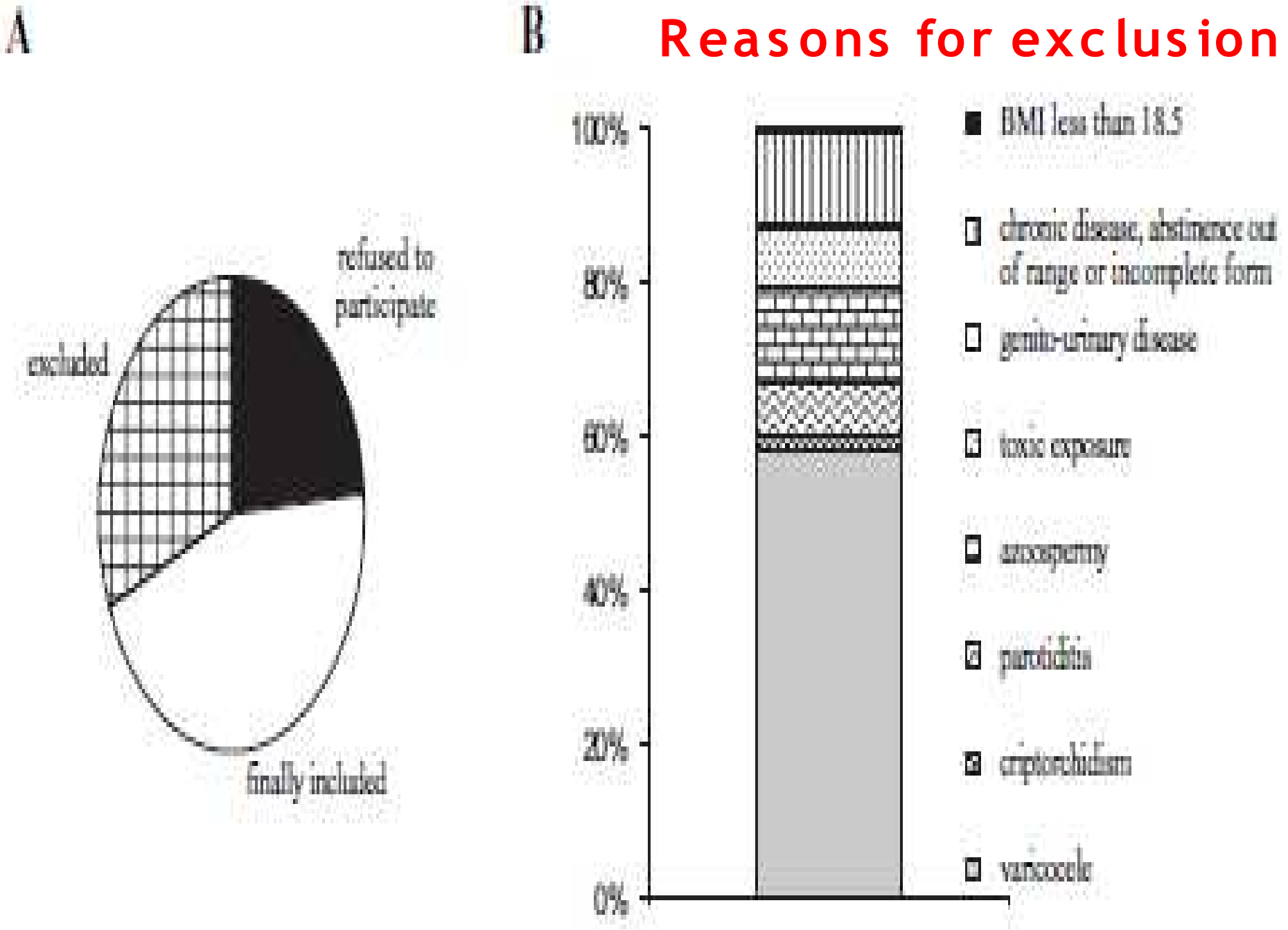
[2] Levels of **functional markers** of epididymis and male accessory glands (seminal vesicles and prostate)

[3] T-concentration

MATERIALS AND METHODS

- Andrology & Reproduction Laboratory in Cordoba, Argentina, 2006–2007
- 1,758 patients → 45.2% , 794 patient included
- Height and weight, age, abstinence period, toxic exposure, genitourinary & other diseases that can alter the hypothalamic–hypophyseal–testicular axis
- 3 groups according to BMI:
  - Normal (18.5 % BMI < 25)
  - Overweight (25 % BMI < 30)
  - Obese (30 % BMI % 50)

Reasons for exclusion



Samples

- Abstinence of 2–10 days → semen samples were collected
- When necessary, transported to the laboratory maintained at approximately 37”C
- Analyzed within 1 hour after collection

Seminal Parameters Evaluated

- Liquefaction → Semen analysis: according to the WHO recommendations
  - ***Sperm morphology***: Papanicolaou staining, Kruger's strict criteria
  - ***Sperm concentration & motility***: conventional methods in a Makler counting chamber
  - ***Sperm viability***: supra-vital eosin Y technique
  - ***Sperm chromatin condensation***: Aniline blue technique
  - ***Spermatozoa***: Hypo-osmotic swelling test

- ***Seminal volume***: In a graduated conic tube
- ***Functional markers*** of epididymis, seminal vesicles, prostate (Colorimetric techniques): Seminal plasma concentrations of

➔ Neutral a-glucosidase (NAG), Fructose, Citric acid

➔ Expressed in relation to semen volume

- ***Seminal total T levels***: commercial RIA kit, sensitivity: 0.08 ng/mL
- Results were adjusted according to seminal volume

Statistical Analysis

- Mean SEM
- Multivariate regressions (linear regression)
- Independent variables: BMI, age, & abstinence
- Significance: 0.05

RESULTS

Characteristics of the patients enrolled in the present study.

Parameters	Total patients (range), n = 794	Patients grouped by BMI		
		Normal (n = 251)	Overweight (n = 388)	Obese (n = 155)
Patients included in each category (%)	100.0	31.6	48.9	19.5
BMI (kg/m^2)	27.2 ± 0.1 (18.6–46.8)	23.4 ± 0.1	27.3 ± 0.1	33.2 ± 0.3
Age (y)	34.9 ± 0.2 (20–65)	34.1 ± 0.4	35.1 ± 0.3	36.0 ± 0.5
Abstinence period (d)	4.0 ± 0.1 (2–10)	3.9 ± 0.1	4.1 ± 0.1	4.1 ± 0.1

77.4%, BMI = 30 ~ 35 (obesity I)

16.8%, BMI = 35 ~ 40 (obesity II)

5.8%, 40 < BMI ≦ 50 (morbid obesity)

Slope of BMI and *P* value of linear multivariate regressions on seminal parameters from patients attending an andrology laboratory.

Seminal parameters	Normal (n = 251)	Overweight (n = 388)	Obese (n = 155)	BMI (slope)	P value
Seminal volume (mL)	3.2 ± 0.1	3.1 ± 0.1	3.1 ± 0.1	−0.01	0.526
Sperm concentration (× 10^6/mL)	43.7 ± 1.9	44.2 ± 1.8	43.0 ± 3.2	−0.45	0.162
Motility (% of total motile spermatozoa)	51.4 ± 1.2	50.2 ± 1.0	46.6 ± 1.7	−0.49	0.007
Rapid motility (% of rapid spermatozoa)	39.8 ± 1.2	38.8 ± 0.9	35.9 ± 1.6	−0.41	0.019
Viability (% of dead spermatozoa)	16.9 ± 0.6	17.8 ± 0.5	19.0 ± 1.0	0.10	0.321
Kruger's morphology (% of normal spermatozoa)	8.3 ± 0.4	8.4 ± 0.3	8.7 ± 0.5	0.001	0.973
OMS morphology (% of normal spermatozoa)	19.3 ± 0.7	19.7 ± 0.6	20.5 ± 1.0	0.06	0.552
HOS (% of reactive spermatozoa)	79.3 ± 0.9	78.1 ± 0.8	76.1 ± 1.7	−0.16	0.306
Nuclear maturity (% of mature nuclei sperm)	66.9 ± 1.2	66.8 ± 1.0	66.7 ± 1.5	−0.03	0.886
Alpha-glucosidase (mg%)	71.7 ± 3.5	65.0 ± 2.4	62.6 ± 3.5	−0.99	0.033
Fructose (mg%)	333.6 ± 8.1	329.4 ± 6.8	351.6 ± 9.6	2.27	0.049
Citric acid (mg%)	460.9 ± 10.4	443.9 ± 8.8	449.6 ± 12.1	−0.44	0.769

- Seminal T levels between groups
  - → No significant differences
  - Normal, 1.41 ± 0.13 ng/Ml ejaculate, n = 27
  - Overweight, 1.47 ± 0.12 ng/mL ejaculate, n = 27
  - Obese, 1.97 ± 0.29 ng/mL ejaculate, n = 26

DISCUSSION

↑ BMI —deleterious effect→ • parameters reflecting semen quality

- Sperm quality
- Levels of functional markers of the epididymis & male accessory glands
- T concentration

- Obesity
  - → Sperm parameters : controversial issue
  - → More deleterious effects, sperm density / motility

- Healthy volunteers (n = 1558), men with BMI >25 kg/m^2 → 20% ↓ in **sperm concentration** & **total sperm count**..... *Jensen et al.*
- Normozoospermia, higher BMI (30.1–39) → significantly lower **sperm concentration**

  Similarly, Koloszar et al.
- Sperm morphology /Gamete density → reflect spermatogenesis/androgen-dependent process
- "massively" obese – hypotestosteronemia → ↓spermatogenesis

- 990 fertile males → significant alterations in underweight men (BMI < 18.5)
  ... ... .Qin et al.
- *"being overweight may be a protective factor for low sperm concentration and low total sperm count"*
- BMI
  Sperm density

not dependent on

reproductive hormones

plasma levels

(T, FSH, LH, E2)

- Alterations in reproductive hormones in obese men (diminution in free and total T and FSH) did

This study

- Failed to find…
  - → significant association between BMI & sperm concentration
  - → alterations in sperm morphology, (WHO1992 or Kruger's strict criteria)
- differences in the diminution trend between obesity II or morbid obesity and obesity I (linear regression analysis)
- Association between BMI and other seminal parameters

- Not healthy volunteers
- 94.2%, BMI <40 (obesity I plus obesity II); 5.8%, 40 < BMI < 50 (morbid obesity)
- Discrepancies may be due to differences in
  - Volunteers' BMI range
  - Distribution in the obese group

- Negative association between BMI &
  - Sperm motility (total & rapid motility)
  - NAG levels ($P < 0.05$)

  → An enzyme secreted into the epididymal fluid, as modulator of epididymal maturation (a process involved in sperm motility acquisition)

  → Androgen-dependency
- obese patients → androgen level alterations
- obesity → epididymal function (deleterious effect)

BMI

- Most widespread parameter used to assess body composition
- Possibly not the most accurate
- Measure of weight in relation to height → does not directly reflect the % of body fat

- Androgen levels are more closely associated with abdominal fat levels than with BMI
- Differences in dietary proteins and fibers (not fat or carbohydrates) → major determinants of sex hormone binding globulin plasma levels

Leptin

- Serum levels
  - positively correlate with BMI
  - negatively correlate with sperm concentration, motility, morphology, and plasma T levels
- Detected also in tubuli seminiferi & seminal plasma
- Leptin receptor: Expressed in testicular germ cells

➔ Mediates a link between obesity & male infertility

In summary

- The results support the idea of
  - → A deleterious effect of obesity on seminal quality
  - → probably mediated by alterations in epididymal function
- Fertility ↓ in obese men, multiple factorials, in which semen quality ↓ has a documented effect

- Other factors must be taken into account
  - accumulation of toxic substances and endocrine disruptors in the fatty tissue
  - life style
  - and/or sexual dysfunction
- Obesity ↑ → obese men with reduced fertility ↑

THANKS FOR LESCINING