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Original Research Article

Correlation of body mass index with serum total PSA, total testosterone and prostatic volume in a sample of men

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ABSTRACT

Introduction: The prevalence of both obesity and prostate cancer are increasing worldwide.
Aim: The aim of this study was to correlate BMI with serum total PSA, serum total testosterone and prostatic volume.
Material and methods: This study was conducted on 100 consecutive male patients aged ≥50 years old recruited from the Urogenital Surgery outpatient clinic. Exclusion criteria were history of previously diagnosed or treated cancer prostate, the use of 5-α-reductase inhibitors and patients with serum PSA ≥10 ng/mL.
Results and discussion: The mean age of patients was 57.5 ± 5.4 years (range: 50–72). The mean BMI was 33.1 ± 6.5 kg/m^2, (range: 23.7–51.3). The mean serum PSA was 4.1 ± 0.8 ng/mL (range: 0.9–5.4). The mean serum testosterone was 4.6 ± 2.2 nmol/L (range: 0.8–9.8). The mean prostate volume was 54 ± 14 cm^3 (range: 19–90). Higher BMI was significantly associated with a lower serum PSA, testosterone and higher prostate volume ($P < 0.05$ for all factors).
Conclusions: Patients with higher body mass index are more liable to have lower serum total PSA, lower serum total testosterone and higher prostate volume. Obesity may be associated with hormonal independent growth of prostatic tissues.

1. Introduction

The prevalence of both obesity and prostate cancer are increasing worldwide. Recently, there has been an interest in the relationship between obesity and the biology of cancers, including prostate cancer.[1] A study showed that a body mass index (BMI) >40 kg/m^2 was associated with a more than 50% increase in cancer mortality across a wide range of malignancies, including prostate cancer.[2]

We believe that to understand the relationship of obesity and prostate cancer, we should, at first, study the correlation

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with parameters affecting prostatic growth. So; the aim of this study was to correlate BMI with serum total PSA, serum total testosterone and prostatic volume.

2. Aim

The aim of this study was to correlate BMI with serum total PSA, serum total testosterone and prostatic volume.

3. Material and methods

This study was conducted on 100 consecutive male patients aged ≥50 years old recruited from the Urogenital Surgery outpatient clinic. Exclusion criteria were history of previously diagnosed or treated cancer prostate, the use of 5-α-reductase inhibitors and patients with serum PSA ≥10 ng/mL.

Determination of the body mass index was performed using Mosteller's formula.[3] Venous blood (4 mL from each patient) was withdrawn under standard aseptic technique. Serum was separated for determination of both PSA and serum testosterone levels. Serum samples were aliquot and stored at −20 °C until assayed. Quantitative determination of serum total PSA and serum total testosterone was done using electrochemiluminescence immunoassay.[4,5] prostate volume was measured using ellipsoid formula. Data were analyzed using SPSS software package version 18.0.

4. Results

The mean age of patients was 57.5 ± 5.4 years (range: 50–72). The mean BMI was 33.1 ± 6.5 kg/m^2, (range: 23.7–51.3 kg/m^2). No cases were underweight, 8 cases (8%) were of normal BMI (18–24.9 kg/m^2). Other 30 cases (30%), 22 cases (22%) and 40 cases (40%) were overweight, obese and morbidly obese, respectively.

The mean serum PSA was 4.1 ± 0.8 ng/mL (range; 0.9–5.4 ng/mL). The mean serum testosterone was 4.6 ± 2.2 nmol/L (range: 0.8–9.8 nmol/L). The mean prostate volume was 54 ± 14 cm^3 (range: 19–90 cm^3).

Table 1 shows the analytical correlations between BMI and the determined variables. Figs. 1–3 represent scatter charts for all the patients, showing the negative correlation between BMI and both PSA and testosterone, and the positive correlation with prostate volume.

5. Discussion

The mean PSA value in the present study was 4.1 ± 0.8 ng/mL which is identical to Hanash et al. study[6] that showed a mean PSA among Saudi population to be 4.1 compared to PSA of 2.7 in western population. Kehinde et al.[7] reported the mean PSA values among Kuwaitis of 4.79 ng/mL. In Hekal study in Mansoura (2010),[8] the mean PSA value was 5.8 ng/mL. They also reported that in obese and severely obese patients, the mean PSA was 3.8 ng/mL and 2.1 ng/mL respectively, with evident inverse relationship of obesity to PSA. The current study showed a mean PSA of 4.04 ng/mL and 3.35 ng/mL for obese and severely obese patients respectively, which is slightly higher than Hekal study. We could also identify an inverse relationship of BMI to PSA.

In 2010, a group of Korean investigators searched the effect of BMI on PSA and prostate volume.[9] The study included 10,380 healthy men who received routine comprehensive health evaluations from March 2004 to June 2009. BMI was found to be negatively associated with PSA and positively associated with prostate volume. Similarly, Price et al.[10] studied the relationship between BMI, PSA and digital rectal examination findings among participants in a prostate cancer screening clinic.

Table 1 – Relationship between BMI and the mean prostate volume, PSA, and serum testosterone levels among patients.

	Body Mass Index (BMI)				Significance of change
	Normal	Overweight	Obese	Severe obesity	
Prostate volume (cm^3)					
Range	18.8–76.7	24.6–81.1	29.9–85.3	55.2–90.3	F = 10.348
Mean	**50.125**	**53.032**	**55.481**	**61.130**	**P = 0.0001***
SD	18.316	13.106	15.343	5.874	
Median	53.090	53.600	55.010	60.150	
PSA (ng/mL)					
Range	0.90–5.40	3.60–5.10	3.30–5.20	1.50–4.10	F = 8.031
Mean	**4.36**	**4.24**	**4.04**	**3.35**	**P = 0.0001***
SD	1.083	0.489	0.592	1.236	
Median	4.55	4.20	4.10	3.90	
Testosterone (nmol/L)					
Range	1.09–9.79	1.85–9.52	1.81–9.39	0.83–7.21	F = 5.071
Mean	**5.085**	**4.812**	**4.722**	**4.328**	**P = 0.005***
SD	2.201	3.142	1.947	2.612	
Median	5.84	4.55	4.38	2.86	

F – Anova test, P – Probability, SD – Standard Deviation, P is significant at P ≤ 0.05.
* Significant value.

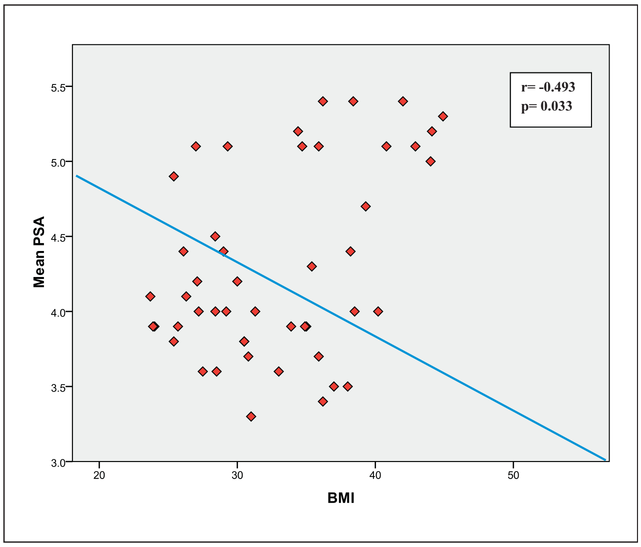

Fig. 1 – Scatter chart showing the negative correlation between serum PSA and BMI among patients.

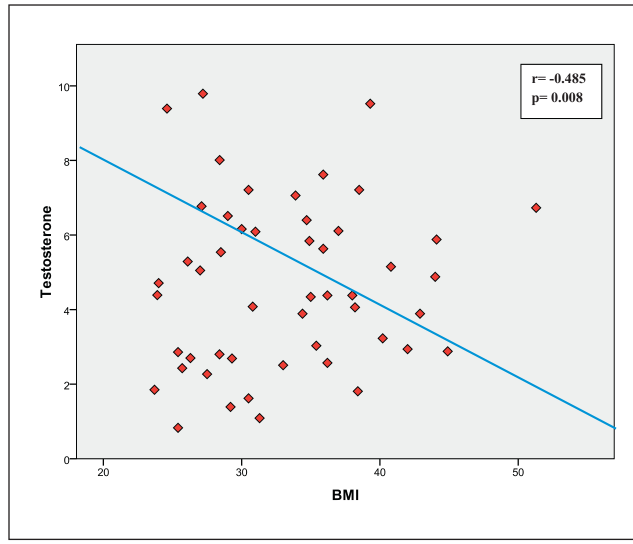

Fig. 2 – Scatter chart showing the negative correlation between serum testosterone levels and BMI among patients.

A total of 544 consecutive participants volunteered for screening. The researchers found that increased BMI was associated with lower PSA values in the studied subjects. The mean PSA reported for normal weight men was 2.2 ± 2.0 ng/mL, for overweight men was 2.2 ± 1.8 ng/mL and for severely obese men was 1.6 ± 0.2 ng/mL. Baillargeon et al.[11] studied the association of BMI and PSA in a population-based study in nearly 3 000 men without prostate cancer. The authors found that the mean PSA level decreased with increasing BMI. The author reported that age and race did not affect the association between PSA levels and BMI. The reported median PSA values in this study were 1.42 ng/mL for normal weight men, 1.36 ng/mL for overweight men, and 0.94 ng/mL for severely obese men.

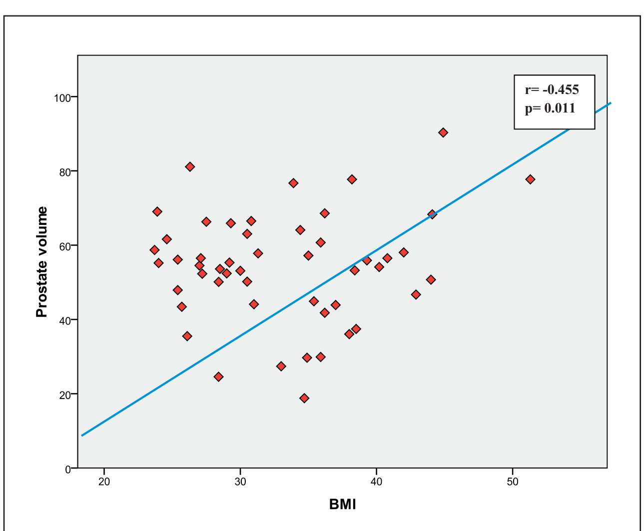

Fig. 3 – Scatter chart showing the positive correlation between prostate volume and BMI among patients.

In contrary, a Canadian study[12] on 630 men without known prostate cancer, who participated in an annual prostate cancer screening event, the Prostate Cancer Awareness Days (PCAD) showed that BMI has little if any effect on PSA distribution. This study addressed white French-Canadians, whose gene pool may differ from English speaking Canadians or from men from the United States. It demonstrates that the lack of BMI effect may transcend several ethnic backgrounds.

The association between BMI and decreased PSA levels was hypothesized to be due to lower testosterone serum levels[11] or plasma hemodilution where obesity causes larger plasma volume in comparison to non-obese persons which might affect the levels of molecular markers.[10]

Freedland et al.,[13] in a study included 1 414 men, confirmed that increasing BMI was associated with larger prostate size. However, the authors reported that this finding was only observed in men younger than 63 years old, similar to our cohort with a mean age of 57.5 ± 5.4 years, and showing the same positive relation. Loeb et al.[14] did not find such an association between prostate size and obesity. The differences between the Loeb study and the current study can be attributed to different methodology used in both studies, where Loeb did not calculate BMI for the patients included and instead used height, weight and waist circumference as a reference to the degree of obesity. In addition, Loeb et al. included patients scheduled for radical prostatectomy in contrast to the present study which did not include patients with a history or clinical evidence of a previously diagnosed or treated cancer prostate.

Obesity and the metabolic syndrome might alter levels of multiple hormones and growth factors (e.g. testosterone, estrogen, letpin, insulin and insluin-like growth factor-1) with competing effects on prostate growth and size. The relationship between obesity and increased prostate volume was hypothesized as a consequence of the hyperinsulinemic state associated with obesity.[15]

The current study also reported a negative correlation between serum testosterone and BMI values. This observation has been established in several studies throughout the literature.[16,17] Several mechanisms were introduced that explained this relationship including increased estrogen levels,[18–21] polymorphism of the aromatase enzyme,[22,23] endogenous opiods,[24–26] sleep apnea,[27–32] insulin resistance,[33,34] and direct effect on testicular function.[35–39]

Our research is unique in that it evaluated the effect of BMI on serum testosterone, PSA and prostate volume in the same cohort of patients. Collectively; it shows that higher BMI is associated with lower PSA, lower testosterone and higher prostate volume. In other words, higher BMI may be associated with more androgen independent growth of the prostatic tissue; a fact that may conclude why some literatures have reported higher rate of early castration resistant prostatic cancer cases.

6. Conclusions

Patients with higher body mass index are more liable to have lower serum total PSA, lower serum total testosterone and higher prostate volume. Obesity may be associated with hormonal independent growth of prostatic tissues.

Conflict of interest

None declared.

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