RESEARCH COMMUNICATION

Prostate-Specific Antigen Levels among Chinese, Malays and Indians in Singapore from a Community-Based Study

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Abstract

The purpose of this study was to examine the distribution of prostate-specific antigen levels among Chinese, Malays and Indians in Singapore, taking the effect of age into consideration. The study was carried out as part of the Singapore Prostate Awareness Week from 23-26th February 2004. Men above 50 years old went to four government-restructured hospitals to participate in the study. Participants filled up a questionnaire and provided 5 ml of blood for measurement of PSA levels using the Abbott IMx Total PSA assay (Abbott Laboratories). 3,486 men responded to the study, comprising 92.8% Chinese, 3.0% Malays, 2.5% Indians and 1.8% Others. 92.7% of them had PSA levels of 4 μg/L or less. There were no significant differences ($p<0.05$) between the mean PSA levels of Chinese (1.60 μg/L), Malays (1.39 μg/L), Indians (1.23 μg/L) and Others (1.70 μg/L). PSA levels were significantly associated with age (Spearman's $r= 0.27$, $p<0.01$). PSA levels increased with each 10-year age group and these trends were significant ($p<0.0001$) across both PSA group levels and age groupings. In the ≤50 and >50-60 years age groups, the prevalence of PSA levels >4 μg/L were 1.1% and 3.7% respectively. This rose rapidly to 11.3% and 23.5% for age groups >60-70 and >80 years respectively. Our study shows that the median PSA levels in the Caucasian population in the USA are higher than those of Chinese, Malays and Indians in Singapore. PSA levels were positively associated with age. It may be more appropriate to offer PSA testing to men who are >60 years old rather than the current >50 years.

Key Words: Prostate - prostate-specific antigen - Singapore - ethnic groups

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Introduction

The incidence of prostate cancer in different parts of the world differs quite markedly (GLOBOCAN, 2002). The factors responsible for the differences remain unclear. The age-standardized rates (world standard) of the incidence of prostate cancer could range from 124.8 and 90.9 per 100,000 in USA and Sweden, respectively, to 12.6 per 100,000 in Japan and 1.7 per 100,000 in China (GLOBOCAN, 2002). Although the incidence of prostate cancer in Singapore is not as high as that of the USA or the Nordic countries, it is on the rise. Prostate cancer is now the fifth most frequent cancer among Singaporean males, and the incidence has been increasing steadily over the last 35 years. The average annual rate of increase between 1968 and 2002 was 5.6%, with the last 10 years having seen a relatively steeper increase. The age-adjusted risk of this cancer in 1998-2002 was 17.4 compared to 4.2 per 100,000 in 1968-1972 (Seow et al., 2004). What could be the factors that could have contributed to this increase especially after the 1990's? One possible reason could be the use of the prostate-specific antigen test in screening and detection of prostate cancer cases.

The PSA test was developed as an assay for an immunologic marker that corresponded well with clinical stage in patients known to have prostate cancer (Stamey et al., 1987). It was subsequently found to be able to identify prostate cancer in men not known to have the cancer (Catalona et al., 1991). Since then, PSA screening was widely adopted in many countries even before there was any evidence of its effectiveness in reducing prostate cancer mortality.

Men with prostate cancer generally exhibit elevated levels of PSA in their serum; this tumor marker is now frequently used for prostate cancer screening, diagnosis and monitoring of response to therapy (Oesterling, 1991). To date, studies conducted to establish normal serum PSA values have involved study populations that have included North America, Europe, Japan, Korea and China. To our knowledge, there are no reports of population studies involving Southeast Asian countries. Singapore is situated at the tip of the Malayan peninsula with a mix of three large ethnic groups viz. Chinese, Malays and Indians in her population. The objective of this study was to study

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Table 1. Characteristics of the Study Population by Ethnic and Age Groupings

Age (years) Ethnicity	Chinese		Malay		Indian		Others		Total	
<=50	166	5.2%	3	2.9%	6	7.1%	8	13.3%	183	5.3%
>50-60	1,661	52.2%	64	62.7%	46	54.8%	27	45.0%	1,798	52.5%
>60-70	1,134	35.7%	30	29.4%	23	27.4%	18	30.0%	1205	35.2%
>70-80	202	6.4%	5	4.9%	9	10.7%	6	10.0%	222	6.5%
>80	16	0.5%	0	0.0%	0	0.0%	1	1.7%	17	0.5%
Total	3,179	92.8%	102	3.0%	84	2.5%	60	1.8%	3,425	100.0%

the distribution of PSA levels among the Chinese, Malays and Indians in Singapore taking the effect of age into consideration.

Materials and Methods

Study Subjects and Data Collection

This study was carried out as part of the Singapore Prostate Awareness Week (PAW) from 23-26 February 2004, which was organized by the Singapore Urological Association. The PAW included health education messages on prostate diseases that occur in ageing men, namely, benign prostate hyperplasia, prostatitis and prostate cancer. The PAW campaign was announced in the local newspapers and men above the age of 50 years were invited to go to any of four government-restructured hospitals to participate in the study. Participants were asked to fill up a questionnaire and provide 5 ml of blood sample for measurement of their PSA levels. Signed informed consent was obtained from all participants and the relevant Institutional Ethical Review Boards approved the study. Men with known prostate conditions who were previously under treatment were excluded from the study.

Laboratory Analysis

All serum samples from the four institutions were couriered to a designated laboratory to prevent inter-laboratory variation in measurements of PSA levels. The free serum total PSA level was assayed by immunometric analysis using the Abbott IMx Total PSA assay kit (Abbott Laboratories).

Statistical Analysis

The relationship between serum PSA and age was described and tested using Spearman nonparametric correlation. We divided subjects into 10-year age groups to study the influence of age on serum PSA levels. ANOVA was used to test for differences in the means of PSA levels among the different ethnic groups as well as between the different age groups. We also divided serum PSA levels into three groups (0-2 μg/L, >2-4 μg/L and >4 μg/L) to see the PSA level trend across the different age groups. All statistical analyses were performed using SPSS version 11.0 (SPSS Inc., Chiacago, Illinois).

Results

Some 3,486 men responded to the study during the PAW campaign. Of these, 20 did not provide blood samples. These subjects with missing PSA level data were not statistically different with regards to age or ethnicity. Table 1 shows the characteristics of the study subjects by ethnic and age groupings. Although the study was only open to men above 50 years old, there were 183 subjects (mean ± SD age was 48 ± 2.2 years, range 41-50 years) under 50 years of age who wanted to participate in the study. These subjects were included in our analysis. Chinese subjects constituted the majority (92.8%); with Malays, Indians and Others forming the remaining, at 3.0%, 2.5% and 1.8% respectively (Table 1). The "Others" group is made up of ethnic minorities in Singapore. The distribution of the age groups (10-year intervals) was fairly similar among the four ethnic groups with the 50-60 years age group being the majority followed by the 60-70 years age group (Table 1).

92.7% of all the study's subjects had PSA levels of 4 μg/L or less. Table 2 shows the PSA levels of the three main ethnic groups in Singapore compared with other population groups. There were no significant differences ($p<0.05$) in the means of PSA levels of Chinese (1.60 μg/L), Malays (1.39 μg/L), Indians (1.23 μg/L) and Others (1.70 μg/L) using the one-way analysis of variance (ANOVA).

PSA levels were significantly associated with age (Spearman's $r= 0.27$, $p<0.01$). PSA level increased with each 10-year age group and these trends were significant ($p<0.0001$) between different PSA groups levels and different age groupings (Table 3). In the ≤50 and >50-60 years age groups, the prevalence of PSA levels >4 μg/L were 1.1% and 3.7%, respectively. However, the prevalence rose rapidly to 11.3% and 23.5% respectively for age groups >60-70 and >80 years (Table 3).

Table 2. Median PSA levels ((g/L)) According to Age among Caucasian, Japanese, Korean, Chinese (China), Chinese (Singapore), Malay and Indian men

Age group (years)	Caucasian # (USA)	Japanese^	Korean*	Chinese + (China)	Chinese (Singapore)	Malay (Singapore)	Indian (Singapore)
40-49	0.7	0.6	0.77	0.54	0.7	0.5	0.8
50-59	1.0	0.7	0.83	0.82	0.8	0.6	0.9
60-69	1.4	0.9	1.01	0.93	1.2	1.5	1.2
70-79	2.0	1.4	1.24	1.17	1.4	1.9	1.8

Oesterling et al, 1993; ^ Oesterling et al, 1995; * Lee et al, 2000; + He et al 2004

Table 3. PSA Levels (μg/L) by Study Population Age Groups

Age group (years)	≤50		>50-60		>60-70		>70-80		>80		Total	
0 - 2	169	92.3%	1,556	86.9%	848	70.9%	138	63.6%	9	52.9%	2,720	79.9%
>2 - 4	12	6.6%	168	9.4%	213	17.8%	43	19.8%	4	23.5%	440	12.9%
>4	2	1.1%	66	3.7%	135	11.3%	36	16.6%	4	23.5%	243	7.1%
Total	183		1790		1196		217		17		3403	

p-value for chi-square trend test is significant at <0.0001 for all three groups of PSA levels against age groups

There were significant differences in the mean PSA levels for age group ≤50 years compared with all the different age groups. Likewise, there were also significant differences in the mean PSA levels for different age groups (Figure 1). There was generally a progressive increase in the mean PSA levels for each of the age groups within the Chinese, Malays and Indians. However, this relationship was not so clear in the "Others" ethnic group (Figure 2).

Discussion

This study was conducted as part of a Prostate Awareness Week (PAW) programme where the main aim of the campaign was to educate the public on prostate diseases that occur in ageing men, namely, benign prostate hyperplasia, prostatitis and prostate cancer. The PAW campaign was announced in the local newspapers and men above the age of 50 were invited to go to any of four government-restructured hospitals to participate in the study. There was no systematic sampling of the subjects and thus biases could be introduced. As such, the subjects included in the study would consist of men who could possibly have different types of prostate diseases as well as healthy men. Although the subjects were asked about their medical conditions, we did not ascertain their conditions against medical records, as this was not available to us. Thus, the results of the PSA levels in the subjects could reflect an underlying prostate disease (e.g. benign prostate hypertrophy, prostate cancer, etc). If this were so, then these men with prostate diseases would skew the PSA levels. However, we do not think this is likely as men with known prostate conditions previously under treatment were excluded from our study. Moreover, men with prostate diseases (with symptoms) would have been seen by a urologist and PSA tests would have been done. Thus, it is unlikely that they participated in this health education campaign on prostate diseases, as their doctors would have already educated them on their conditions.

It is a well-documented phenomenon that health conscious men are those who usually respond to any health education or disease screening campaign while the reverse is true for those who are not health conscious. Other than urethral instrumentation, no definite lifestyle habits have

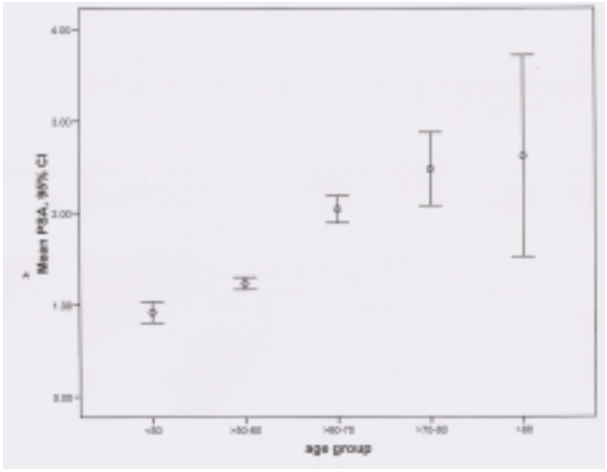

Figure 1. Mean and 95% Confidence Interval (CI) of PSA levels by Age Groups

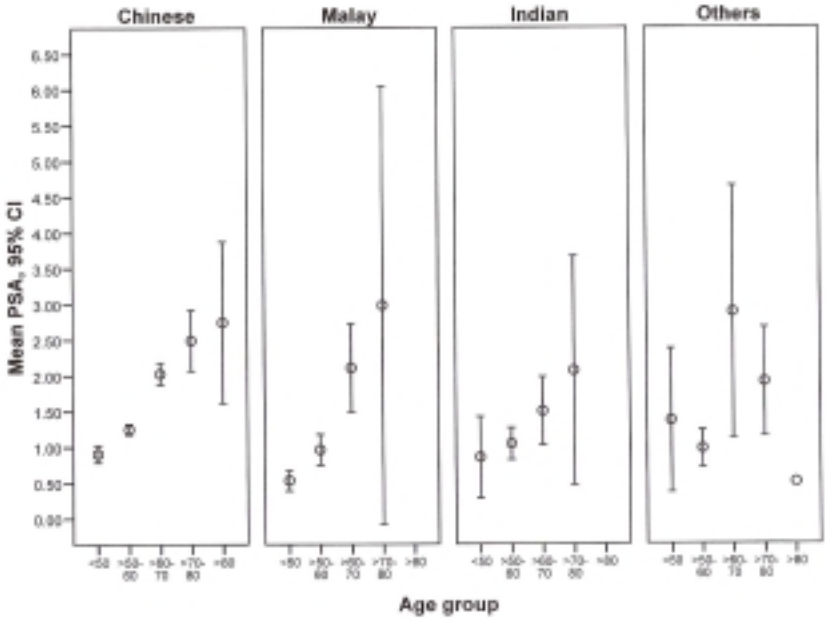

Figure 2. Mean and 95% Confidence Interval (CI) of PSA levels by Ethnicity and Age Groups

been found to strongly correlate with PSA levels. As such, the health consciousness of men who participate in this study is unlikely to affect the PSA levels significantly. Most prostate diseases, with the exception of prostatitis, are unlikely to have any symptoms at the early stage. Therefore, it is possible that men with an underlying prostate disease (e.g. benign prostate hypertrophy, prostate cancer, etc) could still be included in the study. Herein also lies the strength of this study, as we would include both men with and without prostate diseases, which is what a population-based study of PSA levels should reflect.

Chinese constituted 92.8% of the subjects, which is above the population average of 80% for Chinese males ≥50 years old. Conversely, Malays (3.0%), Indians (2.5%) and Others (1.8%) (Table 1) were under represented for males ≥50 years old for Malays (10.1%), Indians (8.4%) and Others (2.5%) in Singapore (Singapore Department of Statistics, 2003). The study population does not reflect Singapore's ethnic distribution and thus the study of PSA levels cannot be extrapolated to the entire population.

Across all the age groups, the median PSA levels of Singaporean Chinese were slightly higher compared to that of the Chinese from China except for ages 50-59. This is understandable given that He et al. (2004) only recruited subjects who did not have "prior diagnosis of prostate cancer, a previous history of prostate surgery, or prostatitis…" (He et al., 2004). For our study, everyone who came for the PAW campaign was included in the analysis. The Singapore Chinese median PSA levels for all the different age groups were comparable to that of the Japanese and Koreans. Generally, Caucasian median PSA levels, for all age groups (Table 2), are still higher than the Japanese, Koreans, Chinese (from China and Singapore), Malays and Indians. Our observations are in agreement with previous reports (He et al., 2004; Lee et al., 2000) citing that Caucasians have generally higher PSA levels compared to Koreans and Chinese from China. Given the small sample sizes in each of the age groups (Table 1) for the Malays and Indians, it would be premature to make any inference regarding their median PSA levels. Although there were differences in the mean PSA levels between the four ethnic groups, these differences were not significant at $p<0.05$. This observation was also true for the different ethnic groups stratified by their 10-year age groups (Figure 2).

We found that PSA levels were positively associated with age. This finding has also been reported in the American Caucasian and Japanese groups (Le et al., 2000). Since PSA is produced in the prostate and the prostate generally enlarges after age 50, the increase in PSA levels with age is understandable. The age group >50-60 years constituted 11.8% of the Singapore population in 2003. The prevalence of PSA levels >4 μg/L was 3.7% for this age group. But the prevalence rose by three fold in the age group >60-70 years to 11.3% (Table 3). The current international recommendation is to offer a PSA test for men >50 years old. In light of our study's findings on the large differences in the age-specific prevalence rate of elevated PSA, perhaps in the context of Singapore, it may be more appropriate to suggest that men who are >60 years old should go for PSA testing rather than the current >50 years. Of course it would also be dependent on the detection rate of prostate cancer based on the currently defined PSA level of >4 μg/L. We are in the process of analyzing this part of the data.

In conclusion, we have found that the median PSA levels in the Caucasian population in the USA are higher than Chinese, Malays and Indians in Singapore. There were no significant differences in the mean age-specific group PSA levels for Chinese, Malays and Indians. PSA levels were positively associated with age. Hence, it may be more appropriate to offer PSA testing to men who are >60 years old rather than the current recommendation of >50 years old.

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