

Erectile Dysfunction in Singapore: Prevalence and Its Associated Factors – A Population-Based Study

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ABSTRACT

Purpose: To study the prevalence of erectile dysfunction (ED) in Singapore males aged 30 and above and its association with demographic, medical and other risk factors.

Methodology: A population based cross sectional study of 729 men aged 30 and above in Singapore was conducted using the abridged, five-item version of the International Index of Erectile Function (IIEF-5). Presence of erectile dysfunction was defined as IIEF-5 score of less than 21. Erectile dysfunction was further categorised into mild (IIEF-5: 16-20), moderate (IIEF-5: 11-15) and severe (IIEF-5: <11). A logistic regression model was used to identify significant independent risk factors for ED.

Results: Overall, 51.3% of respondents (n=374) reported some degree of erectile dysfunction. Of these, 23.2% have mild ED, 8.8% have moderate ED and 19.3% had severe ED. The prevalence of ED increased from 42.8% for men in their forties to 77.4% in their sixties. The prevalence of severe ED increased from 9.1% in men in their forties to 43.5% in their sixties and 77.0% in those aged 70 and above. Age above 50 years is the single most significant risk factor on multivariate analysis when adjusted for all confounding factors. Other important risk factors include Indian ethnic group, lower household income, physical inactivity, diabetes mellitus and cardiac diseases.

Conclusion: Erectile dysfunction is common amongst Singaporean men. Age is the single most important physiologic factor affecting erectile function. The prevalence and severity increased significantly with age after 50 years old. With an ageing population, erectile dysfunction may become a significant health problem. Health care providers should plan their resources accordingly.

Keywords: erectile dysfunction, prevalence, population-based study

INTRODUCTION

Erectile dysfunction (ED) is defined as the inability to achieve or maintain an erection sufficient for satisfactory sexual performance⁽¹⁾. The Massachusetts Male Aging Study reported a prevalence of 52% in men aged 40 to 70⁽²⁾. It is estimated that in 1995 there were over 152 million men worldwide who experienced erectile dysfunction. With the ageing worldwide population, it has been projected that by the year 2025, 322 million men will have some degree of erectile dysfunction⁽³⁾.

Data on the prevalence of ED in Asia are limited. A recent study conducted in Thailand reported an overall prevalence rate of 37.5% amongst men 40 to 70 years of age⁽⁴⁾. No epidemiological studies on erectile dysfunction have been done in Singapore previously. With an ageing population, erectile dysfunction may become a significant health problem in Singapore.

We therefore conducted a cross-sectional population-based study to define the prevalence of ED in Singaporean men aged 30 and above and to determine the association of demographic, medical and other risk factors with erectile dysfunction.

METHODOLOGY

A population-based cross-sectional survey was conducted in Singapore in 1999 to evaluate lower urinary tract symptoms (LUTS), pain symptoms, erectile dysfunction (ED) and anxiety. A proportional stratified random sample of 3,000 household units (stratified by household type) was selected from a sampling frame of all households in Singapore, the latter of which was obtained from the Statistics Department of Singapore. From each household, one individual aged twenty and above was selected randomly, using an assigned random table of numbers, for a face-to-face interview by trained interviewers.

The response rate was 78.2%. Fifty subjects were eliminated from the data set due to missing data on sex and/or age. Twenty other subjects were deemed non-eligible because they were

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mistakenly interviewed despite being below the age of 20. The final data set consisted of 2,276 subjects (1,143 males and 1,133 females). They did not differ significantly from non-respondents by type of household (private housing: 14.6% vs. 13.2%; one to two room apartment: 6.9% vs. 5.6%; three to four room apartment: 61.0% vs. 63.5% and five room apartment 17.3% vs. 17.5%).

Interviewers, mainly undergraduate students and part-time nurses were recruited and trained by the team of investigators to conduct the door-to-door questionnaire survey. Administrative and logistic details such as handling non-responders and partial responders were covered during the training sessions. Medical terms were clearly defined and explained. The questionnaire was also translated into Chinese by a team of very experienced and bilingual "field workers" from the Department of Community, Occupational and Family Medicine who have translated and participated in many previous questionnaire surveys. The questionnaire was first translated into Chinese and then back into English to check for accuracy of meaning. Certain key words were also translated into Malay to facilitate interviewing of Malay-speaking respondents.

Questionnaire

The whole questionnaire contained 115 questions categorised into the following domain: demographic data, medical and surgical history, lower urinary tract symptoms and bothersome score according to the International Prostate Symptoms Score and Madsen Iverson Index, pain symptom, quality of life score (QoL) and anxiety score. Only males were requested to respond to the erectile function domain.

Physical activity or inactivity was assessed subjectively. In general, "inactive" referred to sedentary jobs and lifestyles with minimal amount of strenuous activities. "Very active" referred to sportsmen, manual workers and labourers who expand a lot of energies daily.

Erectile Function Domain

The IIEF15 is an internationally validated questionnaire specifically designed for the assessment of male erectile dysfunction⁽⁵⁻⁶⁾. The abridged five-item version IIEF5 has five items selected from the IIEF15 which were based on ability to identify the presence or absence of ED and on adherence to the National Institute of Health's definition of ED. These items focused on erectile function and intercourse satisfaction, particularly questions 2, 4, 5, 7, and 15 of the IIEF15, giving a total aggregate score of 25. Using a cutoff score of 21, the sensitivity and specificity

Table 1. Descriptive profile of 729 study subjects.

Variable*		Number	%
Age Group (years)	30 - 39	228	31.3
	40 - 49	285	39.1
	50 - 59	114	15.6
	60 - 69	62	8.5
	≥70	40	5.5
Ethnicity	Chinese	537	73.7
	Malay	95	13.0
	Indian	67	9.2
	Others	30	4.1
Marital Status	Single	67	9.2
	Married	639	88.0
	Separated/Widowed	20	2.8
Education Level	None	36	5.0
	Primary	145	20.1
	Secondary	328	45.6
	Tertiary	211	29.3
Household Income (Sing \$/month)	<1000	52	8.2
	1000 - 2999	306	48.4
	3000 - 4999	166	26.3
	≥5000	108	17.1
Work Status	Currently Working	598	84.2
	Not working/Retired	112	15.8
Activity Level	Inactive	59	8.5
	Moderately Active	403	58.2
	Very Active	231	33.3
Medical Conditions	Diabetes	38	5.3
	Hypertension	85	11.8
	Cardiac Disease	22	3.1

* Missing values for all variables except for "age group" and "ethnicity".

of discriminating between ED and no-ED was 0.98 and 0.88 respectively⁽⁷⁾. We have similarly defined the presence of erectile dysfunction in our study as IIEF5 score of less than 21. We further subdivided the severity of erectile dysfunction arbitrarily into mild (IIEF-5 score of 16-20), moderate (11-15) and severe or complete (10 or less).

For the purpose of studying erectile dysfunction, only 924 males aged 30 and above were included in the study. Excluded were 219 subjects aged 20 to 29 as 77.6% (170) of them were either single or had no current sexual partners. Excluded from the final analysis were 195 (21.1% of 924) respondents who either had refused to answer the IIEF-5 or had answered it incompletely resulting in the inability to aggregate the IIEF-5 score. Finally there were 729 respondents with evaluable IIEF-5 score. The actual response rate was 78.9% (729/924 respondents).

Data analysis

All statistical analyses were performed using the Statistical Package for Social Sciences for

Table II. Prevalence of erectile dysfunction by age group and ethnicity.

Age Group (years)	Chinese		Malay		Indian		Others		All Patients	
	N	Prevalence (95% CI)	N	Prevalence (95% CI)	N	Prevalence (95% CI)	N	Prevalence (95% CI)	N	Prevalence (95% CI)
30-39	155	39.4	37	48.6	23	43.7	13	46.2	228	47.1 (35.3-48.1)
40-49	202	37.1	41	61.0	33	57.6	9	33.3	285	42.8 (37.1-48.6)
50-59	91	62.6	12	50.0	6	100.0	5	80.0	114	64.0 (55.2-72.8)
60-69	53	75.5	3	66.1	4	100.0	2	100.0	62	77.4 (67.0-87.8)
≥70	36	88.9	2	100.0	1	100.0	1	100.0	40	90.0 (80.7-99.3)
All Patients	537	49.3 (45.1-53.6)	95	55.8 (45.8-65.8)	67	59.7 (48.0-71.4)	16	53.3 (35.5-71.1)	729	51.3 (47.4-54.9)

Windows (SPSS 9.05 for Windows)⁽⁸⁾. Prevalence was presented as percent (per 100 persons), with 95% confidence intervals. χ^2 tests were used for the initial selection of predictor variables which influence the outcome, namely ED. For each variable, univariate odds ratios (OR) were calculated to determine risks for ED when compared with the reference group, where OR=1. These were adjusted taking into consideration the influence of confounding, by logistic regression. Variables adjusted for included age, ethnicity, educational level, household income, activity level, and medical conditions including diabetes, hypertension and cardiac disease. As age was an effect modifier for some of the variables, OR for subjects <50 and ≥50 years of age were calculated and presented separately.

RESULTS

As the focus of this report is on the prevalence of erectile dysfunction, the other results from the LUTS study will be reported separately.

DEMOGRAPHICS

The demographic profile of the 729 respondents is presented in Table I. The mean age of the respondents was 46.0 (standard deviation of 11.6) and a range of 30.0 to 92.0.

The distribution of respondents according to the various ethnic groups was as follows: 73.7% "Chinese", 13.0% "Malay", 9.2% "Indian" and 4.1% "Others". This was generally quite similar to the Singaporean male population's ethnic distribution of 76.9%, 14.0%, 7.7% and 1.4% respectively obtained from the Census of Population Office, Department of Statistics⁽⁹⁾.

Prevalence and severity of erectile dysfunction

Summary statistics on the prevalence of ED according to age group and ethnic group are shown in Table II. Overall, 51.3% (n=374) have some degree of erectile dysfunction. While the prevalence of ED was similar amongst the 30-39 (47.1% have ED) and 40-49 (42.8%) age groups, the prevalence rate started to increase after the age of 50. The prevalence of ED increased significantly from 64.0% (50-59 years) through 77.4% (60-69 years) to 90.0% (70 years and above). While 49.0% of Chinese have ED, 60.0% of Indians have ED.

In terms of severity, 23.2% have mild ED, 8.8% have moderate ED and 19.3% have severe ED (Table III). This refers to all subjects, with or without ED. Of those with ED, 45.2% (169/374) had mild ED, 17.1% (64/373) had moderate ED, and 37.7% (141/374) had severe ED. The degree of severity was noted to increase with age. While only 9.1% of men in their forties have severe ED, this percentage increased to 43.5% in their sixties and 77.0% in those aged 70 and above. A sub-analysis of 460 men with and without ED aged 40 to 69 gave a prevalence rate of 52.7% with the following distribution: mild (27.1%), moderate (8.9%) and severe (16.7%).

Risk factor analysis

The association between ED and demographic factors, medical conditions and other risk factors are summarised in Table IV. On univariate analysis, the significant risk factors were age above 50 years old, lower educational level, lower household income level, physical inactivity, diabetes mellitus, hypertension and cardiac disease. However, when the odds ratios (OR) were adjusted for all variables, only "age above 50 years" and "Indian" ethnicity

Table III. Prevalence of erectile dysfunction (ED) by degree of severity*.

Age Group (Years)	Total Number of Patients	No ED		Mild ED		Moderate ED		Severe ED	
		N	Prevalence (95% CI)	N	Prevalence (95% CI)	N	Prevalence (95% CI)	N	Prevalence (95% CI)
30-39	228	133	58.3	41	18.0	21	9.2	33	14.5
40-49	285	163	57.2	77	27.0	19	6.7	26	9.1
50-59	114	41	36.0	36	31.6	13	11.4	24	21.1
60-69	62	14	22.6	12	19.4	9	14.5	27	43.5
≥70	40	4	10.0	3	7.5	2	5.0	31	77.5
All Patients	729	355	48.7 (45.1-52.3)	169	23.2 (20.1-26.2)	64	8.8 (6.7-10.8)	141	19.3 (16.5-22.2)

* No ED : IIEF score 21-25
 Mild ED : IIEF score 16-20
 Moderate ED : IIEF score 11-15
 Severe ED : IIEF score ≤10

Table IV. Odds ratios of demographic and medical variables associated with erectile dysfunction.

Variable		N	Univariate Odds Ratio (95% CI)	Adjusted Odds Ratio* (95% CI)	
				By Age	By All Variables in Table
1. Demographic					
Age Group (Years)	30-39	288	1.00		1.00
	40-49	285	1.05 (0.74-1.49)		1.04 (0.70-1.56)
	50-59	114	2.49 (1.57-3.97)		2.10 (1.20-3.66)
	60-69	62	4.80 (2.50-9.20)		4.35 (1.81-10.49)
	≤70	40	12.60 (4.34-36.59)		6.53 (1.26-33.86)
Ethnicity	Chinese	537	1.00	1.00	1.00
	Malay	95	1.30 (0.84-2.01)	1.69 (0.67-3.14)	1.45 (0.86-2.43)
	Indian	67	1.52 (0.91-2.55)	1.90 (1.11-3.24)	1.93 (1.07-3.49)
	Others	30	1.17 (0.56-2.45)	1.45 (0.67-3.14)	1.61 (0.73-3.58)
Educational Level	Tertiary	211	1.00	1.00	1.00
	Secondary	328	1.60 (1.12-2.26)	1.36 (0.95-1.95)	1.29 (0.82-2.04)
	Primary	145	2.10 (1.37-3.23)	1.40 (0.88-2.22)	1.32 (0.72-2.41)
	No Education	36	6.14 (2.57-14.66)	2.22 (0.85-5.78)	2.41 (0.55-10.63)
Household Income (SGD/month)	≥5,000	108	1.00	1.00	1.00
	3,000 - 4,999	166	1.34 (0.82-2.19)	1.34 (0.81-2.22)	1.26 (0.72-4.64)
	1,000 - 2,999	306	1.55 (0.99-2.42)	1.57 (1.00-2.48)	1.19 (0.69-2.07)
	<1000	52	5.04 (2.38-10.68)	3.55 (1.62-7.75)	1.83 (0.72-2.21)
Activity Level	Very Active	231	1.00	1.00	1.00
	Moderately Active	403	1.39 (1.00-1.92)	1.23 (0.88-1.72)	1.20 (0.83-1.73)
	Inactive	59	2.66 (1.45-4.87)	2.21 (1.18-4.14)	1.90 (0.92-3.94)
2. Medical					
Diabetes	No	679	1.00	1.00	1.00
	Yes	38	2.88 (1.38-6.01)	2.06 (0.96-4.43)	1.85 (0.79-4.30)
Hypertension	No	636	1.00	1.00	1.00
	Yes	55	1.90 (1.19-3.05)	1.21 (0.73-2.02)	1.08 (0.60-1.97)
Cardiac Disease	No	697	1.00	1.00	1.00
	Yes	22	4.57 (1.53-13.63)	2.84 (0.92-8.74)	1.36 (0.39-4.79)

* By logistic regression

were significant risk factors. Physical inactivity with an adjusted OR of 1.9 (95% CI of 0.9-3.9) approached statistical significance as a risk factor for ED. In terms of age, men in their fifties have an adjusted OR of 2.10 (95% CI of 1.20-3.66) and the OR increased to 4.35 (95% CI of 1.81-10.49) in men in

their sixties and 6.53 (95% CI of 1.26-33.86) in men aged 70 and above. Age is therefore the most important physiological factor strongly associated with ED. Men of Indian ethnicity have an adjusted OR of 1.93 (95% CI of 1.07-3.49) even after confounding factors like age, educational level,

Table V. Odds ratios of selected variables associated with erectile dysfunction in subjects aged <50 years and ≥50 years.

Variable		N		Univariate Odds Ratio (95% Confidence Interval)		Adjusted* Odds Ratio (95% Confidence Interval)	
		<50	≥50	Age <50 years	Age ≥50 years	Age <50 years	Age ≥50 years
Activity level	Very active	182	49	1.00	1.00	1.00	1.00
	Moderately active	276	127	1.19 (0.82 - 1.75)	1.54 (0.72 - 3.07)	1.22 (0.81 - 1.84)	1.16 (0.47 - 2.87)
	Inactive	34	25	1.53 (0.73 - 3.19)	7.28 (1.54 - 34.49)	1.56 (0.69 - 3.55)	6.73 (0.72 - 62.86)
Diabetes	No	493	186	1.00	1.00	1.00	1.00
	Yes	15	23	1.23 (0.44 - 3.44)	4.526 (1.03 - 19.95)	0.87 (0.28 - 2.69)	6.37 (0.76 - 53.42)
Hypertension	No	476	160	1.00	1.00	1.00	1.00
	Yes	32	53	1.08 (0.53 - 2.23)	1.42 (0.69 - 2.94)	1.28 (0.58 - 2.83)	0.89 (0.38- 2.37)
Cardiac Disease	No	502	195	1.00	1.00	1.00	1.00
	Yes	5	17	2.12 (0.35 - 12.80)	3.10 (0.69 - 13.99)	0.62 (0.71 - 5.44)	2.28 (0.40 - 13.10)

* Adjusted by logistic regression, for age, ethnic group, educational level, household income, activity level, diabetes, hypertension and cardiac disease.

household income, presence of diabetes, hypertension, heart disease have been controlled for. Indians therefore have almost twice the risk of having ED compared to the predominantly Chinese cohort of respondents.

When the OR was adjusted for age alone, the other significant risk factors associated with ED was low household income (<\$1,000 per month). Compared to men with a high monthly household income of more than \$5,000, those with a monthly household income of less than \$1,000 has an adjusted OR of 3.55 (95% CI: 1.62-7.75). Men with no education also had a higher risk of ED (OR=2.22) but the association was not statistically significant as the number of men with no education was small (n=36).

Although medical conditions like diabetes mellitus and cardiac disease were significant risk factors on univariate analysis, they were not statistical significant risk factors after adjustment for all variables and even after adjustment for age alone. As age could be an effect modifier, the odds ratio were recalculated after dichotomising the respondents to two groups: age below 50 years and age 50 years and above and then adjusted for all variables. The result shown in Table V shows that physical inactivity, diabetes mellitus and cardiac disease were associated with an increased risk of ED for men aged 50 years and above. For men aged 50 and above who were physically inactive, the OR adjusted by logistic regression were 6.73 (95% CI: 0.72-62.86). For men below age of 50, physical inactivity was not a factor contributing to ED. For men aged 50 and above, the adjusted OR for diabetes mellitus and cardiac disease were 6.37 (95% CI: 0.76-53.42) and 2.28 (95% CI: 0.40-13.10) respectively. Despite the increased association between these risk

factors and ED, statistical significance was again not achieved. There is insufficient “power” in our study to detect a difference as the number of men aged 50 and above with diabetes mellitus was small (n=23).

DISCUSSION

In this large cross sectional study, the overall prevalence of ED was 51.3% and the prevalence rate increased significantly with age. A sub-analysis of 460 men aged 40 to 69 gave a prevalence rate of 52.7% which is very similar to the figures of 52% reported in the Massachusetts Male Aging Study (MMAS) despite a very different sample population – mainly Caucasians and utilising a different research instrument and methodology. While the distribution of mild, moderate and severe ED in the MMAS study was 17.2%, 25.2% and 9.6% respectively, our local study revealed the following distribution of severity: 27.1% (mild), 8.9% (moderate), and 16.7% (severe) in our 40 to 69 year old subgroup. While it is not possible to do a direct comparison with other reported studies due to different methodology and “sampling technique”, we found the prevalence rate of ED in Singapore higher than that reported in Thailand⁽⁴⁾ (37.5% of men 40-70 years old), Australia⁽¹⁰⁾ (33.9% of men 40-69 years old) and Italy⁽¹¹⁾ (14% in men 40-70 years old). We do not think we have overestimated the prevalence of ED in Singapore. In fact if we have IIEF-5 scores from the excluded group of 195 men (due to incomplete questionnaire) whose mean age was significantly higher (52.9 vs. 46.0), the estimated prevalence rate may increase by another 5-10%.

In this study, the risk of ED was higher in men of Indian ethnic group, lower household income, physical inactivity, diabetes mellitus and cardiac

disease. However, the single most significant risk factor in our study remained age above 50 years. The fact that age is strongly associated with ED has been noted in other studies as well, notably the MMAS study which showed the prevalence of complete ED tripling from 5% to 15% between subject ages 40 and 70 years.

Indians seem to have twice the risk of having ED compared to Chinese. No reason is immediately apparent in our study. It may be related to other confounding factors not investigated in our study such as genetics, presence of vasculogenic or neurogenic factors or difference in the perception of illness. Ethnicity was reported in two previous studies to be unassociated with ED^(12,13). However, the subjects in those two studies were mainly Caucasians with minor representations from Afro-Americans, Hispanics and Arabics. No comparative studies on Asians have been done so far. Further research such as a case control study is necessary to confirm our finding.

We found that lower monthly household income was associated with ED even when the risk was adjusted for age. This is consistent with other studies where men with higher income and higher educational level were associated with a lower risk of ED⁽¹⁴⁾.

For men aged 50 and above, physical inactivity was associated with ED, with an adjusted OR of 6.73 (95% CI: 0.72-62.86). As the number of men above 50 years old who were inactive physically was small (n = 25), statistical significance was not achieved. For men below age of 50, physical inactivity was not a factor contributing to ED. This clinically important finding is supported by a recent report identifying physical inactivity as a significant risk factor associated with ED⁽¹⁴⁾. Another recent report examined the issue whether lifestyle changes can modify the risk of having erectile dysfunction⁽¹⁵⁾. Based on a prospective study of a cohort of 1,709 subjects aged 40 to 70 years, subjects with a sedentary lifestyle had a significantly increased risk of developing erectile dysfunction compared to those who remained physically active or initiated physical activity. The authors concluded that physical activity might reduce the risk of erectile dysfunction even if initiated in midlife. Our findings and other recent reports raise the possibility of prevention of ED. Early adoption of healthy lifestyles may be the best approach to reducing the burden of erectile dysfunction on the health and well being of older man.

Diabetes mellitus is a well-known risk factor associated with ED. In our study, diabetes mellitus was also noted to be associated with ED. The odds

ratio was fairly large (>6) and we can say that this is a clinically noteworthy finding (though statistically not significant due to the small number of diabetics in our sample population). More noteworthy is the great difference in the OR among those <50 years old and those ≥ 50 , further confirming our suspicion that age is an effect modifier. Statistical significance can be achieved with a larger number of subjects.

This is the first questionnaire survey using the abridged five-item IIEF-5 in estimating a population's prevalence of erectile dysfunction. Findings of this cross-sectional study will form the basis of a population based longitudinal study of ED whereby the incidence, risk factors and possible modifiable behavior can be examined more closely. Health seeking behavior, quality of life issues and association with LUTS will also be studied in the future.

Currently, treatment for erectile dysfunction is effective and easily accessible. With an ageing population, erectile dysfunction may become a significant health problem. Health care providers should plan their resources accordingly.

CONCLUSION

Erectile dysfunction is common amongst Singaporean men. Age is the single most important physiologic factor affecting erectile function. The prevalence rate and severity increased significantly with age after 50 years old. With an ageing population, erectile dysfunction may become a significant health problem. Health care providers should plan their resources accordingly.

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