Original Article

pISSN: 2287-4208 / eISSN: 2287-4690
World J Mens Health 2019 May 37(2): 199-209
https://doi.org/10.5534/wjmh.180054

The World Journal of Men's Health

Changes in the Prevalence and Risk Factors of Erectile Dysfunction during a Decade: The Korean Internet Sexuality Survey (KISS), a 10-Year-Interval Web-Based Survey

Won Hoon Song[1], Juhyun Park[1,2], Sangjun Yoo[2], Sohee Oh[3], Sung Yong Cho[2], Min Chul Cho[2], Hyeon Jeong[1,2], Hwancheol Son[1,2]

[1]Department of Urology, Seoul National University College of Medicine, Departments of [2]Urology and [3]Biostatistics, SMG-SNU Boramae Medical Center, Seoul, Korea

Purpose: Although the prevalence of erectile dysfunction (ED) can be affected by social changes, this association has not been well evaluated. We aimed to evaluate the prevalence and risk factors of ED through a 10-year-interval web-based survey using the previous database of same group of panels, with same methodology.

Materials and Methods: We sent e-mails and surveyed the panels registered in the Internet survey agency.

Results: In total, 900 participants were recruited in 2016. The age-adjusted overall prevalences of self-reported ED (self-ED) and International Index of Erectile Function-5-assessed ED (IIEF-5-ED; score ≤21) in the 2016 study were 3.2% and 44.8%, respectively, which were lower than the prevalences of 8.1% (p=0.036) and 51.4% (p=0.323), respectively, in the 2006 study. The risk factors of IIEF-5-ED in their 20s and 30s in 2016 were psycho-social factors such as depression, low frequency of conversation about sex with sexual partner. The risk factors of IIEF-5-ED in their 40s to 60s in 2016 were organic factors, such as hypertension, diabetes mellitus, smoking, alcohol use, and self-reported premature ejaculation.

Conclusions: Although the age-adjusted overall prevalence of self-ED has decreased during a decade, there was no difference in the age-adjusted overall prevalence of IIEF-5-ED. Psycho-social support may be important for young men with ED and overall healthcare can be helpful for elderly men with ED.

Keywords: Erectile dysfunction; Internet; Prevalence; Risk factors

INTRODUCTION

Erectile dysfunction (ED) has been an important cause of decreased quality of life in men [1]. In addition, ED has been reported to be strongly associated with a quadrupling of the prevalence of treated heart disease, a tripling of diabetes mellitus (DM) risk, and a doubling in chronic disease prevalence in smokers [2]. Therefore, ED is thought to be an important disease that not only deteriorates the quality of life [1], but is

Received: Jun 24, 2018 **Revised:** Sep 15, 2018 **Accepted:** Sep 17, 2018 **Published online** Dec 5, 2018
Correspondence to: Hwancheol Son https://orcid.org/0000-0001-5033-0153
Department of Urology, SMG-SNU Boramae Medical Center, 20 Boramae-ro 5-gil, Dongjak-gu, Seoul 07061, Korea.
Tel: +82-2-870-2391, **Fax:** +82-2-870-3863, **E-mail:** volley@snu.ac.kr

also closely related to various disease groups and may be affecting an estimated 30 million men in the United States [3].

Since the Massachusetts Men's Aging Study, a large epidemiological investigation, discovered a high ED prevalence of 52% in the general population of men aged 40 to 70 years from 1987 to 1994 [4], related studies have been conducted [5,6]. In addition to increasing interest in ED and changes in the awareness about the disease, our research group also reported on the prevalence and risk factors of ED in Korean adult men based on an Internet questionnaire survey in 2006 [7]. In these studies, systemic chronic diseases and related characteristics such as aging, DM, and hypertension (HTN) have been reported as well-known risk factors of ED [4,8]. However, some studies reported that not only chronic diseases but also lifestyle changes, sociocultural and socio-psychological phenomena, such as obesity, physical activity, marital status, and anxiety have been known to affect ED [9,10].

Although many studies have investigated the prevalence and risk factors of ED, most previous studies were carried out through a cross-sectional survey [3,8,11,12]. Even if some cohort studies have provided useful information [4], few longitudinal studies have been conducted because of the time and cost problems associated with following up the same subjects [3,5,6,8]. However, because social changes could have an impact on the prevalence of ED [3], longitudinal studies are required in elucidating this issue. In addition, age has been a well-known important risk factor of ED.

This study was a 10-year-interval survey about the prevalence and risk factors of ED. Moreover, the prevalence and risk factors of ED were estimated according to age groups, because the prevalence of ED has been strongly associated with age and/or age-related diseases [5]. We aimed to elucidate the changes in ED prevalence according to age groups associated with a sociocultural transition and the alterations in risk factors accompanying them, through a 10-year survey targeting the same previous group of panel participants with the same methodology.

MATERIALS AND METHODS

1. Study design

This study was based directly on the same methodology of the web-based survey used in the 2006 study [7], and was conducted for the panels registered with the same company. This nationwide survey included men in their 20s to 60s, who had 1 or more sexual encounters per month in the last 6 months. Only those men who answered all questionnaire items were included in the results. We recruited participants by e-mailing 100,000 panel members extracted using the proportional quota sampling method, and finally selected 2,569 men who expressed interest in participating. When the maximum response loading time of 1 frame of questionnaires exceeded 8 minutes, the questionnaire progress was automatically terminated. As with previous studies, data with a minimal mean response time of 10% were excluded automatically, to exclude unfaithful answers. The final number of subjects was 900 and the total response rate was 35.0% (900 of the total 2,569 respondents). Among them, 200 men were in their 20s, 200 in their 30s, 200 in their 40s, and 200 in their 50s. For the 60s age group, only 100 participants were recruited owing to the small number of eligible Internet users. The investigation period was from December 8, 2016, to January 7, 2017.

The survey consisted of 111 questions in Korean. First, general demographics, such as smoking status, drinking status, age, body mass index (BMI; normal <23.0 kg/m^2, overweight 23.0–24.9 kg/m^2, obese ≥25.0 kg/m^2, according to the Asian criteria [13]), social history, sexual history, and general health problems were surveyed. Then, the International Index of Erectile Function-5 (IIEF-5; normal 22–25, mild 17–21, mild to moderate 12–16, moderate 8–11, severe 5–7) and International Prostate Symptom Score (IPSS) were assessed. Self-reported ED (self-ED) was determined using a single question: "Do you have ED?" IIEF-5-ED was defined as an IIEF-5 score of ≤21 [8,14]. The primary end point was the prevalence of IIEF-5-ED, which is known to be a more objective assessment than self-ED [11,15], and the secondary end point was the prevalence of self-ED.

2. Calculation for determining the number of target participants

The number of target subjects per age group was determined based on the prevalence determined in our previous study. The number of target participants was calculated by applying the following prevalence model: N (sample size)=($Z_{\alpha/2}$×P [1-P])/(D/2)^2, where P is prevalence, $Z_{\alpha/2}$=1.96, D=0.1, and α=0.05 [16]. On the basis of the prevalences of self-ED and IIEF-5-ED of 6.7% and

Table 1. Demographics and clinical characteristics in the 2006 and 2016 studies

Variable	20s			30s			40s			50s			60s	
	2006	2016	p-value	2006	2016	p-value	2006	2016	p-value	2006	2016	p-value	2006	2016
Patients	162 (27)	200 (22.2)		268 (44.6)	200 (22.2)		126 (21)	200 (22.2)		45 (7.5)	200 (22.2)		N/A	100 (11.1)
BMI (kg/m^2)	22.7±2.2	23.3±3.2	<0.001	24.1±2.2	24.3±3.2	<0.001	24.8±2.1	24.4±3.0	<0.001	24.9±1.8	24.1±2.7	<0.001	N/A	24.1±2.5
Marital status			<0.001			0.008			<0.001			0.146		
Single	110 (67.9)	178 (89.0)		64 (23.9)	74 (37.0)		3 (2.4)	23 (11.5)		0 (0)	3 (1.5)		N/A	4 (4.0)
Married	52 (32.1)	22 (11.0)		202 (75.4)	124 (62.0)		123 (97.6)	168 (84.0)		45 (100)	184 (92.0)		N/A	95 (95.0)
Divorced or bereaved	0 (0)	0 (0)		2 (0.7)	2 (1.0)		0 (0)	9 (4.5)		0 (0)	13 (6.5)		N/A	1 (1.0)
Smoking history			0.562			0.326			0.134			0.002		
None	86 (53.1)	106 (53.0)		95 (35.4)	81 (40.5)		49 (38.9)	60 (30.0)		13 (28.9)	51 (25.5)		N/A	30 (30.0)
Past	12 (7.4)	21 (10.5)		35 (13.1)	30 (15.0)		15 (11.9)	37 (18.5)		3 (6.7)	64 (32.0)		N/A	33 (33.0)
Present	64 (39.5)	73 (36.5)		138 (51.5)	89 (44.5)		62 (49.2)	103 (51.5)		29 (64.4)	85 (42.5)		N/A	37 (37.0)
Alcohol drinking	128 (79.0)	146 (73.0)	0.185	214 (79.9)	151 (75.5)	0.261	106 (84.1)	164 (82.0)	0.620	39 (86.7)	171 (85.5)	0.840	N/A	79 (79.0)
Chronic medical disease														
Hypertension	4 (2.5)	10 (5.0)	0.214	20 (7.5)	15 (7.5)	0.988	20 (15.9)	42 (21.0)	0.251	13 (28.9)	67 (33.5)	0.551	N/A	39 (39.0)
DM	2 (1.2)	2 (1.0)	0.832	14 (5.2)	6 (3.0)	0.239	12 (9.5)	11 (5.5)	0.167	4 (8.9)	25 (12.5)	0.498	N/A	32 (32.0)
Depression	4 (2.5)	13 (6.5)	0.071	6 (2.2)	5 (2.5)	0.854	4 (3.2)	8 (4.0)	0.700	3 (6.7)	15 (7.5)	0.847	N/A	5 (5.0)
Prostatic diseases	3 (1.9)	2 (1.0)	0.490	8 (3.0)	8 (4.0)	0.550	2 (1.6)	14 (7.0)	0.028	0 (0)	18 (9.0)	0.037	N/A	10 (10.0)
Sexually transmitted disease	6 (3.7)	3 (1.5)	0.181	8 (3.0)	4 (2.0)	0.505	3 (2.4)	2 (1.0)	0.323	0 (0)	6 (3.0)	0.239	N/A	9 (9.0)
Others	33 (20.4)	41 (20.5)	0.976	75 (28.0)	40 (20.0)	0.047	27 (21.4)	65 (32.5)	0.031	12 (26.7)	82 (41.0)	0.074	N/A	36 (36.0)
Academic background			0.302			0.696			0.412			0.220		
≤High school	20 (12.3)	18 (9.0)		27 (10.1)	18 (9.0)		17 (13.5)	21 (10.5)		7 (15.6)	48 (24.0)		N/A	12 (12.0)
≥College	142 (87.7)	182 (91.0)		241 (89.9)	182 (91.0)		109 (86.5)	179 (89.5)		38 (84.4)	152 (76.0)		N/A	88 (88.0)
Monthly income ≥3,521 USD (1 USD=1,136 won),	5 (3.1)	14 (7.0)	0.097	58 (21.6)	76 (38.0)	<0.001	65 (51.6)	122 (61.0)	0.094	21 (46.7)	112 (56.0)	0.256	N/A	32 (32.0)
Occupation			0.008			0.212			0.270			0.564		
Unemployed	71 (43.8)	102 (51.0)		2 (0.7)	6 (3.0)		0 (0.0)	1 (0.5)		0 (0)	4 (2.0)		N/A	35 (35.0)
Professional	19 (11.7)	23 (11.5)		43 (16.0)	26 (13.0)		8 (6.3)	25 (12.5)		6 (13.3)	30 (15.0)		N/A	0 (0)
Office worker	38 (23.5)	58 (29.0)		168 (62.7)	122 (61.0)		83 (65.9)	121 (60.5)		17 (37.8)	87 (43.5)		N/A	30 (30.0)
Others	34 (21.0)	17 (8.5)		55 (20.5)	46 (23.0)		35 (27.8)	53 (26.5)		22 (48.9)	79 (39.5)		N/A	35 (35.0)
No. of sexual partners	4.8±4.7	5.4±7.2	0.369	5.5±6.4	9.5±10.1	<0.001	5.8±6.6	10.0±12.6	<0.001	7.0±5.5	7.6±9.1	0.349	N/A	6.0±4.1
No. of morning erections per week	4.1±2.2	5.1±2.2	<0.001	4.0±2.0	4.8±2.2	<0.001	3.6±1.8	4.1±2.3	0.469	2.3±1.0	3.4±2.2	<0.001	N/A	3.2±2.0
Homosexual experience	11 (6.8)	4 (2.0)	0.023	7 (2.6)	5 (2.5)	0.940	3 (2.4)	4 (2.0)	0.817	3 (6.7)	0 (0.0)	<0.001	N/A	0 (0)
Experience of rape or sexual harassment	10 (6.2)	13 (6.5)	0.899	27 (10.1)	8 (4.0)	0.013	10 (7.9)	16 (8.0)	0.984	1 (2.2)	21 (10.5)	0.079	N/A	9 (9.0)
Self-PE	19 (11.7)	39 (19.5)	0.045	56 (20.9)	43 (21.5)	0.874	38 (30.2)	42 (21.0)	0.061	4 (8.9)	51 (25.5)	0.016	N/A	20 (20.0)
IIEF-5	20.3±3.3	21.9±2.8	0.001	21.3±3.0	21.7±2.6	0.372	20.7±3.1	21.2±2.9	0.462	19.2±3.5	19.4±4.1	0.453	N/A	18.5±4.1
Total IPSS	6.6±6.6	5.6±5.9	0.310	7.7±6.9	5.5±5.5	0.006	7.8±6.3	7.2±6.4	0.429	8.8±6.5	8.7±6.7	0.594	N/A	9.9±6.8

Values are presented as number (%) or mean±standard deviation.

BMI: body mass index, DM: diabetes mellitus, USD: US dollar, Self-PE: self-reported premature ejaculation, IIEF-5: International Index of Erectile Function-5, IPSS: International Prostate Symptom Score, N/A: not available.

41%, respectively, in the 2006 study [7], the sample size was calculated using the above formula, which indicated the need for 197 participants. Thus, we targeted 200 participants as the maximum number for each age group.

3. Statistical analysis

All numerical data were expressed as means and standard deviations. For comparison between 2 groups, the independent t-test for continuous variables and chi-square test for categorical variables were used. The age-adjusted prevalence of ED was calculated after adjusting for 10-year age groups, according to the direct standardization method used for the 2006 male population from Statistics Korea.

As total IPSS was an important risk factor of ED in the 2006 study, we examined the relationship between ED severity according to IIEF-5 scores and total IPSS by using a chi-square test. Because self-reported premature ejaculation (self-PE), determined using a single question, was the significant risk factor of ED in the 2016 study, we determined the relationship between ED and self-PE using a chi-square test.

Univariate and multivariable logistic regression analyses were done to determine the odds ratios and 95% confidence intervals to find the ED risk factors. Variables with a p-value of <0.05 in univariate analysis were included in the multivariable model. IBM SPSS ver. 23.0 (IBM Co., Armonk, NY, USA) and R ver. 3.4.2 (http://www.r-project.org) were used in statistical analyses.

4. Ethics statement

The present study protocol was reviewed and approved by the institutional review board of SMG-SNU Boramae Medical Center (Reg. No. 16-2016-108). Informed consent was submitted by all subjects when they were enrolled.

RESULTS

1. Participant characteristics

The different characteristic regardless of age group, between the 2006 and 2016 study groups, was BMI (p<0.001), and the number of subjects with BMI ≥23.0 kg/m^2 in the 2016 study was higher than that in the 2006 study (Table 1). In 2016, the number of subjects in their 20s and 40s with single marital status was higher than that in the same age group in 2006 (p<0.001). In 2016, the number of subjects in their 20s and 30s with large numbers of sexual partners and morning erections was higher than that in the same age group in 2006 (p<0.001).

2. Prevalence of erectile dysfunction during a decade

Similar to the finding of the 2006 study, the prevalence of ED in the 2016 study was found to increase with age. Although the overall prevalence of IIEF-5-ED in 2016 without adjusting for age was lower than that in 2006, the age-adjusted overall prevalence of IIEF-5-ED in 2016 was comparable to that in 2006 (Fig. 1; 2016: 44.8% *vs.* 2006: 51.4%, p=0.323). However, when

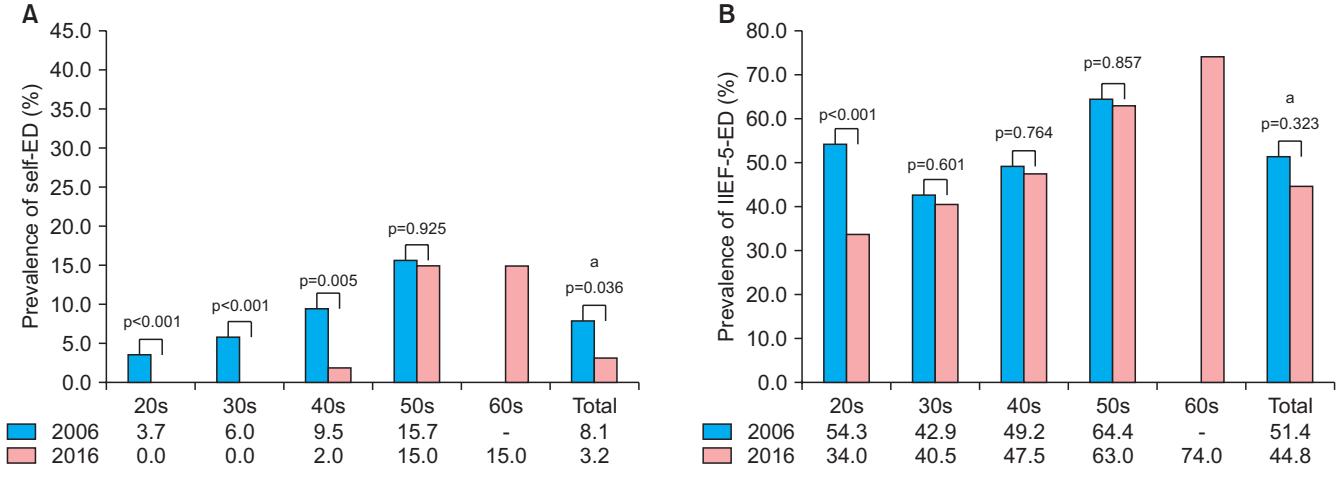


Fig. 1. Comparison of age-adjusted prevalence of self-reported erectile dysfunction (self-ED) and International Index of Erectile Function-5–assessed erectile dysfunction (IIEF-5-ED) between the 2006 and 2016 studies. (A) Age-adjusted prevalence of self-ED between 2006 and 2016. (B) Age-adjusted prevalence of IIEF-5-ED between 2006 and 2016. aFor comparison with the 2006 study, the age-adjusted overall prevalence was calculated excluding the 60s age group.

Table 2. Change in prevalence of IIEF-5-ED during a decade according to age groups after adjusting for other variables[a]

Variable (age groups, y)	Multivariate scores	
	Adjusted OR (95% CI)	p-value
20s	0.418 (0.251–0.697)	0.001
30s	1.220 (0.782–1.904)	0.381
40s	0.898 (0.529–1.524)	0.690
50s	0.689 (0.308–1.546)	0.367

IIEF-5-ED: International Index of Erectile Function-5–assessed erectile dysfunction, OR: odds ratio, CI: confidence interval.
[a]Other variables: body mass index, academic background, monthly income, occupation, marital status, smoking, alcohol, hypertension, diabetes mellitus, depression, prostatic disease, sexually transmitted disease, contraception, age at first intercourse, no. of sexual partners, no. of intercourse per month, homosexual experience, masturbation, experience of rape or sexual harassment, conversation about sex with the sexual partner, circumcision, self-reported premature ejaculation, and total International Prostate Symptom Score.

compared by age group, the prevalence of IIEF-5-ED for the 20s age group in 2016 was lower than that in 2006 (p<0.001), although there was no difference in other age groups. However, not only the age-adjusted overall prevalence of self-ED in 2016 (p=0.036) but also the prevalence of self-ED in all age groups except for the 50s was lower than that in 2006 (p<0.005).

Table 2 shows the difference by age group at evaluation on the prevalence of ED according to age group after adjusting for other variables. There was no difference in the prevalence of IIEF-5-ED in subjects beyond their 30s between the 2006 and 2016 studies; however, there was a significant difference in IIEF-5-ED in the 20s age group only (p=0.001).

3. Risk factors of erectile dysfunction

The ED risk factors for the 20s age group in the 2016 study were psycho-social risk factors such as depression and lack of conversation about sex with the sexual partner (Table 3). The ED risk factors for the 30s age group were HTN and lack of conversation about sex with the sexual partner. The ED risk factors for the 40s age group were lack of conversation about sex with the sexual partner and systemic risk factors such as HTN, DM, and self-PE. The ED risk factors for the 50s age group were lower monthly income, present smoking, DM, and self-PE. The ED risk factor for the 60s age group was alcohol drinking. The risk factors of IIEF-5-ED for all age's subjects were aging, lower income, smoking, HTN, DM, depression, homosexual experience, lack of conversation about sex with the sexual partner, self-PE, and total IPSS (Supplement 1). As total IPSS was one of the important risk factors of ED in the 2006 study, we also examined the relationship between total IPSS and ED in this study. The mean total IPSS for the normal, mild, mild to moderate, moderate, and severe IIEF-5-ED groups was 6.9±0.3, 6.8±0.3, 8.3±0.7, 9.4±1.6, and 12.0±4.1, respectively (p=0.081, Fig. 2). There was no statistically significant difference, although they were related to each other. Additionally, the prevalence of self-PE in the non-self-ED and self-ED groups was 19.9% and 53.1%, respectively (p<0.001, Supplement 2). The prevalence of self-PE in the non-IIEF-5-ED and IIEF-5-ED groups was 14.7% and 28.8%, respectively (p<0.001).

DISCUSSION

ED has been reported to be an important cause of decreased quality of life in men [1] and is strongly associated with systemic chronic diseases [4]. In this regard, many studies have investigated the prevalence and risk factors of ED as the interest in the disease increased. However, most previous studies were cross-sectional in nature, and only a few longitudinal studies have been conducted. As socio-cultural changes can have an impact on the prevalence and risk factors of ED [3], longitudinal studies are needed. Furthermore, although age was reported to be an important risk factor of ED [5], studies on risk factors according to age groups have been uncommon. Some previous longitudinal studies have reported the importance of age-related ED and its medical and psycho-social relationships [4]. In this study, we assessed the changes in the prevalence and risk factors of ED according to age groups during the last decade through a web-based survey, and attempted to obtain sincere and truthful answers on sensitive sexual issues.

The prevalence of ED was reported to be widely variable, which might be due to the different definitions for ED, different methodologies, and different characteristics of the study populations among studies. In addition, racial differences might be another reason for the wide variation in ED prevalence [17]. The prevalences of self-ED and IIEF-5-ED (IIEF-5≤21) based on an online survey were reported to be 7.0% and 45.1% in the United States, respectively [8]. In a European study, the prevalences of self-ED and IIEF-5-ED (IIEF-5<20) based on interviews were reported to be 25% and 31.6%, respectively [14]. In

https://doi.org/10.5534/wjmh.180054

Table 3. Risk factors according to age groups for IIEF-5-ED in the 2016 study

Variable	20s				30s				40s				50s				60s			
	Univariate score		Multivariate score		Univariate score		Multivariate score		Univariate score		Multivariate score		Univariate score		Multivariate score		Univariate score		Multivariate score	
	OR	p-value	Adjusted OR (95% CI)	p-value	30s	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value
BMI	1.020	0.677	1.027 (0.926–1.139)	0.612	1.040	0.382	1.037 (0.940–1.145)	0.466	0.974	0.572	0.927 (0.827–1.040)	0.199	0.963	0.500	0.971 (0.853–1.104)	0.653	1.026	0.778	1.064 (0.851–1.330)	0.585
Academic background (≥college)	1.003	0.950			1.077	0.884			0.804	0.636			0.810	0.547	1.100 (0.460–2.634)	0.830	0.533	0.438	1.201 (0.171–8.444)	0.854
Monthly income (≥3,521 USD)	1.085	0.888			0.714	0.263			0.923	0.783			0.423	0.005	0.399 (0.187–0.850)	0.017	0.540	0.193	0.549 (0.172–1.755)	0.312
Occupation (unemployed)	Reference	0.078	Reference	0.055	Reference	0.898			Reference	0.460			Reference	0.958			Reference	0.121		
Office worker	2.090	0.031	2.126 (0.989–4.570)	0.053	0.718	0.693			0.000	1.000			0.000	0.999			0.375	0.082		
Professional	1.280	0.614	1.048 (0.348–3.156)	0.933	0.625	0.606			0.000	1.000			0.000	0.999			1.000	1.000		
Others	0.514	0.323	0.542 (0.137–2.143)	0.382	0.586	0.540			0.000	1.000			0.000	0.999						
Marital status (married)	Reference	0.480			Reference	0.539	Reference	0.270	Reference	0.559			Reference	0.544						
Single	1.425	0.482			1.393	0.266	1.536 (0.767–3.079)	0.226	1.536	0.338			0.293	0.320						
Divorced or bereaved					0.000	0.999	0.000 (0.000)	0.999	1.477	0.571			1.319	0.655						
Smoking history (absent)	Reference	0.656			Reference	0.936			Reference	0.070e	Reference	0.437	Reference	0.051	Reference	0.020	Reference	0.173	Reference	0.508
Present	0.790	0.466			1.040	0.900			2.128	0.024	1.553 (0.706–3.413)	0.274	2.444	0.016	2.650 (1.077–6.518)	0.034	2.991	0.061	1.647 (0.379–7.151)	0.506
Past	0.687	0.473			1.171	0.715			1.960	0.114	1.378 (0.502–3.784)	0.534	1.500	0.285	1.373 (0.558–3.376)	0.490	1.544	0.425	1.175 (0.294–4.693)	0.819
Alcohol drinking	1.677	0.145	2.194 (0.959–5.023)	0.063	1.233	0.537	1.610 (0.703–3.686)	0.260	1.162	0.685			1.465	0.347	2.049 (0.738–5.687)	0.168	3.580	0.014	6.988 (1.736–28.134)	0.006
HTN	4.934	0.024	3.464 (0.711–16.875)	0.124	4.518	0.012	4.912 (1.321–18.263)	0.018	2.382	0.016	2.484 (1.123–5.493)	0.025	1.190	0.579	1. 209 (0.585–2.501)	0.608	1.031	0.948	0.703 (0.180–2.754)	0.613
DM	1.955	0.637	3.265 (0.168–63.407)	0.434	3.039	0.206	1.460 (0.220–9.696)	0.695	5.390	0.034	7.206 (1.324–39.234)	0.022	3.500	0.027	3.518 (1.025–12.073)	0.046	1.806	0.261	1.356 (0.296–6.214)	0.695
Depression	7.414	0.003	10.020 (2.232–44.972)	0.003	2.250	0.380	2.272 (0.299–17.259)	0.428	1.110	0.885			2.491	0.169						
Prostatic disease	1.955	0.637	1.172 (0.048–28.749)	0.923	0.477	0.372			1.517	0.456	0.984 (0.289–3.354)	0.980	1.588	0.399	1.863 (0.492–7.050)	0.360	3.462	0.250	3.263 (0.319–33.349)	0.319
STD	0.970	0.980			0.483	0.532											1.254	0.787		
Contraception (condom)	1.845	0.213	0.855 (0.275–2.652)	0.786	1.169	0.596			1.408	0.231	1.589 (0.840–3.005)	0.154	1.059	0.866						

Table 3. Continued

Variable	20s				30s				40s				50s				60s			
	Univariate score		Multivariate score		Univariate score		Multivariate score		Univariate score		Multivariate score		Univariate score		Multivariate score		Univariate score		Multivariate score	
	OR	p-value	Adjusted OR (95% CI)	p-value	30s	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value
Age at first intercourse	0.986	0.807			1.041	0.289	1.066 (0.971–1.170)	0.180	0.969	0.346	1.017 (0.935–1.107)	0.690	0.982	0.648			0.976	0.744	1.049 (0.852–1.292)	0.654
No. of sexual partners	0.981	0.430	0.961 (0.904–1.022)	0.207	1.014	0.324	1.017 (0.984–1.052)	0.316	1.014	0.223	1.030 (0.999–1.061)	0.056	0.977	0.148	0.978 (0.9431.014)	0.231	0.973	0.610	0.940 (0.813–1.088)	0.408
No. of intercourse per month	0.987	0.614	0.995 (0.937–1.055)	0.857	0.987	0.602			0.976	0.352	0.980 (0.923–1.041)	0.516	0.937	0.059	0.947 (0.878–1.022)	0.161	0.950	0.649	0.930 (0.690–1.254)	0.635
Homosexual experience					2.250	0.380			0.362	0.382	0.438 (0.029–6.564)	0.550								
Masturbation	1.495	0.460	1.207 (0.341–4.275)	0.770	1.061	0.888			1.316	0.421			1.495	0.184	1.164 (0.568–2.384)	0.679	1.362	0.515		
Experience of rape or sexual harassment	3.387	0.039			0.477	0.372			0.848	0.754	0.550 (0.156–1.944)	0.353	2.729	0.082	1.949 (0.556–6.829)	0.297	3.030	0.307	2.495 (0.221–28.115)	0.459
Conversation about sex with the sexual partner (sometimes)	Reference	0.057	Reference	0.029	Reference	<0.001	Reference	<0.001	Reference	0.010	Reference	0.014	Reference	0.094	Reference	0.322	Reference	0.619	Reference	0.512
Often	0.488	0.034	0.363 (0.167–0.789)	0.010	0.306	0.002	0.299 (0.133–0.672)	0.003	0.347	0.004	0.389 (0.172–0.877)	0.023	0.509	0.068	0.633 (0.272–1.476)	0.290	0.813	0.720	0.991 (0.248–3.953)	0.989
Never	1.158	0.732	8.858 (0.317–2.323)	0.763	2.844	0.018	3.173 (1.212–8.310)	0.019	0.922	0.815	1.022 (0.483–2.161)	0.955	1.259	0.539	1.081 (0.445–2.628)	0.863	1.575	0.435	1.449 (0.368–5.706)	0.596
Circumcision	0.967	0.920			1.180	0.627	1.386 (0.631–3.043)	0.417	1.130	0.684			1.016	0.958			1.303	0.602		
Self PE	0.964	0.922			1.963	0.052	1.941 (0.888–4,243)	0.097	3.110	0.002	3.133 (1.400–7.011)	0.005	7.935	0.000	6.498 (2.237–18.871)	0.001	2.287	0.219	2.737 (0.568–13.189)	0.210
Total IPSS	1.004	0.875			0.985	0.581	0.966 (0.908–1.027)	0.264	0.975	0.256	0.986 (0.936–1.038)	0.586	0.998	0.938	1.009 (0.958–1.063)	0.728	0.952	0.138	0.937 (0.868–1.012)	0.097

IIEF-5-ED: International Index of Erectile Function-5–assessed erectile dysfunction, OR: odds ratio, CI: confidence interval, BMI: body mass index, USD: US dollar, HTN: hypertension, DM: diabetes mellitus, STD: sexually transmitted disease, Self-PE: self-reported premature ejaculation, IPSS: International Prostate Symptom Score.

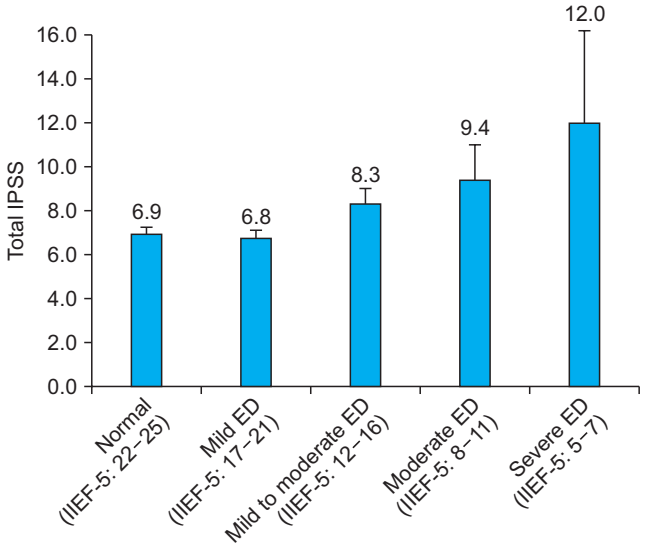


Fig. 2. Total International Prostate Symptom Score (IPSS) according to the severity of International Index of Erectile Function-5 (IIEF-5)–assessed erectile dysfunction (score ≤21) in the 2016 study.

this study, the prevalences of IIEF-5-ED (IIEF-5≤21) in 2006 and 2016 were 51.4% and 44.8%, respectively, whereas those of self-ED in 2006 and 2016 were 8.1% and 3.2%, respectively. In the previous Korean study, the prevalence of IIEF-5-ED (IIEF-5≤17) was 32.4% [18], which was almost similar to that in the current study (*i.e.*, 28.0%). In addition, the prevalence of self-ED was also comparable to that in other studies, and the results of the current study were considered to be reliable. However, as mentioned above, the prevalence of self-ED was considerably lower than the prevalence of IIEF-5-ED. The suggested reason for this finding was that the prevalence of self-ED might be underestimated and undisclosed in the absence of life-threatening conditions and because it is considered a sensitive issue [19].

This interval study on the prevalence of ED made it possible to understand the relationship between age-related ED and socio-cultural changes. According to the current study, the overall prevalence of IIEF-5-ED has not changed (p=0.323), but the prevalence of self-ED has changed throughout the last decade (p=0.036). Although a statistical significance was not achieved among other age groups, the prevalence of IIEF-5-ED in young men in their 20s has slightly decreased. Even if other variables were adjusted, there was a difference in the prevalence of IIEF-5-ED only in the 20s age group during a decade (p=0.001). In addition, the prevalence of self-ED considerably decreased from 8.1% to 3.2%, and the prevalence of self-ED in young men has more clearly decreased. Unlike IIEF-5-ED, which can be objectively assessed by physicians, self-ED is likely to be influenced by psycho-social factors at the time of assessment. The increase in the prevalence of single marital status, the decrease in the number of times ED was mentioned in mass media, and the assessment of ED according to strict medical guidelines through multimedia information including the Internet in 2016 compared with 2006 when sildenafil had just been launched could have been the cause of self-ED decline (Table 1) [20,21]. However, IIEF-5-ED will be more useful and reliable than self-ED when evaluating and diagnosing ED. The prevalence of IIEF-5-ED in the 20s age group in the 2006 study was also higher than that in the 30s or 40s age group. The reason for this is believed to be the tendency of young men to show off and overestimate their sexual abilities. Although they did not have self-ED, they had IIEF-5-ED when checked for each item of the objective IIEF-5-questionnaire. However, these results need to be interpreted with caution because the characteristics of the study population were slightly different between the groups, although age was adjusted before the comparison.

To investigate the causes and relevance of the difference in ED prevalence according to age during 10 years, we analyzed the risk factors of ED in each age group. Psycho-social factors such as depression, age at first intercourse, homosexual experience, and conversation about sex with the sexual partner were risk factors of ED in young ages, whereas systemic factors such as smoking and DM were risk factors in old ages, which were similar to the findings of a previous study [22]. Compared with the 2006 study, although some risk factors changed (Supplement 3, 4), there was still no change in the prevalence of ED. This was probably because systemic chronic diseases are still crucial risk factors of ED in old ages, although socio-cultural and socio-psychological factors are more important in younger ages. Supplement 5 shows the risk factors of self-ED for all ages between 2006 and 2016 study. Aging was still risk factor for self-ED, but chronic medical diseases such as DM, prostatic disease, and self-PE were emerging risk factors of self-ED in 2016. In 2006 study, only the 20s to 50s were included, and the ratio between 40s and 50s was low. However, in the 2016 study, 20s to 60s were included, and 20s to 50s were the same rate. Therefore, chronic diseases would have been

a risk factors of ED because more elderly subjects were included. In addition, the prevalence of chronic medical diseases has recently been increased in Korea.

Smoking was a risk factor of IIEF-5-ED in subjects beyond their 40s in this study. Clinical studies have provided strong indirect evidence that smoking may affect erectile function by causing impairment of endothelium-dependent smooth muscle relaxation [23]. The association of ED with risk factors such as coronary artery diseases and HTN appears to be amplified by cigarette smoking [23]. Smoking may double the likelihood of moderate or complete ED [23]. Therefore, even if a young man who smokes has no ED, clinicians should positively recommend avoiding smoking to young people.

PE, which has been recently focused on as an important comorbidity of ED, was determined as another risk factor of ED in the current study. In the previous study, men with PE showed lower levels of libido, frequency of sexual intercourse, and satisfaction after sexual intercourse, and more ED than men without PE. Moderate or severe IIEF-5-ED was found more frequently in men with PE [24], which is in accordance with the findings of the current study. Furthermore, moderate ED diagnosed according to the Sexual Health Inventory for Men was reported to be present in 10% of men with self-reported acquired PE, 10% of men with lifelong PE, and 3% of men who self-reported as not having PE [25].

Moreover, total IPSS was a risk factor of IIEF-5-ED in the 20s and 30s age groups during a decade. There have been only a few studies on the association between total IPSS and ED. Reports on the pathophysiology of lower urinary tract symptoms (LUTS) showed a close relationship with ED and an independent relationship with comorbidities such as DM and HTN [26]. In such studies, combined treatment for LUTS and ED with type-5 inhibitor (phosphodiesterase type 5 inhibitor) has been presented [27]. Egan et al [28] reported that the co-occurrence of ED and benign prostatic hyperplasia was evident in about 10% of men ≥40 years of age and was associated with significant clinical correlates. On the basis of the results of this study, clinicians may consider these issues when evaluating patients with ED.

This study has several limitations. Although it was similar to the cohort study conducted on the same panel group registered with the same Internet survey company, there might be a selection bias in the inclusion criteria. This study excluded men with no sexual experience because we applied the same inclusion criteria for comparison with previous study. Therefore, this study can be applied only to men who regularly engage in sexual intercourse. Also, a web-based survey study may have a selection bias [11,12]. The ratio of total population is only an estimate. The maximum acceptable standard error in this study was ±3.3% in 95% confidence interval, which needs to be noted. Nevertheless, this study was a relatively large-scale Internet-based survey with the same questionnaires and research methodology, and with a 10-year follow-up. The low response rate and representativeness of population were still a big limitation of every internet-based survey studies [11,12,29]. There are many methodological disputes such as the representative of the sample, the non-response error, and the measurement error in internet survey study [30]. Securing the representative is in a probabilistic sampling. For this, there should be no discrepancy between the target population and the frame population. These discrepancies are closely related to the internet penetration rate. Although the internet penetration rate has increased compared to 10 years ago and the probabilistic sample extraction through the Proportionate Quota Sampling method has been carried out to overcome the limitation of representativeness, it still has the limitation. This study did not include questionnaires on experience of treating ED with PDE5i administration. However, because there has been no other large-scale longitudinal study, we believe that our study is valuable and useful to clinicians.

CONCLUSIONS

This 10-year-interval web-based survey showed that there was no difference in the age-adjusted overall prevalence of IIEF-5-ED, although the age-adjusted overall prevalence of self-ED considerably decreased. Generally, psycho-social factors were relatively important in young men with ED younger than 40 years, and systemic factors were more associated with ED as age increased. Therefore, a psycho-social approach needs to be considered in healthy young patients with ED; in older patients with ED, a focus on chronic diseases is required. Further longitudinal studies on these issues are warranted.

Disclosure

The authors have no potential conflicts of interest to disclose.

Author Contribution

Conceptualization: Son H, Song WH, Park J. Data curation: Son H, Song WH, Yoo S. Formal analysis: Oh S, Song WH. Funding acquisition: Son H. Investigation: Son H, Song WH, Cho SY. Methodology: Cho MC, Jeong H. Project administration: Son H, Cho SY, Cho MC, Jeong H. Software: Oh S, Song WH, Yoo S. Supervision: Son H. Validation: Oh S, Song WH, Yoo S. Writing–original draft: Song WH, Park J, Yoo S. Writing–review & editing: Song WH, Yoo S, Son H.

Supplementary Materials

Supplementary materials can be found via https://doi.org/10.5534/wjmh.180054.

REFERENCES

1. Choi WS, Song SH, Son H. Epidemiological study of complementary and alternative medicine (CAM) use for the improvement of sexual function in young Korean men: the Korean Internet Sexuality Survey (KISS), part II. J Sex Med 2012;9:2238-47.
2. Cho SY, Son H, Kim SW, Paick JS. Should men with mild erectile dysfunction be closely evaluated for cardiovascular diseases in the Korean population? Aging Male 2014;17:81-6.
3. Laumann EO, Paik A, Rosen RC. Sexual dysfunction in the United States: prevalence and predictors. JAMA 1999;281:537-44.
4. Feldman HA, Goldstein I, Hatzichristou DG, Krane RJ, McKinlay JB. Impotence and its medical and psychosocial correlates: results of the Massachusetts Male Aging Study. J Urol 1994;151:54-61.
5. Braun M, Wassmer G, Klotz T, Reifenrath B, Mathers M, Engelmann U. Epidemiology of erectile dysfunction: results of the 'Cologne Male Survey'. Int J Impot Res 2000;12:305-11.
6. Tan HM, Low WY, Ng CJ, Chen KK, Sugita M, Ishii N, et al. Prevalence and correlates of erectile dysfunction (ED) and treatment seeking for ED in Asian Men: the Asian Men's Attitudes to Life Events and Sexuality (MALES) study. J Sex Med 2007;4:1582-92.
7. Kim M, Shin GH, Ryoo S, Ko S, Kim H, Song SH, et al. The prevalence and risk factors for erectile dysfunction in Korean young men: a web-based survey. Korean J Androl 2006;24:76-83.
8. Shaeer O, Shaeer K. The Global Online Sexuality Survey (GOSS): the United States of America in 2011. Chapter I: erectile dysfunction among English-speakers. J Sex Med 2012;9:3018-27.
9. Esposito K, Giugliano F, Di Palo C, Giugliano G, Marfella R, D'Andrea F, et al. Effect of lifestyle changes on erectile dysfunction in obese men: a randomized controlled trial. JAMA 2004;291:2978-84.
10. Shabsigh R, Broderick GA, Althof S, Natanegara F, Wong DG. Daily patterns of sexual intercourse attempts by men with erectile dysfunction treated with tadalafil: influence of age and marital status. Int J Impot Res 2009;21:285-91.
11. Son H, Song SH, Kim SW, Paick JS. Self-reported premature ejaculation prevalence and characteristics in Korean young males: community-based data from an internet survey. J Androl 2010;31:540-6.
12. Son H, Song SH, Lee JY, Paick JS. Relationship between premature ejaculation and depression in Korean males. J Sex Med 2011;8:2062-70.
13. Choo V. WHO reassesses appropriate body-mass index for Asian populations. Lancet 2002;360:235.
14. Giuliano F, Chevret-Measson M, Tsatsaris A, Reitz C, Murino M, Thonneau P. Prevalence of erectile dysfunction in France: results of an epidemiological survey of a representative sample of 1004 men. Eur Urol 2002;42:382-9.
15. Malavige LS, Jayaratne SD, Kathriarachchi ST, Sivayogan S, Fernando DJ, Levy JC. Erectile dysfunction among men with diabetes is strongly associated with premature ejaculation and reduced libido. J Sex Med 2008;5:2125-34.
16. Nicolosi A, Moreira ED Jr, Shirai M, Bin Mohd Tambi MI, Glasser DB. Epidemiology of erectile dysfunction in four countries: cross-national study of the prevalence and correlates of erectile dysfunction. Urology 2003;61:201-6.
17. Laumann EO, West S, Glasser D, Carson C, Rosen R, Kang JH. Prevalence and correlates of erectile dysfunction by race and ethnicity among men aged 40 or older in the United States: from the male attitudes regarding sexual health survey. J Sex Med 2007;4:57-65.
18. Ahn TY, Park JK, Lee SW, Hong JH, Park NC, Kim JJ, et al. Prevalence and risk factors for erectile dysfunction in Korean men: results of an epidemiological study. J Sex Med 2007;4:1269-76.
19. Al Naimi A, Majzoub AA, Talib RA, Canguven O, Al Ansari A. Erectile dysfunction in qatar: prevalence and risk factors in 1,052 participants-a pilot study. Sex Med 2014;2:91-5.
20. NIH Consensus Conference. Impotence. NIH consensus development panel on impotence. JAMA 1993;270:83-90.

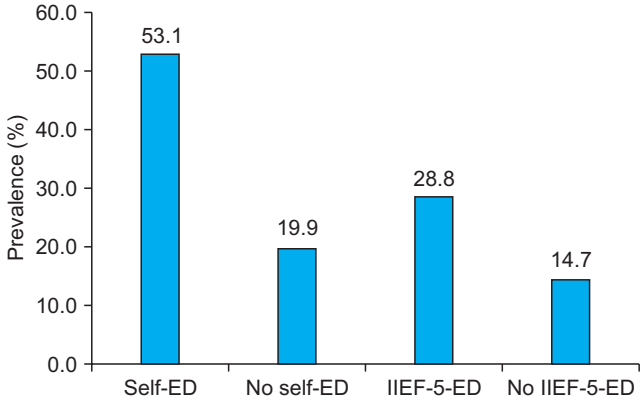
21. Morgentaler A. Male impotence. Lancet 1999;354:1713-8.
22. Nguyen HMT, Gabrielson AT, Hellstrom WJG. Erectile dysfunction in young men: a review of the prevalence and risk factors. Sex Med Rev 2017;5:508-20.
23. McVary KT, Carrier S, Wessells H; Subcommittee on Smoking and Erectile Dysfunction Socioeconomic Committee, Sexual Medicine Society of North America. Smoking and erectile dysfunction: evidence based analysis. J Urol 2001;166:1624-32.
24. Lee SW, Lee JH, Sung HH, Park HJ, Park JK, Choi SK, et al. The prevalence of premature ejaculation and its clinical characteristics in Korean men according to different definitions. Int J Impot Res 2013;25:12-7.
25. McMahon CG, Lee G, Park JK, Adaikan PG. Premature ejaculation and erectile dysfunction prevalence and attitudes in the Asia-Pacific region. J Sex Med 2012;9:454-65.
26. Rosen R, Altwein J, Boyle P, Kirby RS, Lukacs B, Meuleman E, et al. Lower urinary tract symptoms and male sexual dysfunction: the multinational survey of the aging male (MSAM-7). Eur Urol 2003;44:637-49.
27. Kim SW, Park NC, Lee SW, Yang DY, Park JK, Moon DG, et al. Efficacy and safety of a fixed-dose combination therapy of tamsulosin and tadalafil for patients with lower urinary tract symptoms and erectile dysfunction: results of a randomized, double-blinded, active-controlled trial. J Sex Med 2017;14:1018-27.
28. Egan KB, Burnett AL, McVary KT, Ni X, Suh M, Wong DG, et al. The co-occurring syndrome-coexisting erectile dysfunction and benign prostatic hyperplasia and their clinical correlates in aging men: results from the National Health and Nutrition Examination Survey. Urology 2015;86:570-80.
29. Manana PN, Kuonza L, Musekiwa A, Koornhof H, Nanoo A, Ismail N. Feasibility of using postal and web-based surveys to estimate the prevalence of tuberculosis among health care workers in South Africa. PLoS One 2018;13:e0197022.
30. Couper MP. Web surveys: a review of issues and approaches. Public Opin Q 2000;64:464-94.

Supplement 1. Risk factors of IIEF-5-ED for all age's patients in the 2016 study

Variable	All age			
	Univariate score		Multivariate score	
	OR	p-value	Adjusted OR (95% CI)	p-value
Age	1.065 (1.027–1.103)	0.001	1.025 (1.014–1.036)	<0.001
BMI	1.013 (0.970–1.058)	0.567		
Academic background (≥college)	0.721 (0.488–1.067)	0.102		
Monthly income (≥3,521 USD)	0.918 (0.702–1.199)	0.528	0.748 (0.586–0.954)	0.019
Occupation (unemployed)	Reference	0.125		
Office worker	1.242 (0.853–1.811)	0.259		
Professional	0.911 (0.549–1.512)	0.719		
Others	1.479 (0.977–2.240)	0.065		
Marital status (married)	Reference	0.001		
Single	0.627 (0.475–0.828)	0.001		
Smoking history (absent)	Reference	0.003	Reference	0.020
Present	1.587 (1.179–2.135)	0.002	1.403 (1.106–1.779)	0.005
Past	1.676 (1.166–2.410)	0.005	1.210 (0.874–1.675)	0.251
Alcohol drinking	1.640 (1.183–2.273)	0.003		
HTN	2.639 (1.856–3.752)	<0.001	1.445 (1.040–2.008)	0.028
DM	4.683 (2.619–8.373)	<0.001	1.916 (1.196–3.071)	0.007
Depression	3.068 (1.567–6.006)	0.001	2.684 (1.478–4.877)	0.001
Prostatic disease	1.847 (1.034–3.299)	0.038		
STD	2.554 (1.049–6.219)	0.039		
Contraception (condom)	0.667 (0.513–0.868)	0.003		
Age at first intercourse	1.020 (0.984–1.056)	0.288		
No. of sexual partners	1.001 (0.988–1.015)	0.871		
No. of intercourse per month	0.962 (0.937–0.988)	0.004		
Homosexual experience	1.655 (0.537–5.098)	0.380	2.870 (1.368–6.021)	0.005
Masturbation	0.817 (0.604–1.106)	0.191		
Experience of rape or sexual harassment	1.801 (1.078–3.010)	0.025		
Conversation about sex with the sexual partner (sometimes)	Reference	<0.001	Reference	<0.001
Often	0.396 (0.287–0.546)	<0.001	0.663 (0.513–0.857)	0.002
Never	1.405 (0.991–1.992)	0.056	1.378 (1.040–1.825)	0.026
Circumcision	0.806 (0.614–1.059)	0.121		
Self PE	2.352 (1.690–3.274)	<0.001	2.089 (1.594–2.737)	<0.001
Total IPSS	1.008 (0.987–1.029)	0.454	1.027 (1.010–1.045)	0.002

IIEF-5-ED: International Index of Erectile Function-5–assessed erectile dysfunction, OR: odds ratio, CI: confidence interval, BMI: body mass index, USD: US dollar, HTN: hypertension, DM: diabetes mellitus, STD: sexually transmitted disease, Self-PE: self-reported premature ejaculation, IPSS: International Prostate Symptom Score.

The World Journal of
Men's Health



Supplement 2. Prevalence of self-reported premature ejaculation according to self-reported erectile dysfunction (Self-ED) and International Index of Erectile Function-5–assessed erectile dysfunction (IIEF-5-ED) in the 2016 study.

Supplement 3. Multivariate analysis of risk factors of IIEF-5-ED according to age groups during a decade

Variable	20s				30s				40s				50s			
	Univariate score		Multivariate score		Univariate score		Multivariate score		Univariate score		Multivariable score		Univariate score		Multivariate score	
	OR	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value	OR	p-value	Adjusted OR (95% CI)	p-value
Year (2016 *vs.* 2006)	0.433	0.000	0.418 (0.251–0.697)	0.001	0.906	0.601	1.22 (0.782–1.904)	0.381	0.934	0.764	0.898 (0.529–1.524)	0.690	0.939	0.856	0.689 (0.308–1.546)	0.367
BMI	1.018	0.641			1.019	0.594			1.003	0.944			0.961	0.442	0.962 (0.852–1.086)	0.531
Academic background (≥college)	0.928	0.829			0.543	0.053	0.582(0.290–1.168)	0.128	0.642	0.204	0.913(0.414–2.012)	0.821	0.797	0.484	0.830 (0.375–1.838)	0.646
Monthly income (≥3,521 USD)	0.760	0.573			1.038	0.855			0.775	0.257	0.911(0.546–1.519)	0.720	0.645	0.103	0.688 (0.361–1.311)	0.256
Occupation (unemployed)	Reference	Reference			Reference	Reference			Reference	Reference						
Office worker	1.345	0.246			0.461	0.295			0.000	1.000						
Professional	0.863	0.677			0.410	0.247			0.000	1.000						
Others	0.982	0.955			0.347	0.163			0.000	1.000						
Marital status (married)	Reference	Reference	Reference		Reference	Reference	Reference	Reference	Reference	Reference			Reference	Reference		
Single	0.865	0.579	1.128 (0.609–2.089)	0.702	1.219	0.333	1.223 (0.773–1.936)	0.390	1.293	0.531			0.290	0.315		
Divorced or bereaved					0.000	0.999	0.000 (0.000)	0.999	1.386	0.632			1.303	0.667		
Smoking history (none)	Reference	Reference			Reference	Reference			Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Present	1.157	0.517			1.034	0.870			1.990	0.006	2.014 (1.130–3.589)	0.018	2.306	0.010	2.335 (1.087–5.016)	0.030
Past	1.032	0.935			1.003	0.993			1.659	0.137	1.952 (0.902–4.228)	0.090	1.481	0.267	1.229 (0.531–2.844)	0.630
Alcohol drinking	1.447	0.144	1.503 (0.836–2.701)	0.173	1.176	0.478	1.381 (0.812–2.351)	0.234	0.770	0.374	0.547 (0.278–1.076)	0.081	1.548	0.236	2.072 (0.828–5.183)	0.120
HTN	0.195	0.013	5.939 (1.413–24.960)	0.015	1.947	0.061	1.741 (0.808–3.752)	0.157	1.509	0.148	1.602 (0.845–3.038)	0.149	1.316	0.339	1.309 (0.680–2.522)	0.421
DM	4.020	0.230			2.152	0.100	1.899 (0.704–5.125)	0.205	1.189	0.690	1.315 (0.514–3.367)	0.568	4.135	0.011	4.195 (1.251–14.068)	0.020
Depression	6.671	0.003	7.298 (1.768–30.128)	0.006	2.481	0.152	2.560 (0.686–9.558)	0.162	1.531	0.475	1.301 (0.351–4.820)	0.694	1.556	0.416		
Prostatic disease	2.000	0.451			0.451	0.174	0.410 (0.073–2.309)	0.312	1.407	0.508	0.723 (0.211–2.475)	0.605	1.556	0.416	1.725 (0.481–6.185)	0.403
STD	1.058	0.934	0.302 (0.051–1.774)	0.185	0.454	0.241	1.140 (0.142–9.176)	0.902	4.392	0.188	3.950 (0.267–58.513)	0.318				
Contraception (condom)	0.688	0.122	0.798 (0.450–1.412)	0.438	1.120	0.547			1.426	0.123	1.585 (0.939–2.676)	0.085	1.075	0.813		
Age at first intercourse	0.911	0.027	0.897 (0.815–0.988)	0.028	1.027	0.232	1.076 (1.018–1.138)	0.009	0.960	0.119	0.982 (0.922–1.046)	0.573	0.979	0.584		
No. of sexual partners	0.990	0.584	0.969 (0.923–1.017)	0.208	1.013	0.260	1.025 (0.999–1.052)	0.057	1.013	0.230	1.017 (0.993–1.042)	0.173	0.975	0.104	0.975 (0.941–1.009)	0.148
No. of intercourse per month	0.989	0.592	0.967 (0.921–1.015)	0.176	1.000	0.981			0.972	0.227	0.982 (0.932–1.034)	0.478	0.929	0.023	0.944 (0.880–1.013)	0.109
Homosexual experience	20.211	0.004	18.575 (2.086–165.417)	0.009	2.851	0.091	2.884 (0.794–10.478)	0.108	0.804	0.777			0.286	0.309	0.537 (0.039–7.429)	0.643
Masturbation	0.790	0.434			0.809	0.323	0.798 (0.497–1.282)	0.351	0.989	0.966			1.455	0.166	1.106 (0.588–2.079)	0.756
Experience of rape or sexual harassment	3.249	0.012	1.914 (0.631–5.802)	0.251	1.718	0.126	1.172 (0.527–2.608)	0.697	1.083	0.845			2.825	0.068	2.348 (0.682–8.092)	0.176
Conversation about sex with the sexual partner (sometimes)	Reference	Reference			Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Often	0.624	0.044			0.573	0.016	0.655 (0.403–1.067)	0.089	0.711	0.216	0.661 (0.358–1.221)	0.186	0.602	0.128	0.739 (0.344–1.585)	0.437
Never	0.913	0.768			1.677	0.040	1.719 (1.013–2.916)	0.045	1.473	0.159	1.363 (0.757–2.456)	0.302	1.354	0.380	1.390 (0.625–3.094)	0.419
Circumcision	1.276	0.352			0.578	0.008	0.560 (0.360–0.869)	0.010	1.055	0.819			1.087	0.755		
Self-PE	1.000	0.999			1.480	0.085	1.632 (1.002–2.659)	0.049	4.243	0.000	4.405 (2.425–8.003)	<0.001	8.095	0.000	7.563 (2.677–21.367)	<0.001
Total IPSS	1.055	0.002	1.048 (1.009–1.088)	0.016	1.054	0.000	1.049 (1.016–1.084)	0.003	1.009	0.599	1.020 (0.982–1.060)	0.305	0.999	0.945	1.002 (0.957–1.049)	0.941

IIEF-5-ED: International Index of Erectile Function-5–assessed erectile dysfunction, OR: odds ratio, CI: confidence interval, BMI: body mass index, USD: US dollars, HTN: hypertension, DM: diabetes mellitus, STD: sexually transmitted disease, Self-PE: self-reported premature ejaculation, IPSS: International Prostate Symptom Score.

https://doi.org/10.5534/wjmh.180054

The World Journal of Men's Health

Supplement 4. Comparison of risk factors in self-reported erectile dysfunction during a decade by using multivariate analysis

Variable	Univariate score		Multivariate score	
	OR	p-value	Adjusted OR (95% CI)	p-value
Year (2016 *vs*. 2006)	0.606	0.036	0.213 (0.119–0.382)	<0.001
Age (y)	1.077	<0.001	1.105 (1.074–1.136)	<0.001
BMI	1.025	0.561		
Academic background (≥college)	0.741	0.358		
Monthly income (≥3,521 USD)	1.179	0.502		
Occupation (unemployed)	Reference	Reference		
Office worker	3.830	26.000		
Professional	4.357	0.024		
Others	3.599	0.041		
Marital status (married)	Reference	Reference		
Single	0.141	<0.001		
Divorced or bereaved	1.661	0.418		
Smoking history (none)	Reference	Reference		
Present	2.018	0.012		
Past	1.608	0.209		
Alcohol drinking	1.214	0.535		
HTN	3.049	0.000		
DM	4.204	0.000	2.650 (1.432–4.904)	0.002
Depression	2.130	0.092		
Prostatic disease	3.794	0.001	4.553 (2.084–9.946)	<0.001
STD	6.478	0.000		
Contraception (condom)	0.387	0.000		
Age at first intercourse	0.977	0.468		
No. of sexual partners	1.002	0.871		
No. of intercourse per month	0.878	0.002	0.899 (0.825–0.981)	0.016
Homosexual experience	1.583	0.454		
Masturbation	1.385	0.271	2.061 (1.176–3.611)	0.011
Experience of rape or sexual harassment	4.074	0.000	4.672 (2.557–8.535)	<0.001
Conversation about sex with the sexual partner (sometimes)	Reference	Reference		
Often	0.611	0.119		
Never	1.295	0.360		
Circumcision	0.921	0.747		
Self-PE	3.237	0.000	3.021 (1.858–4.912)	<0.001
Total IPSS	1.059	0.000		

OR: odds ratio, CI: confidence interval, BMI: body mass index, USD: US dollars, HTN: hypertension, DM: diabetes mellitus, STD: sexually transmitted disease, Self-PE: self-reported premature ejaculation, IPSS: International Prostate Symptom Score.

Supplement 5. Risk factors of self-ED for all ages between 2006 and 2016 study

Variable	Multivariate score			
	2006		2016	
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age	1.077 (1.037–1.118)	<0.001	1.126 (1.065–1.190)	<0.001
Occupation (unemployed)			Reference	0.042
Office worker			1.565 (0.488–5.017)	0.451
Professional			3.255 (0.753–14.057)	0.114
Others			0.581 (0.171–1.968)	0.383
Smoking history (absent)			Reference	0.002
Present			4.792 (1.737–13.219)	0.002
Past			1.461 (0.467–4.570)	0.515
DM			3.171 (1.362–7.386)	0.007
Prostatic disease			4.664 (1.771–12.282)	0.002
Sexual transmitted disease	4.876 (1.396–17.035)	0.013		
Contraception (condom)			0.278 (0.083–0.926)	0.037
Masturbation	2.952 (1.242–7.016)	0.014		
Experience of rape or sexual harassment			7.027 (2.867–17.220)	<0.001
Self PE			5.545 (2.624–11.718)	<0.001
Total IPSS	1.056 (1.010–1.103)	0.016		

self-ED: self-reported erectile dysfunction, OR: odds ratio, CI: confidence interval, DM: diabetes mellitus, elf-PE: self-reported premature ejaculation, IPSS: International Prostate Symptom Score.