Original article

Investigating the connection between age progression and erectile dysfunction incidence in chronic kidney disease patients undergoing hemodialysis

Dandi P Widiaputro[1*], Heru Suwito[1], Helsa Eldatarina[1], Wahyu Firmansah[1], Muhamad JT Akbar[1], Rosmince B Wattimury[1], Ketut A Rahardja[1], Dheni P Haryanto[1], Atma Gunawan[2]

[1]Department of Internal Medicine, Universitas Brawijaya, Malang, Indonesia; [2]Division of Nephrology & Hypertension, Department of Internal Medicine, Universitas Brawijaya, Malang, Indonesia.
*Corresponding author: Dandi Prasetianto Widiaputro (Email: dandi1992@gmail.com)

Citation: Widiaputro DP, Suwito H, Eldatarina H, et al. Investigating the connection between age progression and erectile dysfunction incidence in chronic kidney disease patients undergoing hemodialysis. Deka in Medicine. 2024; 1(2): e210

Received: March 29, 2024
Revised: June 5, 2024
Accepted: June 12, 2024
Published: July 5, 2024

ABSTRACT

BACKGROUND: Erectile dysfunction is frequently observed in patients with chronic kidney disease (CKD), especially in the elderly population. However, studies have presented diverse outcomes on this matter.

OBJECTIVES: To assess the correlation between age progression and the prevalence of erectile dysfunction in chronic kidney disease patients receiving hemodialysis.

METHODS: The study employed a retrospective design and was conducted at RSUD Dr. Saiful Anwar, Malang, during June-July 2022. Data collection involved retrieving age, the erection hardness score (EHS), and baseline characteristics from medical records. Statistical analysis focused on assessing the correlation between age and erectile dysfunction using linear regression.

RESULTS: The study population consisted of 59 patients with erectile dysfunction and 61 patients without erectile dysfunction. The primary findings highlighted a substantial and moderately negative association between age and the EHS score, which serves as a key indicator of erectile function. The results suggested that as individuals aged, there was a noticeable trend towards a decrease in the EHS score, implying a decrease in erectile capacity.

CONCLUSION: Our findings emphasize the crucial importance of age as a determining factor in the development of erectile dysfunction.

KEYWORDS: Age progression; erectile dysfunction; chronic kidney disease; hemodialysis; sexual health.

INTRODUCTION

Chronic kidney disease (CKD) was identified as a substantial health challenge due to its potential complications, including cognitive decline, anemia, fractures, and disturbances in mineral and bone metabolism. CKD was also associated with issues such as uremia, arterial hypertension, electrolyte imbalances, dyslipidemia, and an increased risk of cardiovascular events.[1] Recent studies had examined the connection between CKD and erectile dysfunction, revealing associations between renal dysfunction and sexual health. While hormonal and vascular factors contributed to erectile dysfunction in CKD, psychological factors were also recognized as influential.[2-4] Erectile dysfunction, previously known as impotence, was a prevalent condition characterized by the inability to achieve or maintain an erection sufficient for sexual activity.[5] Its prevalence had been observed to increase with age, particularly affecting men over 40. Epidemiological projections had anticipated a significant rise in the global burden of erectile dysfunction, highlighting the importance of comprehensive strategies to address this public health concern.[6] These findings underscored the need to understand the complex relationship between CKD and sexual function, informing holistic approaches to patient care that prioritize renal health and quality of life.

Erectile dysfunction, although not typically deemed life-threatening, exerted profound implications for both affected individuals and their partners, extending beyond the realm of physical health.[5] The burden of erectile dysfunction extended to psychological well-being, social interactions, and economic aspects. Erectile dysfunction led to withdrawal from sexual activities, contributing to a decline in self-confidence, increased susceptibility to depression and anxiety, and disrupted interpersonal relationships. Moreover, the economic consequences of erectile dysfunction were significant, as diminished work productivity due to psychological distress and reduced quality of life ensued. The negative impact of erectile dysfunction extended to the partners of affected individuals, with potential strain on intimate relationships and decreased sexual satisfaction.[7] This confluence of factors underscored the pressing need for comprehensive research aimed at elucidating the multifaceted etiology of erectile dysfunction, with a particular focus on exploring the intricate interplay of age-related factors. Hence, the primary objective of this study was to explore and analyze in detail the correlation between advancing age and the incidence of erectile dysfunction in patients afflicted with CKD disease undergoing hemodialysis, with the ultimate aim of informing targeted interventions and improving patient outcomes.

METHODS

Study design

A retrospective investigation was carried out at RSUD Dr. Saiful Anwar Malang over the period of June-July 2022. In order to fulfill the study's objectives, data extraction from medical records was undertaken, and pertinent information was gathered for subsequent analysis. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for observational studies was utilized as a guiding framework for the study protocols.[8] The study protocol was in accordance with the principles outlined in the Helsinki Declaration[9] and received approval from the local ethical committee (No. 400/143/K.3/302/2021).

Participants & eligibility criteria

The sample selection for this study adhered to the sample size formula applicable to retrospective studies.[10] Sample size determination was conducted utilizing G*power version 3.1 (Universität Düsseldorf, Düsseldorf, Germany). A minimum sample size of 120 participants was deemed necessary for this investigation. Inclusion criteria encompassed patients diagnosed with CKD who undergo regular hemodialysis treatment at our institution. Exclusion criteria comprised individuals with hepatitis B, HIV, and pre-existing erectile dysfunction prior to enrollment in the study.

Data collection

Data collection for this study took place at RSUD Dr. Saiful Anwar Malang during the period of June to July 2022. The method employed for data collection utilized a pilot form. The data collected included the participants' names, medical record numbers, age, gender, occupation, BMI, history of alcohol consumption, and comorbidities such as hypertension and diabetes mellitus, as well as erectile dysfunction assessed using the EHS score. Data collection was conducted independently by two authors. In case of any discrepancies encountered during the process, discussions were held to resolve them.

Covariates

In our study, the predictor variable was age, and data were retrieved from medical records. The outcome variable was erectile dysfunction, as evaluated by the erection hardness score (EHS). The EHS score interpretation for erectile dysfunction was as follows: a score of 1 indicated that the penis was larger than normal, but not adequately hard; a score of 2 signified that the penis was hard but not rigid enough for penetration; a score of 3 suggested that the penis was sufficiently hard for penetration but not completely rigid; finally, a score of 4 indicated that the penis was completely hard and fully rigid.[11]

Statistical analysis

Data were presented as mean ± SD or median (IQR) for numerical variables and as n(%) for categorical variables. Baseline data were analyzed using t-tests for numerical variables and chi-squared tests for nominal variables. To mitigate bias, t-tests for numerical variables and chi-squared tests for nominal variables were

performed on baseline characteristic covariates; a p-value > 0.05 indicated homogeneity of data between groups with and without erectile dysfunction. The main findings were assessed using linear regression analysis, with p-values < 0.05 considered to indicate significant effects. Effect estimates were measured using r-squared. Statistical analyses were conducted using Statistical Package for the Social Sciences 17.0 software (SPSS Inc., Chicago, IL).

RESULTS

Baseline characteristics of patients

In the category of occupational status, three classifications were identified: unemployed, employed, and freelancers. Among the unemployed individuals, 42 patients exhibited erectile dysfunction, while 32 did not. In the employed category, 13 patients experienced erectile dysfunction, compared to 22 who did not. Among freelancers, 4 patients had erectile dysfunction, while 7 did not. Analysis of patient occupations revealed a significant difference ($p<0.05$) between groups with and without erectile dysfunction. In terms of BMI categories, five classifications were identified: underweight, normal, overweight, obesity I, and obesity II. Across these categories, the presence or absence of erectile dysfunction varied. However, comparison of BMI categories yielded no significant difference ($p>0.05$) between groups with and without erectile dysfunction. Regarding alcohol consumption habits, 28 patients reported such habits, while 92 did not. Among those with CKD undergoing HD, the presence of alcohol consumption habits showed variation in the presence of erectile dysfunction. Nonetheless, comparison of alcohol consumption history did not reveal a significant difference ($p>0.05$) between groups with and without erectile dysfunction. Similarly, analysis of comorbidities among CKD patients did not show a significant difference ($p>0.05$) between groups with and without erectile dysfunction. The baseline characteristics data in our study are presented in Table 1.

Table 1. Baseline characteristics of patients in our study.

Parameters		Erectile dysfunction		p
		(+), n=59	(-), n=61	
Age (years), mean±SD		54.6±9.34	45.88±12.6	
Occupational status				
	Unemployed	42 (71.2)	32 (52.5)	0.039
	Employees	13 (22.0)	22 (36.1)	
	Freelance	4 (6.8)	7 (11.5)	
BMI categories				0.674
	Underweight	3 (5.1)	3 (4.9)	
	Normal	30 (50.8)	26 (42.6)	
	Overweight	9 (15,3)	18 (29.5)	
	Obesity I	15 (25.4)	10 (16.4)	
	Obesity II	2 (3.4)	4 (6.6)	
Alcohol				
	No	44 (74.6)	48 (78.7)	0.596
	Yes	15 (25.4)	13 (21.3)	
Comorbidity (DM & HT)				
	(-)	1 (1.7)	1 (1.6)	0.981
	(+)	58 (98.3)	60 (98.4)	

Note, data were presented in mean±SD or n(%); BMI, body mass index; DM, diabetes mellitus; HT, hypertension.

Correlation between age and erectile dysfunction EHS score

In the group of patients who had experienced erectile dysfunction, the mean age was observed to be 54.6±9.34, whereas for those without erectile dysfunction, it measured 45.88±12.6. Our results demonstrated a significant difference in the age of patients between those experiencing erectile dysfunction and those who

were not ($p<0.05$). Furthermore, the regression model elucidating the impact of age on the EHS score was represented as $Y = 4.060 - 0.032X$, where Y denoted the EHS score and X represented age. This indicated that without accounting for the influence of age, the EHS score tended to remain consistently high (attributed to the positive coefficient constant). However, consideration of age's effect resulted in a significant reduction in the EHS score ($p=0.000$). The negative association observed between age and the EHS score indicates that as patient age rises, there is a concurrent decrease in the EHS score, whereas younger patients tend to have higher EHS scores. Moreover, regression analysis outcomes disclosed a coefficient of determination (R Square=r2), representing the proportionate influence of age on the EHS score, with the residual proportion (1-R Square) being ascribed to other factors. Thus, age contributed to 17.8% of the variation in the EHS score, while 82.2% was influenced by factors beyond patient age. The regression line plotting age against the EHS score exhibited a slight downward slope, indicative of linearity between age and the EHS score, signifying that as patient age increased, there was a corresponding decline in the EHS score, and conversely, younger patient age was associated with an elevation in the EHS score (Figure 1).

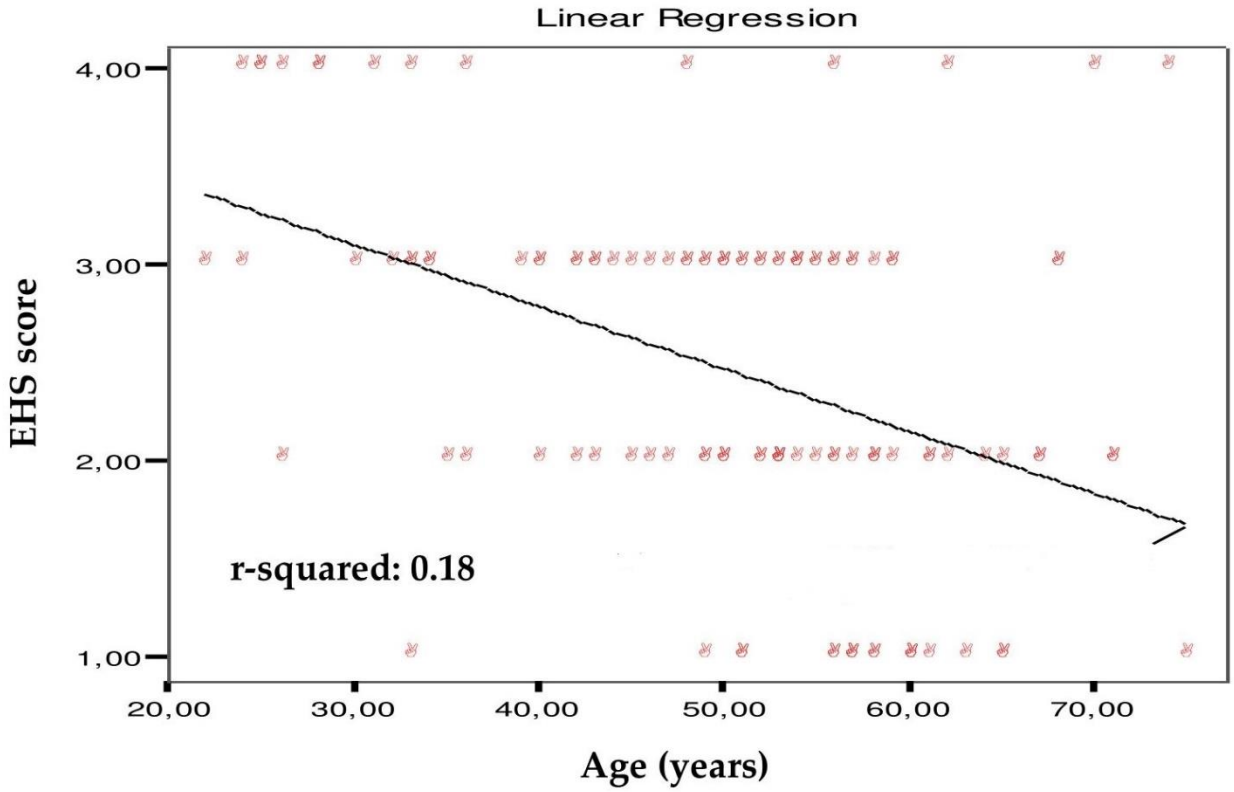

Figure 1. The linear relationship between age and EHS score is depicted in the graph. As age increases, the EHS score tends to follow a consistent pattern, indicating a direct correlation between the two variables (r-squared: 0.18; R2: 15.7%; p: <0.0001).

DISCUSSION

In this study, a significant, moderately negative correlation was identified between age and the EHS score, which serves as a crucial indicator of erectile function. Our findings suggested that as men progressed in age, their EHS score exhibited a tendency to decrease. Specifically, patients diagnosed with erectile dysfunction displayed an average age of 54.6±9.34 years, while those without this condition had an average age of 45.88±12.6 years. Our findings were consistent with earlier epidemiological studies, offering corroborative evidence of the intricate relationship between age and erectile function. For instance, extensive study conducted in New Zealand uncovered varying prevalence rates of erectile dysfunction across diverse age cohorts, with noticeably higher rates discerned among older demographics.[12] Similarly, comprehensive investigations conducted in both the United States and Europe unveiled a discernible decline in sexual activity corresponding to advancing age, concomitant with a heightened utilization of phosphodiesterase 5 inhibitors (PDE5Is) among the elderly male population.[13,14] Moreover, in-depth analyses carried out in

Sweden and Australia divulged an escalating prevalence of erectile dysfunction concomitant with age progression, particularly pronounced among the elderly population.[15,16] Furthermore, the severity of erectile dysfunction exhibited a marked increase among older individuals, particularly those aged 75 years or above.[16] Additionally, pertinent studies underscored a heightened prevalence of erectile dysfunction among elderly patients who had undergone penile surgery, further emphasizing the multifaceted impact of age-related factors on the intricate dynamics of erectile dysfunction manifestation and progression.[17] Hence, it was concluded that our study findings aligned with several previous studies concerning the potential implications of age factors in the development of erectile dysfunction

The theoretical basis concerning our study's findings, which illustrate the substantial implications of age on the progression of erectile dysfunction, presents a complex scenario. While hypertension, diabetes mellitus, and cardiovascular diseases contribute to erectile dysfunction, aging emerges as a primary determinant.[18] Age-related changes encompass penile structural alterations, vascular dysfunction, heightened cardiovascular risk, and hormonal shifts. Vascular factors play a predominant role in erectile dysfunction, indicating intricate associations between vascular complications and erectile dysfunction. With advancing age, structural vascular modifications compromise function, notably vascular tone dysfunction. Nitric oxide (NO) serves a critical role in maintaining vascular stability, but age-related inhibition of NO production leads to reduced smooth muscle activity and increased susceptibility to atherosclerosis.[19] Oxidized low-density lipoprotein is also suspected to contribute to atherosclerosis. Erectile dysfunction may reflect overall vascular function and predict cardiovascular complications, particularly coronary heart disease.[18] Normal penile erection involves a delicate balance of vasoconstriction and vasodilation mechanisms, regulated by NO-induced vasodilation and arterial vasoconstriction mediated by α-adrenergic activation.[20] The heightened risk of metabolic disorders with age, stemming from reduced NO production due to proinflammatory cytokines, exacerbates erectile dysfunction. Declining NO levels may be attributed to reduced NOS3 gene expression.[21] Oxidative stress, particularly reactive oxygen species, contributes to erectile dysfunction by inducing endothelial dysfunction and arterial changes. Maintaining a balanced NO/reactive oxygen species ratio is crucial for preserving erectile function.[22] The explanation could theoretically clarify the role of aging in the progression of erectile dysfunction, as indicated in our study.

However, it was essential for this study to account for employment status as a potential confounding variable. Our findings revealed a disparity in the incidence of erectile dysfunction among employed and unemployed individuals, with a higher prevalence observed among the latter group. This observation may be attributed to the adverse effects of erectile dysfunction on productivity, potentially resulting in a diminished quality of life. As the severity of erectile dysfunction increased, individuals faced greater challenges in their occupational roles.[23,24] Consequently, further investigation is warranted to explore the relationship between employment status and erectile dysfunction.

The clinical implications drawn from this study were significant. Firstly, it emphasized the critical importance of addressing sexual dysfunction in elderly CKD patients undergoing hemodialysis, underscoring its profound influence on their quality of life and overall health. Furthermore, the study findings revealed that age was a notable predictor of erectile dysfunction, consistent with observations in the general population. This underscored the necessity of considering age in the assessment and management of erectile dysfunction among CKD patients undergoing hemodialysis. Additionally, the study's utilization of the EHS score as an assessment tool was noteworthy due to its simplicity and efficacy in measuring erection quality, serving as an indicator of broader health and well-being outcomes. Lastly, the study's revelation of the heightened prevalence of erectile dysfunction among CKD patients undergoing hemodialysis underscored the gravity of the issue and its significant impact on their quality of life.

This study encountered certain limitations that warrant discussion. Firstly, the study did not assess potential confounding factors such as underlying medical conditions, medications, and psychological aspects, which could have introduced biases into the results. These factors are known to influence erectile dysfunction outcomes, and their exclusion may have constrained the study's breadth. Secondly, the sample size employed in our study was relatively small. Despite efforts to ensure representativeness, the limited sample

size might have restricted the generalizability of the findings. Consequently, caution was advised in extrapolating these results to broader populations. Thirdly, the study's retrospective design, reliant on medical records, posed inherent constraints. Retrospective studies are susceptible to various biases, including selection and information bias, potentially impacting the accuracy and reliability of the data. Therefore, these limitations should be carefully considered when interpreting the study's outcomes and guiding future research directions.

CONCLUSION

Our findings highlight the pivotal role of age as a determinant in the progression of erectile dysfunction. With advancing age, individuals face a heightened susceptibility to experiencing erectile dysfunction. This correlation suggests that age serves as a crucial marker for assessing the risk and likelihood of developing erectile dysfunction over time. The findings emphasize the importance of considering age-related factors in understanding and addressing erectile dysfunction within clinical contexts. Additionally, recognizing age as a significant contributing factor can inform preventive measures and tailored interventions aimed at mitigating the onset and progression of erectile dysfunction in older populations. Therefore, a comprehensive understanding of the relationship between age and erectile dysfunction is essential for optimizing patient care and promoting overall well-being in aging individuals.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study procedures were reviewed and approved by the local ethical committee. Participant consent was not required for this study as it involved retrospective data collection.

CONFLICTS OF INTEREST

We have no conflict of interest

FUNDING SOURCES

We have no source of funding

ACKNOWLEDGMENT

None

AUTHOR CONTRIBUTION

Conceptualization: DPW, HS, HE, AG; Data Curation: DPW, HS, HE, WF, MJTA, RBW, KAR, DPH; Formal Analysis: DPW, HS, HE; Investigation: DPW, HS, HE; Project Administration: DPW; Resources: DPW; Methodology: DPW, HS, HE, WF, MJTA, RBW, KAR, DPH; Software: DPW; Visualization: DPW, HS, HE; Supervision: AG; Validation: AG; Writing – Original Draft Preparation: DPW, HS, HE, WF, MJTA, RBW, KAR, DPH; Writing – Review & Editing: AG. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

REFERENCES

1. Levey AS, Coresh J. Chronic kidney disease. Lancet 2012;379(9811):165-180.doi: 10.1016/S0140-6736(11)60178-5. PMID: 21840587
2. Papadopoulou E, Varouktsi A, Lazaridis A, et al. Erectile dysfunction in chronic kidney disease: From pathophysiology to management. World J Nephrol 2015;4(3):379-387.doi: 10.5527/wjn.v4.i3.379. PMID: 26167462
3. Edey MM. Male sexual dysfunction and chronic kidney disease. Front Med (Lausanne) 2017;4(1):32.doi: 10.3389/fmed.2017.00032. PMID: 28382300
4. Fugl-Meyer KS, Nilsson M, Hylander B, et al. Sexual function and testosterone level in men with conservatively treated chronic kidney disease. Am J Mens Health 2017;11(4):1069-1076.doi: 10.1177/1557988317703207. PMID: 28423972
5. Yafi FA, Jenkins L, Albersen M, et al. Erectile dysfunction. Nat Rev Dis Primers 2016;2(1):16003.doi: 10.1038/nrdp.2016.3. PMID: 27188339

6. Pastuszak AW. Current diagnosis and management of erectile dysfunction. Curr Sex Health Rep 2014;6(3):164-176.doi: 10.1007/s11930-014-0023-9. PMID: 25878565
7. Elterman DS, Bhattacharyya SK, Mafilios M, et al. The quality of life and economic burden of erectile dysfunction. Res Rep Urol 2021;13(1):79-86.doi: 10.2147/RRU.S283097. PMID: 33634039
8. Cuschieri S. The STROBE guidelines. Saudi J Anaesth 2019;13(1):S31-S34.doi: 10.4103/sja.SJA_543_18. PMID: 30930717
9. Goodyear MD, Krleza-Jeric K, Lemmens T. The Declaration of Helsinki. BMJ 2007;335(7621):624-625.doi: 10.1136/bmj.39339.610000.BE. PMID: 17901471
10. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med 2013;35(2):121-126.doi: 10.4103/0253-7176.116232. PMID: 24049221
11. Mulhall JP, Goldstein I, Bushmakin AG, et al. Validation of the erection hardness score. J Sex Med 2007;4(6):1626-1634.doi: 10.1111/j.1743-6109.2007.00600.x. PMID: 17888069
12. Quilter M, Hodges L, von Hurst P, et al. Male sexual function in new zealand: A population-based cross-sectional survey of the prevalence of erectile dysfunction in men aged 40-70 years. J Sex Med 2017;14(7):928-936.doi: 10.1016/j.jsxm.2017.05.011. PMID: 28673435
13. Mulhall JP, Luo X, Zou KH, et al. Relationship between age and erectile dysfunction diagnosis or treatment using real-world observational data in the USA. Int J Clin Pract 2016;70(12):1012-1018.doi: 10.1111/ijcp.12908. PMID: 28032424
14. Gareri P, Castagna A, Francomano D, et al. Erectile dysfunction in the elderly: an old widespread issue with novel treatment perspectives. Int J Endocrinol 2014;2014(1):878670.doi: 10.1155/2014/878670. PMID: 24744785
15. Stranne J, Malmsten UG, Areskoug B, et al. Influence of age and changes over time on erectile dysfunction: results from two large cross-sectional surveys 11 years apart. Scand J Urol 2013;47(3):198-205.doi: 10.3109/00365599.2012.726644. PMID: 23035670
16. Weber MF, Smith DP, O'Connell DL, et al. Risk factors for erectile dysfunction in a cohort of 108 477 Australian men. Med J Aust 2013;199(2):107-111.doi: 10.5694/mja12.11548. PMID: 23879509
17. Ortac M, Ozgor F, Caglar U, et al. Older age and a large tunical tear may be predictors of increased erectile dysfunction rates following penile fracture surgery. Int J Impot Res 2020;32(2):226-231.doi: 10.1038/s41443-019-0159-2. PMID: 31165779
18. Echeverri Tirado LC, Ferrer JE, Herrera AM. Aging and erectile dysfunction. Sex Med Rev 2016;4(1):63-73.doi: 10.1016/j.sxmr.2015.10.011. PMID: 27872006
19. Ferrini MG, Gonzalez-Cadavid NF, Rajfer J. Aging related erectile dysfunction-potential mechanism to halt or delay its onset. Transl Androl Urol 2017;6(1):20-27.doi: 10.21037/tau.2016.11.18. PMID: 28217447
20. Matsui H, Sopko NA, Hannan JL, et al. Pathophysiology of erectile dysfunction. Curr Drug Targets 2015;16(5):411-419.doi: 10.2174/1389450116051505041140 41. PMID: 25950641
21. Yang B, Liu L, Peng Z, et al. Functional variations in the nos3 gene are associated with erectile dysfunction susceptibility, age of onset and severity in a han chinese population. J Sex Med 2017;14(4):551-557.doi: 10.1016/j.jsxm.2017.02.003. PMID: 28268155
22. Sopko NA, Hannan JL, Bivalacqua TJ. Understanding and targeting the Rho kinase pathway in erectile dysfunction. Nat Rev Urol 2014;11(11):622-628.doi: 10.1038/nrurol.2014.278. PMID: 25311680
23. Goldstein I, Goren A, Li VW, et al. The association of erectile dysfunction with productivity and absenteeism in eight countries globally. Int J Clin Pract 2019;73(11):e13384.doi: 10.1111/ijcp.13384. PMID: 31389146
24. Burnett AL, Edwards NC, Barrett TM, et al. Addressing health-care system inequities in the management of erectile dysfunction: A call to action. Am J Mens Health 2020;14(5):1557988320965078.doi: 10.1177/1557988320965078. PMID: 33045918