RESEARCH ARTICLE

CYPRUS
JOURNAL OF MEDICAL SCIENCES

DOI: 10.4274/cjms.2024.2023-86
Cyprus J Med Sci 2024;9(2):107-112

Family Physicians' Knowledge and Practice of FRAX® in the Management of Osteoporosis in Jeddah, Saudi Arabia

Emad M. Salawati[1], Waleed M. Alqulayti[2]

[1]Department of Family Medicine, King Abdulaziz University Faculty of Medicine, Jeddah, Saudi Arabia
[2]Department of Family Medicine, King Abdulaziz University Hospital, Jeddah, Saudi Arabia

Abstract

BACKGROUND/AIMS: This study intended to assess the awareness and usage of the FRAX tool among family physicians in Jeddah and to identify gaps in screening knowledge.

MATERIALS AND METHODS: A cross-sectional study on 152 family physicians in Jeddah through a convenient sampling method and Google Forms was used to collect data via an online survey. The questionnaire included six items, and respondents were asked to select "Yes" or "No" as their response options. The chi-square test was used to determine significant associations between the variables related to FRAX tool awareness and practice and certain sociodemographic characteristics.

RESULTS: A total of 152 family physicians participated. The results showed moderate awareness (88.20%). Of those aware of FRAX, only 57.20% reported using it in their practice, with the main barriers being a lack of a country-specific model, a busy practice, and not knowing how to use it. Single participants and those attending King Abdulaziz University were more likely to have used FRAX.

CONCLUSION: Osteoporosis is a significant health problem with a rising incidence and economic burden. The FRAX tool is widely used to evaluate fracture risk. However, healthcare professionals still face perceived barriers, such as a lack of knowledge and awareness of a country-specific calculator. Targeted educational interventions and further studies are needed to overcome these barriers and to improve the tool's usage in clinical practice.

Keywords: Osteoporosis, FRAX, primary healthcare, physicians

INTRODUCTION

Osteoporosis is a systemic skeletal disorder of a metabolic nature which is distinguished by low bone density and micro-architectural deterioration. This leads to an increased risk of fractures due to bone fragility, even from minor falls or injuries. Fractures associated with osteoporosis typically occur in the hip, wrist, or spine.[1] It is estimated that osteoporosis impacts more than 200 million individuals across the globe.[2] In Saudi Arabia, the prevalence of osteoporosis is believed to be 58.4% among women aged 50-80 years and 63.6% among healthy men.[3] Despite sufficient sunlight, vitamin D deficiency is widespread among children and adults in Saudi Arabia.[4] This can be attributed in part to genetic variations and the need for clothing to cover the skin, which limits exposure to sunlight.[5]

The operational definition of osteoporosis relies on the assessment of bone mineral density (BMD) using dual-energy X-ray absorptiometry. Recently, there have been refinements in the definition which places emphasis on using measurements taken at the femoral neck as a reference standard.[6] Originally intended for classification in epidemiological studies, the T-score of -2.5 standard deviations (SDs) or lower, as defined by the World Health Organization (WHO), is now commonly used as both a diagnostic and intervention threshold. However, the main challenge in assessing fracture risk is that this

To cite this article: Salawati EM, Alqulayti W. Family Physicians' Knowledge and Practice of FRAX® in the Management of Osteoporosis in Jeddah, Saudi Arabia. Cyprus J Med Sci 2024;9(2):107-112

ORCID IDs of the authors: E.M.S. 0000-0001-6602-3473; W.M.A. 0000-0003-4580-6318.

Address for Correspondence: Emad M. Salawati
E-mail: esalawati@kau.edu.sa
ORCID ID: orcid.org/0000-0001-6602-3473

Received: 03.08.2023
Accepted: 15.02.2024

threshold has a high specificity but a low sensitivity, meaning that the majority of fragility fractures occur in individuals whose BMD values are above the osteoporosis threshold.[7] Hence, a crucial aspect of patient management involves the capacity to evaluate fracture risk and identify those who are suitable for intervention.

In 2008, the WHO Collaborating Centre located in Sheffield, UK, introduced FRAX®,[8] a computer-based algorithm which calculates an individual's 10-year probability of experiencing hip or major osteoporotic fractures (clinical spine, distal forearm, and proximal humerus). The FRAX tool comprises seven dichotomous clinical risk factors, including prior fragility fracture, parental hip fracture, smoking, systemic glucocorticoid use, excessive alcohol intake, rheumatoid arthritis, and other causes of secondary osteoporosis. These risk factors, along with age, sex, and body mass index, help in estimating an individual's 10-year fracture probability, regardless of their BMD. Although BMD at the femoral neck can be included as an optional input variable, earlier data indicated that BMD measurements have low sensitivity for predicting fractures.[9,10] Consequently, FRAX represented a significant therapeutic advancement outperforming the BMD T-score-based treatment technique. Although FRAX anticipates fractures under conflicting mortality frameworks, it has several limitations which must be considered when interpreting its results, including the fact that the tool does not account for dose responses of specific risk factors and the influence of previous fractures on the calculated absolute fracture risk However, FRAX only considers a binary input for prior fractures.[11-14]

Due to significant variations in fracture probability globally, FRAX models had to be calibrated to the fracture and death epidemiology specific to each country.[15] When FRAX was first launched, only models for eight countries were available. Currently, the FRAX tool is an accessible website which receives approximately three million visits annually, with models for 71 countries in 35 languages, representing over 80% of the world's population, including Saudi Arabia.[16-18]

This study aimed to explore the awareness and practical application of FRAX among family physicians in Jeddah and to identify the physicians' knowledge gaps in osteoporosis screening.

MATERIALS AND METHODS

Ethical statement: The Unit of Biomedical Ethics Research Committee of the King Abdulaziz Faculty of Medicine approved this study (approval number: 236-22, date: 21.04.2022).

Study design and study participants: This cross-sectional study was conducted using a previously validated questionnaire among family physicians in Jeddah, Saudi Arabia from April, 2022 to March, 2023 to assess their knowledge and applications of FRAX as well as the factors influencing the existing situation. Family residents of all levels were eligible to participate in this study. Those participants who did not specify their employment status were excluded from this survey in order to avoid selection bias.

Sampling strategy: The survey link was sent through email or social media to the potential participants. A convenient sampling method was used to reach the participants who met the study's inclusion criteria and completed the questionnaire.

Questionnaire tool: We used a self-administrated online questionnaire, which was adopted from a published study, to investigate the study objectives.[19] The survey was edited to cope with the study objectives and validated by three experts in the field. It was then posted online using Google Forms.

The target population for this study were family residents in Jeddah, Saudi Arabia, and the data was collected through an online survey using Google Forms. The research team distributed the survey link to all family residents via email or social media. The survey questionnaire included a cover page explaining the study's importance regarding the FRAX tool, and an agreement to participate. To ensure anonymity, no identifying details were requested from the respondents.

The assessment tool consisted of six items or questions, and the respondents were asked to select either "Yes" or "No" as their response options. The first part gathered demographic information about the participants. The demographic information which was obtained was gender, age, marital status, university, residency level, and the type and locality of their practice. The second part gathered information about their knowledge of the FRAX tool in osteoporosis treatment among family physicians. The participants were given six questions to answer, each with a Yes/No option. The questions covered topics including the participant's involvement in osteoporosis treatment, their awareness of the FRAX tool, and the success of this tool's incorporation into routine practice. The correlation between the demographic factors and the usage of FRAX was also assessed.

Sample size: WHO recommendations were used to estimate the sample size. The required sample size was calculated to be equal to or greater than 152 participants in order to achieve a 95% confidence interval and a 5% significance level (p-value), estimated using Raosoft® sample size calculator.

Statistical Analysis

SPSS version 26. Means and SD were used to present continuous data, while frequencies and percentages were used to present categorical data. Reliability analysis was performed to validate the self-administered questionnaire in order to assess the awareness and practice of family physicians using Cronbach's alpha. The chi-square test was performed in order to determine significant associations between the variables related to FRAX tool awareness and practice in terms of the sociodemographic characteristics, and a p-value of <0.05 was considered significant.

RESULTS

A total of 152 participants were involved in this study. Most participants were 26-30 years of age (64.50%), followed by 20-25 years (25.70%). Only a few participants were in the 31-35 and 36-40 age ranges. The gender variable revealed that the sample was comparatively evenly split between male and female participants, with (50.70%) being male. More than half of the participants (53.30%) reported being single and attending King Abdulaziz University (52.60%). Nearly half of the participants were at the R_2 level (42.10%), followed by the R_1 level (27.60%) and the R_3 level (20.40%). For the type and locality of their practice, half of the participants (53.30%) reported working in a university or teaching hospital setting (Table 1).

The respondents were asked several questions about their familiarity with and use of FRAX in their practice. Out of the 152 respondents, (73.70%) reported seeing and treating patients with osteoporosis, while (82.20%) reported seeing and treating fewer than ten patients with

osteoporosis per month. Most respondents (88.20%) had heard of FRAX, but only 57.20% reported using it in their practice. Among those who did not use FRAX, the most reported reasons were a lack of a model for their country (57.20%), a busy practice (55.90%), and not knowing how to use it (21.10%) (Table 2). 75% of the respondents believed that FRAX had been incorporated into osteoporosis treatment (Figure 1).

Overall, half (50%) of the male and female respondents, those participants aged 26 to 30 (64.90%), single participants (51.50%), graduates of King Abdulaziz University (56%), and level R_2 residents (42.50%) who practiced primary health care had heard of the FRAX tool. There were no significant gender, age, marital status, residency level, practice type, or practice location differences in FRAX awareness. However, those respondents who had attended King Abdulaziz University and those who practiced in university or teaching institutions tended to be more familiar with FRAX. Marital status had a statistically significant effect on FRAX usage, with a higher proportion of single participants using FRAX. Those participants who had graduated from King Abdulaziz University (50.60%), had residency level R_2 (36.70%) and practiced at a university or teaching facility (50.60%) utilized the FRAX tool in their clinical practice.

Table 1. Socio-demographic and professional characteristics of the participating physicians

Variables	n (%)
Age (years)	
20-25	39 (25.70)
26-30	98 (64.50)
31-35	14 (9.20)
36-40	1 (1.70)
Gender	
Male	77 (50.70)
Female	75 (49.30)
Marital status	
Single	81 (53.30)
Married	69 (45.40)
Divorced	2 (1.30)
University	
Albaha	1 (0.70)
Batterjee Medical College	20 (13.20)
Ibn Sina Medical College	18 (11.80)
King Abdulaziz University	80 (52.60)
King Abdulaziz University for Health Sciences	31 (20.40)
Taif University	1 (0.70)
Uma Alqura University	1 (0.70)
Residency level	
R_1	42 (27.60)
R_2	64 (42.10)
R_3	31 (20.40)
R_4	15 (9.90)
Type and locality of practice	
Community Hospital	11 (7.20)
Primary health care	40 (26.30)
Private practice	20 (13.20)
University or teaching hospital	81 (53.30)

However, the variables of university, residency level, practice type, and practice location lacked statistical significance (Table 3).

DISCUSSION

The incidence of osteoporosis is projected to rise considerably over the next decade, exacerbating an already significant health problem.[20] In Saudi Arabia, the cost of femoral fractures related to osteoporosis is estimated at $1.14 billion annually, and prevention is believed to be one of the most cost-effective strategies.[21] The T-score of -2.5 SD or lower, which has been adopted as the diagnostic and intervention threshold and is widely used today, has high specificity but low

Table 2. Awareness knowledge of the FRAX® tool in OP treatment among family physicians

Question	n (%)
Q1. Do you see and treat patients with osteoporosis?	
Yes	112 (73.70)
No	40 (26.30)
Q2. How many patients with osteoporosis do you currently see and treat per month?	
Less than 10 patients	125 (82.20)
More than 10 patients	27 (17.8)
Q3. Have you heard of the FRAX®?	
Yes	134 (88.20)
No	18 (11.80)
Q4. Have you ever used FRAX® in your practice?	
Yes	87 (57.20)
No	65 (42.80)
Q5. In your opinion, what are the reasons that prevent you from using FRAX®?	
Q5a. Do not know which group of people need FRAX® applications	
Yes	1 (0.70)
No	151 (99.30)
Q5b. The lack of a model for the corresponding country	
Yes	87 (57.20)
No	65 (42.80)
Q5c. Having a practice that was too busy and hence a lack of time to perform a FRAX®	
Yes	85 (55.90)
No	67 (44.10)
Q5d. Do not know how to use it	
Yes	32 (21.10)
No	120 (78.90)
Q5e. Lack of Internet access	
Yes	24 (15.80)
No	128 (84.20)
Q5f. None	
Yes	2 (1.30)
No	150 (98.70)
Q6. As far as you are aware, has FRAX® been incorporated into the osteoporosis treatment?	
Yes	114 (75.00)
No	38 (25.00)

FRAX®: Fracture Risk Assessment Tool.

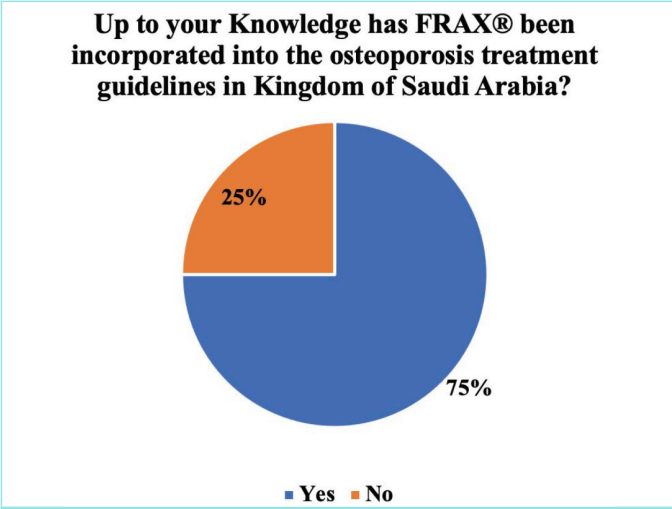

Figure 1. Knowledge of osteoporosis treatment guidelines utilizing FRAX® in Saudi Arabia.

FRAX®: Fracture Risk Assessment Tool.

sensitivity, implying that most fragility fractures occur in individuals whose BMD values are above the abovementioned threshold.[7] Thus, a critical factor for patient management is the ability to assess fracture risks using various screening tools, as they are easy to implement in primary care practices. FRAX was developed in 2008 to evaluate the individualized 10-year probability of a hip or other major osteoporotic fracture (which includes fractures in the clinical spine, distal forearm, or proximal humerus).[22] It has been incorporated into numerous international clinical guidelines as a crucial part of patient screening.[2,23]

FRAX is generally well-received by end-users, doctors, and allied healthcare professionals.[12] Despite the tool's limitations, models for 71 countries are currently accessible, representing 80% of the global population.[17] A country specific FRAX tool has been devised for Saudi Arabia, using an estimate of the incidence of fragility hip fractures in a specific population subset. This model is anticipated to increase the precision of determining the probability of fractures and to assist in treatment decisions.[16]

Our results showed that 88.20% of 152 respondents had heard of FRAX, indicating moderate awareness of this tool among the surveyed group.

Table 3. Factors associated with awareness and practice of the FRAX® tool among family physicians

	Have you ever heard of the FRAX® tool?			Have you ever used the FRAX® tool in your practice?		
	Yes (n, %)	No (n, %)	p	Yes (n, %)	No (n, %)	p
Gender						
Male	67 (50.00)	10 (55.60)	0.658	45 (51.70)	32 (49.20)	0.761
Female	67 (50.00)	8 (44.4)		42 (48.30)	33 (50.80)	
Age						
20-25	34 (25.40)	5 (27.8)	0.839	23 (26.40)	16 (24.60)	0.817
26-30	87 (64.90)	11 (61.10)		55 (63.20)	43 (66.20)	
31-35	12 (9.00)	2 (11.10)		8 (9.20)	6 (9.20)	
36-40	1 (0.70)	0 (0.00)		1 (1.10)	0 (0.00)	
Marital status						
Single	71 (52.99)	12 (66.70)	0.273	39 (44.83)	44 (67.70)	**0.005**
Married	63 (47.01)	6 (33.30)		48 (55.17)	21 (32.30)	
University						
Albaha	1 (0.70)	0 (0.00)	0.204	1 (1.10)	0 (0.00)	0.139
Batterjee Medical College	16 (11.90)	4 (22.20)		9 (10.30)	11 (16.90)	
Ibn Sina Medical College	14 (10.40)	4 (22.20)		8 (9.20)	10 (15.40)	
King Abdulaziz University	75 (56.00)	5 (27.80)		44 (50.60)	36 (55.40)	
King Abdulaziz University for Health Sciences	26 (19.40)	5 (27.80)		23 (26.40)	8 (12.30)	
King Abdulaziz University	1 (0.70)	0 (0.00)		1 (1.10)	0 (0.00)	
King Abdulaziz University	1 (0.70)	0 (0.00)		1 (1.10)	0 (0.00)	
Residency level						
R_1	37 (27.60)	5 (27.80)	0.965	24 (27.60)	18 (27.70)	0.304
R_2	57 (42.50)	7 (38.90)		32 (36.80)	32 (49.20)	
R_3	27 (20.10)	4 (22.20)		20 (23.00)	11 (16.90)	
R_4	13 (9.70)	2 (11.10)		11 (12.60)	4 (6.20)	
Type and locality of practice						
Community hospital	11 (8.20)	0 (0.00)	0.357	8 (9.20)	3 (4.60)	0.188
Primary health care	34 (25.40)	6 (33.30)		20 (23.00)	20 (30.80)	
Private practice	16 (11.90)	4 (22.20)		15 (17.20)	5 (7.70)	
University or teaching hospital	73 (54.50)	8 (44.40)		44 (50.60)	37 (56.90)	

OP: Osteoporosis, FRAX®: Fracture Risk Assessment Tool.

On the other hand, only 57.20% reported using it in their practice. Most respondents who used the FRAX tool were aged 26-30 years (63.20%). These results were consistent with a study on physicians from the United Arab Emirates, Saudi Arabia, Lebanon, and other Middle Eastern countries in which only 42% of professionals used the FRAX tool.[19] Both studies also identified perceived barriers to the use of this tool, such as a lack of knowledge on how to use it or a lack of country-specific calculators.

Our findings indicate no significant difference in awareness of the FRAX tool based on various sociodemographic or occupational characteristics such as gender, age, marital status, residency level, or the type and locality of practice. However, our results showed a trend towards a higher awareness of FRAX among respondents who had attended King Abdulaziz University and those who practiced in university or teaching hospitals, indicating the need for targeted educational interventions for healthcare professionals in other settings. These results draw attention towards the need to improve knowledge and awareness as described in a study conducted in Canada which found that physicians who were more confident in their knowledge of osteoporosis were more likely to use FRAX in their practice.[24]

Most participants reported seeing and treating fewer than ten patients with osteoporosis per month (82.20%), while 73.70% reported seeing and treating patients with osteoporosis in general. Among those who did not use FRAX, the most reported reasons were a lack of a model for their country (57.20%), a busy practice (55.90%), and not knowing how to use it (21.10%). These results suggest that there are perceived barriers to the use of the FRAX tool, which should be addressed in order to improve the tool's usage in the clinical practice. This can be linked to a study which examined the factors which influenced the usage of FRAX in clinical practice and highlighted that the brochure may enhance the knowledge of the FRAX tool as well as medical representative presentations, scientific conferences, and journals.[25]

Study Limitations

This study had some limitations which should be considered when interpreting its results. Firstly, this study used a convenience sampling method, which may have introduced selection bias and limited the generalizability of the findings. Additionally, the small sample size of family physicians may have limited the statistical power of this study and reduced the ability to detect significant associations between the variables. Therefore, further research with a larger sample size, a more diverse population, and multiple specialties treating osteoporosis is needed.

CONCLUSION

In conclusion, the incidence of osteoporosis is projected to rise considerably over the next decade, posing a significant health problem and economic burden. The FRAX tool, which evaluates the individualized 10-year probability of a hip or other major osteoporotic fracture, is widely incorporated into international clinical guidelines and has been adopted in many countries, including Saudi Arabia. Although there is moderate awareness of this tool among healthcare professionals in Saudi Arabia, there are still perceived barriers to its use, such as a lack of knowledge on how to use it and a lack of awareness about country-specific calculators. Targeted educational interventions are needed in order to improve this tool's usage in clinical practice. Further studies are needed to investigate the factors influencing the usage of this tool and to develop strategies to overcome the perceived barriers to its use.

MAIN POINTS

- Numerous countries have adopted the FRAX tool, which calculates the probability of osteoporotic fractures.
- Despite a moderate level of awareness regarding the tool among healthcare professionals in Saudi Arabia, perceived barriers endure.
- There is a need for focused educational interventions to enhance the application of this tool in practice.

ETHICS

Ethics Committee Approval: The Unit of Biomedical Ethics Research Committee of the King Abdulaziz Faculty of Medicine approved this study (approval number: 236-22, date: 21.04.2022).

Informed Consent: It wasn't obtained.

Authorship Contributions

Concept: E.M.S., Design: E.M.S., Data Collection and/or Processing: W.M.A., Analysis and/or Interpretation: E.M.S., W.M.A., Literature Search: W.M.A., Writing: E.M.S., W.M.A.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study had received no financial support.

REFERENCES

1. Harvey N, Dennison E, Cooper C. Osteoporosis: impact on health and economics. Nat Rev Rheumatol. 2010; 6(2): 99-105.
2. Kanis JA, Cooper C, Rizzoli R, Reginster JY; Scientific Advisory Board of the European Society for Clinical and Economic Aspects of Osteoporosis (ESCEO) and the Committees of Scientific Advisors and National Societies of the International Osteoporosis Foundation (IOF). European guidance for the diagnosis and management of osteoporosis in postmenopausal women. Osteoporos Int. 2019; 30(1): 3-44.
3. Sadat-Ali M, AlZamami JF, AlNaimi SN, Al-Noaimi DA, AlDakheel DA, AlSayed HN, et al. Osteoporosis: Is the prevalence increasing in Saudi Arabia. Ann Afr Med. 2022; 21(1): 54-7.
4. Green RJ, Samy G, Miqdady MS, El-Hodhod M, Akinyinka OO, Saleh G, et al. Vitamin D deficiency and insufficiency in Africa and the Middle East, despite year-round sunny days. S Afr Med J. 2015; 105(7): 603-5.
5. Binkley N, Novotny R, Krueger D, Kawahara T, Daida YG, Lensmeyer G, et al. Low vitamin D status despite abundant sun exposure. J Clin Endocrinol Metab. 2007; 92(6): 2130-5.
6. Kanis JA, McCloskey EV, Johansson H, Oden A, Melton LJ 3rd, Khaltaev N. A reference standard for the description of osteoporosis. Bone. 2008; 42(3): 467-75.
7. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis. Report of a WHO Study Group. World Health Organ Tech Rep Ser. 1994; 843: 1-129.
8. FRAX ®Fracture Risk Assessment Tool. Available from: https://frax.shef.ac.uk/FRAX/tool.aspx
9. Kanis JA, Johnell O, Oden A, Johansson H, McCloskey E. FRAX and the assessment of fracture probability in men and women from the UK. Osteoporos Int. 2008; 19(4): 385-97.

10. Johansson H, Azizieh F, Al Ali N, Alessa T, Harvey NC, McCloskey E, et al. FRAX-vs. T-score-based intervention thresholds for osteoporosis. Osteoporos Int. 2017; 28(11): 3099-105.

11. Brennan SL, Leslie WD, Lix LM, Johansson H, Oden A, McCloskey E, et al. FRAX provides robust fracture prediction regardless of socioeconomic status. Osteoporos Int. 2014; 25(1): 61-9.

12. El Miedany Y. FRAX: re-adjust or re-think. Arch Osteoporos. 2020; 15(1): 150.

13. Kanis JA, Harvey NC, Cooper C, Johansson H, Odén A, McCloskey EV, et al. A systematic review of intervention thresholds based on FRAX: A report prepared for the National Osteoporosis Guideline Group and the International Osteoporosis Foundation. Arch Osteoporos. 2016; 11(1): 25.

14. Leslie WD. FRAX: a coming of age. Osteoporos Int. 2019; 30(1): 1-2.

15. Cauley JA, Chalhoub D, Kassem AM, Fuleihan Gel-H. Geographic and ethnic disparities in osteoporotic fractures. Nat Rev Endocrinol. 2014; 10(6): 338-51.

16. Al-Daghri NM, Sabico S, Al-Saleh Y, Sulimani R, Aljohani NJ, Sheshah E, et al. The application of FRAX in Saudi Arabia. Arch Osteoporos. 2021; 16(1): 166.

17. Kanis JA, Johansson H, Oden A, Cooper C, McCloskey EV; Epidemiology and Quality of Life Working Group of IOF. Worldwide uptake of FRAX. Arch Osteoporos. 2014; 9: 166.

18. Saleh YAL, Sulimani RA, Alomary S, Alnajjar YI, Vandenput L, Liu E, et al. Incidence of hip fracture in Saudi Arabia and the development of a FRAX model. Arch Osteoporos. 2022; 17(1): 56.

19. Beshyah SA, Al-Saleh Y, El-Hajj Fuleihan G. Management of osteoporosis in the Middle East and North Africa: a survey of physicians' perceptions and practices. Arch Osteoporos. 2019; 14(1): 60.

20. El-Hajj Fuleihan G, Adib G, Itani N, Nauroy L, Arabi A, Baddoura R. The Middle East & Africa Regional Audit. Osteoporosis International. 2011; 22: S677-S8.

21. Bubshait D, Sadat-Ali M. Economic implications of osteoporosis-related femoral fractures in Saudi Arabian society. Calcif Tissue Int. 2007; 81(6): 455-8.

22. McCloskey EV, Harvey NC, Johansson H, Lorentzon M, Liu E, Vandenput L, et al. Fracture risk assessment by the FRAX model. Climacteric. 2022; 25(1): 22-8.

23. Camacho PM, Petak SM, Binkley N, Diab DL, Eldeiry LS, Farooki A, et al. American Association of Clinical Endocrinologists/American College of Endocrinology Clinical Practice Guidelines for the Diagnosis and Treatment of Postmenopausal Osteoporosis-2020 Update. Endocr Pract. 2020; 26(Suppl 1): 1-46.

24. Leslie WD, Lix LM, Langsetmo L, Berger C, Goltzman D, Hanley DA, et al. Construction of a FRAX® model for the assessment of fracture probability in Canada and implications for treatment. Osteoporos Int. 2011; 22(3): 817-27.

25. Bruyere O, Nicolet D, Compère S, Rabenda V, Jeholet P, Zegels B, et al. Perception, knowledge, and use by general practitioners of Belgium of a new WHO tool (FRAX) to assess the 10-year probability of fracture. Annals of the Rheumatic Diseases. 2013; 71(Suppl 3): 716.