

A National Survey of Self-Prescription of Beta-Blockers and Their Relation to Undiscovered Anxiety Among Medical and Pharmacological Students in Saudi Arabia

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Background: The development of beta-blocker (BB) medications is considered one of the most critical milestones of drug research. Several trials showed possible anti-anxiety effects of BBs. Our primary goal is to investigate the prevalence of anxiety disorder and the use of BBs as anxiolytic without medical prescription among medical and pharmacological students in Saudi Arabia.

Methods: A cross-sectional study was conducted at multiple universities in Saudi Arabia. Students were given a questionnaire containing 44 questions that included demographic data, school location, BB usage behavior, GPA status before and after using BBs, and a GAD-7 anxiety screening questionnaire.

Results: A total of 3326 mainly female senior students participated in the study with a mean age of 21.9±1.7 years. According to the GAD-7 score, half of the sampled students did not meet criteria indicative of anxiety disorder, and one-third were considered to have mild anxiety with a significant positive correlation between the BB usage and the GAD-7 score. A total of 6.4% of the sample reported usage of BBs. Therapeutics and Internal Medicine were the most common subjects for which BBs were used. When compared to pharmacy students, medical students were more likely to be male, smokers, diagnosed with psychiatric illness, having a higher mean GAD-7 score, report BB usage, and correctly identified common and serious BB side effects.

Conclusion: The inappropriate use of BB drugs without medical advice might have short- and long-term effects, and those may be more vulnerable to have psychological issues in the future. Our findings shed light on the need to identify students who are taking BBs as being at high risk of underlying anxiety disorders.

Keywords: beta-blocker, anxiety, student anxiety, self-prescription, undiagnosed anxiety

Introduction

Beta-blocker (BB) drugs are considered one of the most critical milestones of drugs of all time. Not long after the time when BBs were discovered in the early 1960s,¹ these medications became a focus of importance in psychiatry. Therefore, several trials for the possible anti-anxiety effects had followed this discovery. Several trials studied its effective role in the treatment of anxiety, addiction and withdrawal symptoms, schizophrenia, stage fright, and performance anxiety.²

BBs are also used to control cardiovascular disorders that involve angina, tremors, hypertension, and arrhythmias.^{3,4} They achieve slowing of the heart rate

in both patients and healthy people through a combination of decreasing sympathetic outflow and blocking beta-adrenergic receptors.⁵ Despite the medical indications, many recent studies illustrated the increasing use of BBs over time.⁶

Physicians showed great concerns about BB side effects especially non-selective BBs which are associated with more adverse effects, are more commonly used for anxiety (ie, propranolol). Such as BB-induced weight gain and adverse metabolic effects. Moreover, BBs are associated with a slightly increased risk of type II diabetes mellitus. Non-selective BBs may also exacerbate asthmatic attacks due to their blockage of the B2-adrenergic receptors and may need to be avoided in respiratory patients.⁷

Generalized anxiety disorder (GAD) is characterized by six persistent disabling anxiety symptoms for at least six months. Anxiety disorders are one of the common mental illnesses in the community. Their strong adverse effect on patients' life quality is a major reported concern. Despite the availability of their effective treatment, these disorders may still be underdiagnosed and undertreated.⁸

Test anxiety is unpleasant feeling of tension with autonomic system activation that occurs when being assessed for performance or clinical examination.⁹ Students are more prone to experiencing stress due to the nature of their daily work, which may adversely affect their mental health and academic performance. In particular, medical and pharmacological students are more likely to worry about many life and academic issues. Consequently, they are prone to practice different stress-relieving methods. The most common method is the use of medications, such as BBs, to overcome performance anxiety.¹⁰

Short-term memory-related tasks such as exam preparation and public speaking are more sensitive to the negative effects of stress; therefore, tension and stress can reduce performance quality. Propranolol indeed helps in reducing stress, which improves intellectual tasks and the overall exam performance.^{11–13}

A national, non-random online poll for the nonmedical uses of prescription drugs by the journal *Nature* reported that 20% of participants used prescription drugs to improve their concentration for a particular task. Of those polled, 15% had taken BBs such as propranolol.¹⁴ Controlled double-blinded trials showed that propranolol has positive outcomes in treating anxiety.^{15,16}

Self-medication involves using nonprescription medicines, often over-the-counter (OTC) drugs. These are

typically used for minor self-diagnosed conditions without a physician's supervision.¹⁷

Self-medication includes purchasing drugs without a prescription, sharing medications with others, or taking drugs available at home for a prolonged period. This is due to the easy accessibility of drugs in Saudi Arabia, with no need for having medical prescriptions. People can acquire prescribed medicines, such as anti-acne treatments and antibiotics, over-the-counter.¹⁸

The self-prescription of BBs is increasing among the students due to easy availability in pharmacies and the students' specific medical knowledge.^{19,20} Due to its previously mentioned adverse effects, further analysis, and a better understanding of this matter are essential. Safety protocols and measures need to be applied to prevent students' self-prescription behavior.

To the best of our knowledge, this is the first large national study in Saudi Arabia to investigate the use of BBs among medical and pharmacy students as an over-the-counter (OTC) medication. Our primary goal is to investigate the prevalence of anxiety disorder and the use of BBs as an anxiolytic without medical prescription among medical and pharmacological students in Saudi Arabia. Furthermore, we will evaluate the effect of BBs on exam performance and the awareness of BB side effects.

Methods

A cross-sectional study was conducted among medical and pharmacological students in Saudi Arabia. We included all healthy medical and pharmacological students in Saudi Arabia regardless of age, gender, nationality and level. We excluded students with an active psychiatric or chronic illness such as hypertension who were diagnosed before and actively following with their physician. The questionnaire was developed after several reviews by the research team. The questionnaire was composed of 44 questions divided into five parts. The first part included demographic data, school location, educational level of participants, smoking and shisha status (Smoking pipe), and frequency of energy drink consumption. The second part of the questionnaire was applied to identify participants who have chronic diseases, known psychiatric illnesses, or hand tremors. The third part included tasks to identify participants who used BBs before exams and seminars, the reasons for using BBs, GPA status assessed before and after using BBs have been used, knowledge of the side effects of BBs, and real-life experiences of such effect were assessed as well. The fourth part assessed whether another person had recommended the BBs to students and self-

prescription as well; the thought of harmfulness of misuse of BBs was evaluated; also, other self-prescribed medications were evaluated other than BBs. The fifth part was a GAD-7 questionnaire, which is an anxiety screening tool, containing seven items to evaluate the anxiety symptoms in the past two weeks. The GAD-7 score ranges from 0 to 21. The anxiety severity was indicated by the measured score, which is gathered through the answered GAD-7 questionnaire. Those students who did not have anxiety scored less than five in GAD-7, while those scoring 5–9, 10–14, and ≥ 15 were considered to have mild, moderate, and severe anxiety, respectively.

A student from different universities has been contacted and agreed to help in data collection. A group was created, and then the questionnaire was explained to each one of the data collectors. A hard-copy questionnaire was distributed among medical and pharmacological students from different universities in Saudi Arabia. All students agreed to participate before filling the questionnaire. One of the research teams who distributes the questionnaire was available for any inquiry. All data collectors from different regions in Saudi Arabia sent the data files to the main investigator.

The data extracted to excel sheet then export to the Statistical Package for Social Sciences (SPSS) for analysis. We defined statistical significance as $p < 0.05$. *t*-tests were used for continuous variables and chi-squared tests were performed for categorical variables, and unpaired.

Result

A total of 3326 students participated in the study with a mean age of 21.9 ± 1.7 years (Table 1). The sample consisted of mainly female medical students, senior students attending government universities in the western Saudi region. Approximately one-fifth of the sample reports smoking cigarettes, Shisha or Argela. Most of them reported no or rare consumption of energy drinks. Although approximately 16% of the samples reported chronic medical or existed psychiatric disorders, interestingly, 20.6% report hands tremor. Three-fourths of the participants report being diagnosed with psychiatric disorders before college enrollment, with depression, social phobia, and anxiety being the most common disorders reported. According to the GAD-7 score, half of the sample was normal, and one-third was considered to have mild anxiety.

Of those sampled, 6.4% reported usage of BBs, mostly before the clinical exams, seminar presentations, and the theory exam (Table 2). Internists and psychiatrists were the most common providers to prescribe BBs, while

students' course material and advice from college students of the same level were the most common source for the non-prescribed BBs usage. The most common reason for BBs usage was feeling anxious on the exam day and the subjective feeling that the student will do better with BBs usage. Therapeutics and Internal Medicine were the most common subjects for which BBs were used. A quarter of the BBs users experienced related side effects, with only a few of the participating students correctly identified the common or serious side effects of BBs. Most of the students report no change in their GPA with the usage of BBs. More than half of the students believe that non-prescribed BBs are harmful. Self-prescription was common among the BBs users, with analgesics and antibiotics being the most common self-prescribed medications.

When compared to pharmacy students, medical students were more likely to be male ($P < 0.001$), to be private university students ($P < 0.001$), to be smokers (0.078), to be diagnosed with psychiatric illness ($P 0.012$), to have depression ($P 0.043$), to have a higher mean GAD-7 score ($P 0.266$), to have reported BBs usage ($P 0.285$), as using BBs because of being anxious or not feeling well prepared for the exam ($P 0.034$), as mostly avoiding self-prescribed medications ($P < 0.001$), and as correctly identifying common and serious side effects of BBs ($P 0.297$ and $P 0.071$, respectively) (Table 3).

Female respondents were more likely to use BBs when compared to males (Figure 1). Moreover, there was a significant positive relationship between the usage of BBs and the GAD-7 score (Figure 2). Partial correlation adjusting for school location, bachelor's degree specialty, age, gender, smoking, chronic illness, existed psychiatric illness, and tremor showed a non-significant negative correlation between BBs usage and GAD-7 score ($r - 0.181$, $P 0.193$).

Discussion

Test anxiety is unpleasant feeling of tension with autonomic system activation that occurs when being assessed for performance or clinical examination.⁹ Medical education around the globe is considered one of the most demanding training programs; subsequently, much commitment, time, and emotion are necessary.²¹ Such pressure may have a negative impact on student psychology and can trigger anxiety and depression.^{22,23} Anxiety is common among the general population, but it is often undetected and untreated.^{24,25} Anxious people can experience various kinds of symptoms, including fear, palpitations, abdominal pain, shortness of breath, and urinary incontinence.²⁶ The prevalence of a large range of

Table 1 Baseline Characteristics for the Whole Cohort

Baseline Characteristics (N = 3326)	
Mean age (years)	21.9±1.7
Male (%)	33.0
Medical students (%)	79.6
Pharmacy students (%)	20.4
Government university (%)	94.1
Junior student (%)	41.5
Senior student (%)	56.4
Intern (%)	1.1
Graduated (%)	1.0
Location of the college	
Western region of Saudi (%)	25.8
Eastern region of Saudi (%)	16.4
Northern region of Saudi (%)	11.9
Southern region of Saudi (%)	23.6
Central region of Saudi (%)	22.4
Lifestyle habits	
Cigarette smokers %	8.6
Shisha/Argela smokers %	9.9
No energy drinking consumption %	57.9
Daily energy drinking consumption %	4.6
Weekly energy drinking consumption %	9.7
Rarely energy drinking consumption %	27.8
Comorbid conditions	
Chronic medical diseases (%)	8.8
Existed psychiatric disorders %	7.4
Hands tremor (%)	20.6
Chronic medical disease diagnosis	
Asthma and allergy (%)	2.7
Existed Psychiatric diagnosis	
Anxiety (%)	1.8
Schizophrenia (%)	0.3
Depression (%)	2.2
Obsessive compulsive disorders (%)	0.7

(Continued)

Table 1 (Continued).

Baseline Characteristics (N = 3326)	
Existed other psychiatric disorders	
Panic disorders (%)	1.5
Social phobia (%)	2.0
Post-traumatic stress disorder (%)	0.1
Diagnosis was made before college enrolment (%)	74.1
Screening with Generalized Anxiety Disorders 7-items (GAD-7)	
Mean GAD-7 score (SD)	5.3±5.1
Normal (%)	51.2
Mild anxiety (%)	29.8
Moderate anxiety (%)	12.2
Sever anxiety (%)	6.8

anxieties among medical students outside North America had been reported in between 7.7% and 65.5% of individuals.²⁷ We reported 15% of BB users are self-prescribers, which is within the literature-reported range; the main reason was they were studied well, but 53% feel anxious in exams, and 31% of users were feeling more confident in exams. Anxiety among medical and pharmacological students warrants special attention as it can affect academic performance and dropout rates.²⁸ Medical students are predisposed to different types of stress, such as studying overload, lack of sleep, financial burdens, student abuse, and exposure to deaths of patients; all these factors are possible causes for the high rate of anxiety.^{29–32} Our study demonstrated mild anxiety in 30% of medical and pharmacological students which is consistent with the literature. BBs are used to control cardiovascular disorders that involve angina, tremors, hypertension, and arrhythmias.^{3,4} Exam- and stress-related anxiety symptoms can also be relieved by BBs.³³ Students gained a wide knowledge about drugs in medical school and self-prescribed as a common practice.^{34–36} The sources of information regarding the uses of BBs before exams in the present study were 37% and 32% from material studying and friends, respectively.

Propranolol is one of the common self-prescribed drugs among medical, pharmacological, and dental students.^{33,37–39} A single-institution national study among students in 2015 reported that exam performance was improved with users of BBs.³⁷ In the present study, we found the majority of BB users

Table 2 Prevalence and Characteristics of Beta-Blockers Usage

Baseline Characteristics	
Overall Beta blocker usage (%)	6.4
Beta blocker usage before all the exams (%)	1.0
Beta blocker usage before most of the exams (%)	1.4
Beta blocker usage before some of the exams (%)	4.0
Beta blocker usage before theory exam (%)	3.5
Beta blocker usage before clinical exam (%)	4.7
Beta blocker usage before seminar presentation (%)	4.3
Beta blockers prescribed by a health care providers (%)	29.9
Self-prescribed medications other than Beta blockers (%)	15.1
Reason of Beta blockers usage	
I did not study well for the exam (%)	15.0
I studied well, but feels anxious on the exam day (%)	53.5
I feel more confident/will do better on the exam if I take it (%)	31.5
Exam fields where Beta blockers was used for	
Internal medicine (%)	22.6
General surgery (%)	12.3
Obstetrics/Gynecology (%)	14.2
Pediatrics (%)	0.1
Biology (%)	0.1
Biochemistry (%)	7.5
Pharmacology (%)	2.3
Therapeutic (%)	37.7
Others (%)	3.2
Final scores for the topics after Beta blockers usage	
GPA improved after Beta-blockers use (%)	32.3
GPA unchanged after Beta-blockers use (%)	60.0
GPA worsen after Beta-blockers use (%)	7.0
A+ or A (%)	18.1
B+ or B (%)	51.6
C+ or C (%)	22.6
D+ or D (%)	7.7
Did you ever failed an exam after using beta-blocker pills? (%)	17.5
Beta blockers harms	

(Continued)

Table 2 (Continued).

Baseline Characteristics	
Experienced side effects related to Beta blockers usage (%)	24.0
Do you think non-prescribed Beta blockers usage is harmful? (%)	63.9
Study participants whom were able to identify correctly two common side effects (%)	2.7
Study participants whom were able to identify correctly two serious side effects (%)	5.2
Specialty of the health care providers for those who prescribed Beta blockers	
General practitioner (%)	23.3
Family physician (%)	23.3
Internal medicine doctor (%)	26.7
Psychiatric doctor (%)	25.6
Beta blockers users' source of advice/information	
Study materials in college (%)	37.4
Same level college student (%)	32.5
Senior college colleagues (%)	25.2
Junior college colleagues (%)	4.9
Did you review any evidence for Beta blockers usage before the exam?	23.9
Types of the medication that is self-prescribed other than Beta blockers	
Antibiotic (%)	13.8
Antihistamine (%)	10.7
Analgesic (%)	29.8
Others (%)	26

have the same GPA despite using BBs for exam performance, and approximately 32% had grade improvement. Abukhalaf et al conducted a survey among 885 students in a single institution and found 17% used BBs without medical prescription, and the usage was five times more among medical students than dental students. However, the side effects of using BBs, such as hypotension, shortness of breath, and fainting, were experienced by 1.7% of users.³⁷ We found that 24% of participants had experienced BB side effects. However, only 2% and 5% knew the common and serious side effects, respectively. Most participants in the present study (63%) agreed with the harmfulness of non-prescribed BBs.

Table 3 Group Characteristics Based on the College of the Participants

Baseline Characteristics	Medicine	Pharmacy	P value
Number of participants (%)	79.6	20.4	n/a
Mean age (years)	21.8±1.7	21.9±1.6	0.172
Male (%)	34.8	25.1	<0.001
Government university (%)	93.4	97.1	<0.001
Junior student (%)	42.0	38.8	<0.001
Senior student (%)	57.2	54.2	
Intern (%)	0.4	3.8	
Graduated (%)	0.4	3.2	
Lifestyle habits			
Cigarette smokers %	9.0	6.9	0.078
Shisha/Argila smokers %	10.0	9.6	0.763
No energy drinking consumption %	58.9	54.5	0.400
Daily energy drinking consumption %	4.4	5.2	
Weekly energy drinking consumption %	8.2	15.1	
Rarely energy drinking consumption %	28.5	25.2	
Comorbid conditions			
Chronic medical diseases (%)	9.3	6.9	0.046
Existed psychiatric disorders %	7.9	5.1	0.012
Hands tremor (%)	20.4	21.6	0.484
Existed Psychiatric diagnosis			
Anxiety (%)	2.0	1.2	0.184
Schizophrenia (%)	0.3	0.3	0.893
Depression (%)	2.5	1.2	0.043
Obsessive compulsive disorders (%)	0.8	0.5	0.379
Existed other psychiatric disorders			
Panic disorders (%)	1.6	0.1	0.283
Social phobia (%)	2.1	1.5	0.283
Post-traumatic stress disorder (%)	0.1	0.1	0.737
Screening with Generalized Anxiety Disorders 7-items (GAD-7)			
Mean GAD-7 score (SD)	5.4±5.1	5.1±5.4	0.266
Normal (%)	50.9	53.3	0.968
Mild anxiety (%)	30.2	28.2	
Moderate anxiety (%)	12.2	11.8	
Sever anxiety (%)	6.7	6.7	
Beta blockers related data			

(Continued)

Table 3 (Continued).

Baseline Characteristics	Medicine	Pharmacy	P value
Overall Beta blocker usage (%)	6.5	6.2	0.285
Beta blocker usage before all the exams (%)	0.1	1.6	0.285
Beta blocker usage before most of the exams (%)	1.2	2.2	
Beta blocker usage before some of the exams (%)	4.4	2.4	
Beta blocker usage before theory exam (%)	3.2	4.7	0.061
Beta blocker usage before clinical exam (%)	5.2	2.7	0.007
Beta blocker usage before seminar presentation (%)	4.1	5.1	0.276
Beta blockers prescribed by health care providers (%)	29.7	30.6	0.262
Self-prescribed medications other than Beta blockers (%)	13.4	21.3	<0.001
Feels better during the exam that students took Beta blockers for (%)	57.9	53.3	0.858
Reason of Beta blockers usage			
I did not study well for the exam (%)	16.7	7.1	0.034
I studied well, but feels anxious on the exam day (%)	56.5	42.9	
I feel more confident/will do better on the exam if I take it (%)	26.8	50.0	
Final scores for the topics after Beta blockers usage			
GPA improved after Beta-blockers use (%)	30.2	40.5	0.625
GPA worsen after Beta-blockers use (%)	6.9	7.1	
A+ or A (%)	14.8	28.6	0.268
B+ or B (%)	53.4	45.2	
C+ or C (%)	24.4	16.7	
D+ or D (%)	7.4	9.5	
Did you ever failed an exam after using beta-blocker pills? (%)	16.7	21.7	0.724
Beta blockers harms			
Experienced side effects related to Beta blockers usage (%)	24.6	21.7	0.915
Do you think non-prescribed Beta blockers usage is harmful? (%)	63.6	65.0	0.040
Study participants whom were able to identify correctly two common side effects (%)	2.9	2.4	0.297
Study participants whom were able to identify correctly two serious side effects (%)	5.5	4.0	0.071
Beta blockers users' source of advice/information			
Study materials in college (%)	34.2	48.6	0.233
Same level college student (%)	34.7	23.1	
Senior college colleagues (%)	25.0	28.3	
Junior college colleagues (%)	6.1	0.0	
Did you review any evidence for Beta blockers usage before the exam?	20.2	38.0	<0.001
Types of the medication that is self-prescribed other than Beta blockers			

(Continued)

Table 3 (Continued).

Baseline Characteristics	Medicine	Pharmacy	P value
Antibiotic (%)	12.6	16.2	0.062
Antihistamine (%)	12.6	7.1	
Analgesic (%)	27.9	33.3	
Others (%)	24.2	29.3	

Interestingly, Butt et al published a study in 2016 where they found that students who take BBs before exams are at significantly more risk of taking an antidepressant in the future and have a higher rate of suicide attempts than non-BB users.³⁵ Therefore, wide awareness is needed of the fact that BB users before exams might be more vulnerable to psychological issues and need special attention.

Present study has several strengths including large sample size and been the first onsite study done at multiple universities in different regions of Saudi Arabia.

Despite these strengths, this study has several limitations. Present study is a questionnaire-based study, a student who has chronic illnesses or psychiatric disorder was self-reported and not from a national database or contacting treating physician.

Although the GAD-7 is a validated screening questionnaire, the healthy student who has high score was not evaluated by psychiatric physician.

Conclusion

The inappropriate use of BB drugs without medical advice might have short- and long-term effects, and those users may be more vulnerable to having psychological issues in the future. Our findings shed light on the need to take measures to identify students who are taking BB drugs as being at a high risk of underlying anxiety disorders. We suggest implementing a national student support program to help the students with stress and anxiety in different ways rather than using BBs unless indicated.

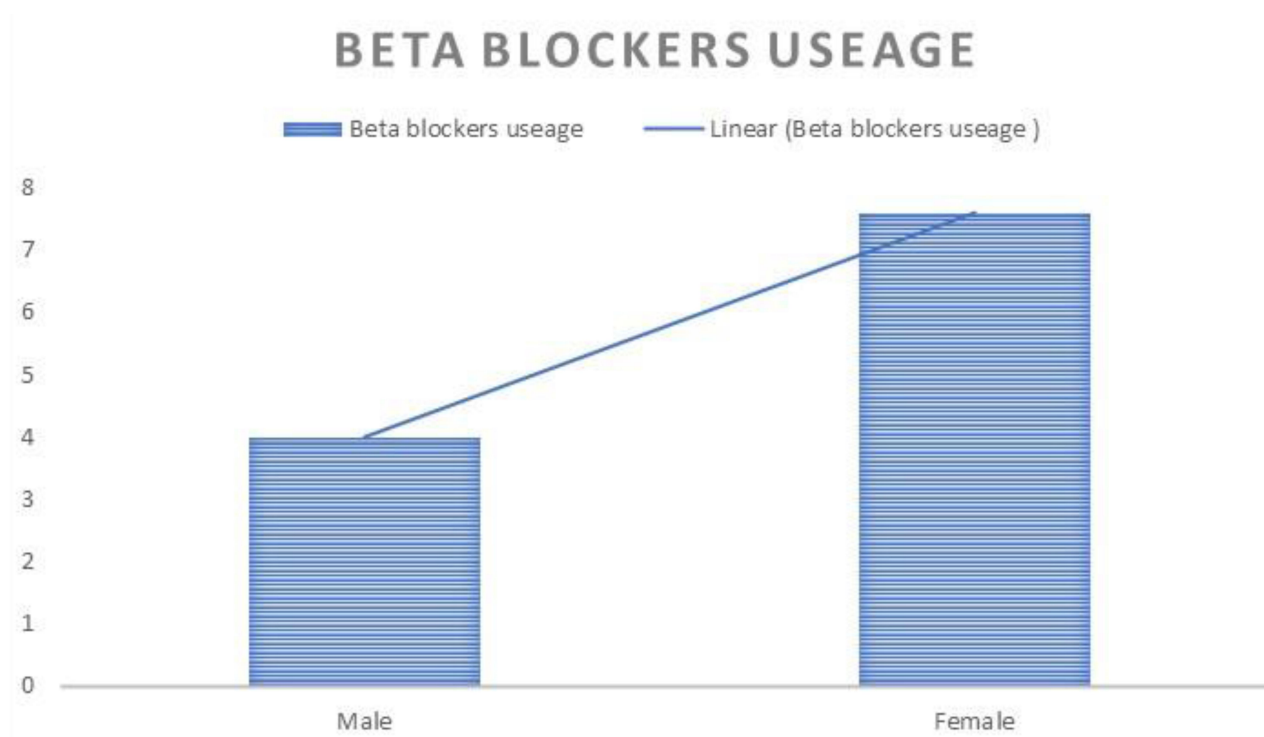


Figure 1 Beta blockers usage based on gender (%). *P* value < 0.001.

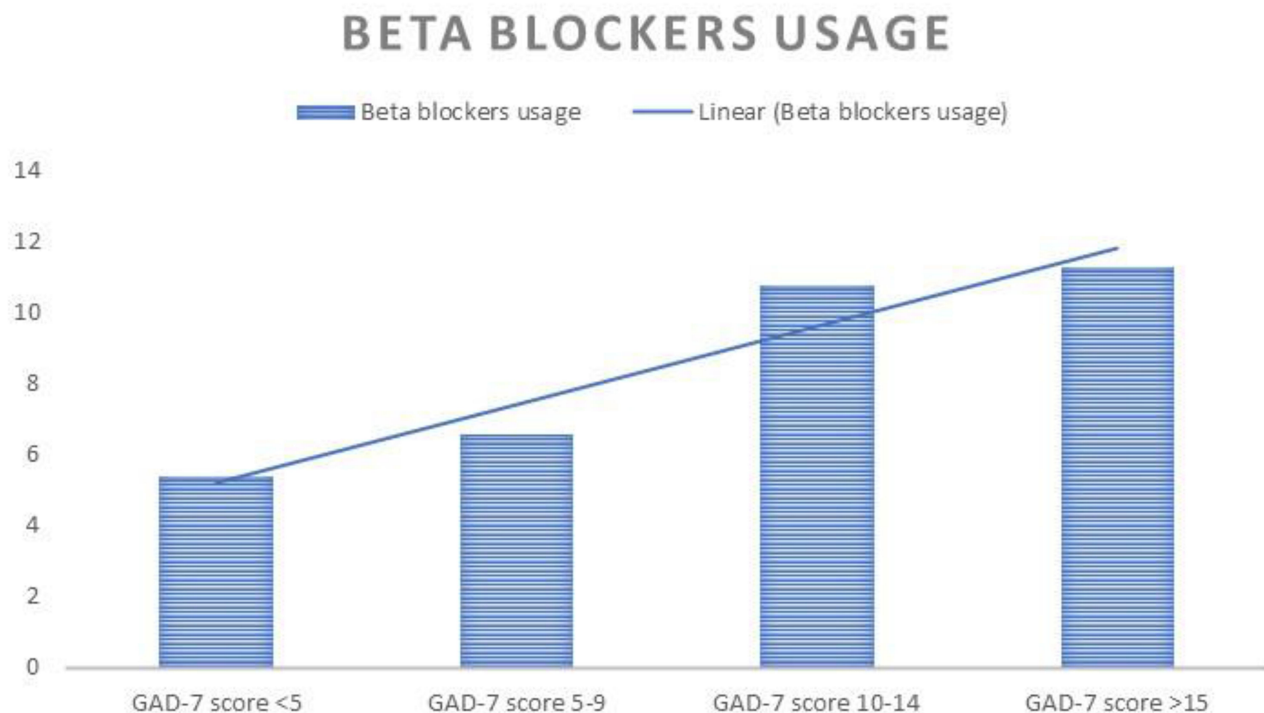


Figure 2 Beta blockers usage based on GAD-7 screening. *P* value 0.009.

Ethical Approval and Consent

The study was conducted in accordance with the Declaration of Helsinki. All students agreed to participate before filling the questionnaire. The research project was approved by the research ethical committee at Taif university (Approval number 42-0047).

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