



Prevalence and patterns of sleep-related melatonin usage among adults in Saudi Arabia: A self-reported cross-sectional national study

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ABSTRACT

Purpose: Despite the surge of melatonin supplement consumption in recent years, data on the prevalence and patterns of melatonin usage in Saudi Arabia is lacking. The aim of this study was to assess the prevalence and pattern of sleep-related melatonin usage among adults in Saudi Arabia.

Methods: This was a cross-sectional, web-based, self-administered survey study conducted across all regions of Saudi Arabia. Participants were recruited from the general population (≥ 18 years). The survey was distributed between February and April 2023. Chi-squared tests and t-tests were performed for comparative bivariate analyses where binary logistic regression was performed to derive the main predictors of melatonin consumption. **Results:** Out of 5,606 participants, 536 (10 %) were consumers of melatonin. Older age (Adjusted OR = 1.01, 95 % CI = 1.01–1.02, $p = 0.002$), being a male (Adjusted OR = 1.76, 95 % CI = 1.46–2.14, $p = 0.001$), individuals with a doctorate degree or an equivalent (adjusted OR 2.37 95 % CI = 1.35–4.17, $p = 0.003$), perceived poor sleep quality (Adjusted OR = 1.52, 95 % CI = 1.10–2.11, $p = 0.01$), and being diagnosed with a sleep disorder (Adjusted OR = 2.55, 95 % CI = 2.04–3.18, $p = 0.001$) were all associated with increased likelihood of sleep-related melatonin usage. 35 % of consumers self-reported taking ≥ 1 tablet per day, while 26 % of them were uncertain about the dosage they consume.

Conclusion: With a notable prevalence of 10% among the general population in Saudi Arabia, melatonin usage was more common in older adults, males, and those with higher education.

1. Introduction

Melatonin is a hormone endogenously produced by the pineal gland (Claustrat et al., 2005), which promotes sleep onset (Ferracioli-Oda et al., 2013). Exogenous melatonin has been traditionally used for a variety of diseases, notably for sleep-related disturbances such as jet lag, delayed sleep-wake phase disorder (DSWPD), insomnia and shift work disorders (Auger et al., 2015; Carriedo-Diez et al., 2022; Costello et al., 2014).

Currently, data on the global prevalence of sleep-related melatonin usage is scarce, although consumption seems to be increasing (Bliddal et al., 2023; Li et al., 2022). A recent study from the United States (US) reported a substantial rise in the consumption of melatonin among adults, which increased from 0.4 % in 1999–2000 to 2.1 % in 2017–2018 (Li et al., 2022). Another study from Denmark found that the prevalence of melatonin consumption among young adults increased from 5 to 16 per 1000 participants in females and from 5 to 12 per 1000 participants in males between 2012 and 2019 (Bliddal et al., 2023). In

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Saudi Arabia, [Alateeq et al. \(2022\)](#) reported that 20 % of 443 healthy adult participants used melatonin supplements as a treatment for mental health issues. Moreover, a recent survey of emergency practitioners showed that melatonin was tried by 15.7 % of residents and 5.1 % of attending physicians, and was consistently used before a night shift by 3.9 % of residents and 5.1 % of attending physicians ([Alaska et al., 2022](#)).

The consumption of sleep aids in Saudi Arabia has been exponentially rising, with the total value of sales increasing from 15 million USD in 2018 to 35 million USD in 2023 ([Euromonitor \[Internet\], 2023](#)). Melatonin had the highest share among the other types of sleep aids, accounting for over 44 % of the national sales ([Euromonitor \[Internet\], 2023](#)). However, to date, there is no data on the prevalence and the patterns of sleep-related melatonin usage among the general population in Saudi Arabia from a consumer perspective. Investigating melatonin use in Saudi Arabia can contribute to a global understanding of sleep aid consumption patterns and potential regional variations. This data can be valuable for informing international public health efforts aimed at promoting healthy sleep practices. Therefore, the aim of this study was to assess the prevalence and patterns of sleep-related melatonin usage among adults in Saudi Arabia.

2. Methods

2.1. Study design and participants

A national, cross-sectional, web-based, self-administered survey was conducted across all 13 administrative regions of Saudi Arabia. Participants were recruited from the general population, targeting adults (≥ 18 years) currently living in Saudi Arabia. The survey was distributed between February and April 2023. To accommodate the non-Arabic speaking individuals, participants had the choice to complete the survey in either English or Arabic language.

This study was conducted in accordance with Good Clinical Practice (GCP) with all applicable regulatory requirements. Ethical approval was obtained from the Institutional Review Board at Imam Abdulrahman bin Faisal University (IRB-2023-03-025) prior to commencing the survey. Participation was voluntary, and potential participants were provided with written informed consent via QuestionPro web-based platform. There were no incentives for participating in the survey. The personal information was stored in QuestionPro platform, accessible exclusively by the research team through their password-protected accounts.

2.2. Survey development

Due to the lack of validated questionnaires that address the aims of this study, a survey was developed by a consensus of experts, including three sleep experts, six medical students, and six healthy participants. It was developed after a thorough assessment of the available literature. This survey was developed following a thorough review of the available literature. It was created using the QuestionPro platform and administered as an open survey via social media.

The survey comprised 43 items and was organized systematically by sections, without randomizing the order of questions as follows:

1. sociodemographic characteristics,
2. employment status,
3. medical history,
4. sleeping patterns over the past month,
5. sleep-related melatonin supplement usage over the past month,
6. and other factors that may impact participants' sleep quality over the past month.

It included adaptive questions to help participants complete the questionnaire based on their responses. A completeness check was implemented, requiring participants to fill out all mandatory items

before submission. Additionally, participants could review and edit their answers at any time during the survey using a back button. The QuestionPro platform identifies unique participants using cookies on the submit button, preventing duplicate entries by restricting participants from accessing the survey after completing it for the first time.

2.3. Survey pretesting

Prior commencing the data collection, pilot testing of the survey was conducted on 46 adults, representing the targeted population. Their input and feedback were used to assess whether the survey questions were clear, comprehensible, and relevant to the aim of the study. Therefore, the results of the pilot testing informed the subsequent processes of survey development until a final version was agreed upon by the research team. This pilot testing also provided data on the feasibility of the preliminary plan for survey administration and data collection. The final version of the survey demonstrated good internal consistency for the overall scale ($\alpha = 0.81$).

2.4. Survey administration

Prior to distributing the survey to potential participants, the minimum number of participants in each region was determined based on the 2017 population estimates from the Saudi General Authority for Statistics ([General Authority for Statistics \[Internet\], 2017](#)). Potential participants were recruited through a convenience sampling technique, targeting all 13 administrative regions of Saudi Arabia. Data collection facilitators were recruited from all administrative regions and, hence, these facilitators were required to recruit participants from their respective administrative region. The facilitators were assigned unique identifying numbers and were instructed to distribute the survey via commonly used social media platforms such as WhatsApp, X (formerly known as Twitter), and Telegram until a minimum of 100 participants per facilitator were recruited; with some administrative regions requiring more than one data collection facilitator.

Ongoing monitoring and evaluation of the recruitment process informed subsequent alterations to the data collection plan, specifically where targeted interventions were needed for certain administrative regions to reach their respective recruitment target.

2.5. Data analysis

The anonymous survey data was imported onto the statistical software, Stata (Version 15, StataCorp LLC, USA) for data analysis. Frequencies and percentages were used to describe categorical variables and mean \pm standard deviation for continuous variables. Chi-squared tests and t-tests were performed for comparative bivariate analyses and to derive p-values. Binary logistic regression analyses, both unadjusted and adjusted, were performed to derive odds ratios and their accompanying 95 % confidence intervals. The level of significance was set to 0.05. Model diagnostics were checked to arrive at the best model fit. This study adheres to the Checklist for Reporting Results of Internet E-Surveys guidelines.

3. Results

Among the initial pool of 7,717 potential participants, a total of 5,606 individuals, constituting 72.6 % of the sample, completed the survey and their data were subsequently incorporated into the final analysis. 1,762 survey responses were omitted from the analysis due to incomplete survey submissions, 169 did not agree with the consent statement in the survey, and 180 were excluded because they were under the age of 18 years old. [Table 1](#) presents an overview of the sociodemographic, sleep, and health characteristics of the survey participants.

Table 1
Associations between sociodemographic, sleep, health characteristics and usage of Melatonin.

Characteristics	Melatonin usage		P-value
	No N (%)	Yes N (%)	
	5,070 (90.44)	536 (09.56)	
Age (years)	30 (≈12)	32 (≈12)	0.008
Sex			<0.001
Males	1,660 (8)	234 (12)	
Females	3,410 (92)	302 (8)	
Marital status			0.12
Single	2,842 (90)	304 (10)	
Married	2,092 (91)	216 (9)	
Divorced	80 (85)	14 (15)	
Widowed	56 (97)	02 (3)	
Educational status			<0.001
High school	1,335 (93)	105 (7)	
Diploma	499 (92)	41 (8)	
Bachelor's degree	2,956 (90)	339 (10)	
Master's	197 (86)	31 (14)	
Doctorate or equivalent	83 (81)	20 (19)	
Sleep duration			0.001
>7 h	1,811 (93)	146 (7)	
6-7 h	937 (89)	113 (11)	
5-6 h	970 (89)	120 (11)	
<5 h	1,352 (90)	157 (10)	
Perceived sleep quality			<0.001
Very bad	370 (82)	80 (18)	
Fairly bad	1,110 (87)	170 (13)	
Moderate	1,817 (91)	184 (09)	
Fairly good	1,208 (94)	72 (6)	
Very good	565 (95)	30 (5)	
Trouble with daily activities			<0.001
No trouble	1,485 (94)	99 (6)	
Less than once a week	1,161 (92)	104 (8)	
Once or twice a week	1,509 (90)	165 (10)	
>Three times a week	915 (84)	168 (16)	
Comorbidities			<0.001
No	2,958 (92)	260 (8)	
Yes	2,112 (88)	276 (12)	
Sleep disorders			<0.001
No	4,541 (92)	392 (8)	
Yes	529 (79)	144 (21)	
Perceived psychological stress (μ, α)	5.50 (≈3)	6.35 (≈3)	<0.001

3.1. Prevalence of sleep-related melatonin usage

Out of 5,606, 536 (10 %) participants were identified as consumers of melatonin. Males exhibited a higher prevalence of melatonin usage compared to females, with percentages of 12 % and 8 %, respectively. Notably, increased levels of sleep-related melatonin usage were associated with higher levels of educational attainment, whereby participants with postgraduate qualifications had a higher proportion of consumers (14 % of those with master's degrees and 19 % of those with doctorate degrees or equivalent), compared to those with an undergraduate qualification or lower (see Table 1).

3.2. Patterns of sleep-related melatonin usage

Further investigation of the 536 consumers of melatonin showed that the highest frequency of usage was once or more per day, constituting 35 % of all consumers. On contrast, the lowest frequency was once biweekly, equating to 6 % of consumers (Fig. 1). The majority of consumers (62 % of participants) reported that they acquired their melatonin from either a hospital dispensary or a pharmacy (Table 2). Most consumers also reported that they were either very satisfied (20 %) or satisfied (44 %) with their melatonin usage, whereas only 4 % of

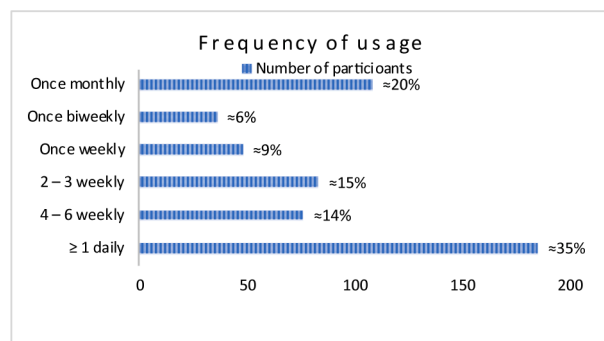


Fig. 1. Self-reported frequency of melatonin usage among the survey participants.

Table 2
Patterns of melatonin usage among consumers.

Pattern of melatonin usage	N (%)
	536 (100.00)
Source of melatonin [‡]	
Hospital dispensary	28 (5)
Pharmacy	340 (57)
Online stores	187 (31)
Friends/family	43 (7)
Perceived benefits [‡]	
Regular sleep	129 (22)
Fall asleep easily	272 (46)
Wake up less frequently	100 (17)
Have less nightmares	26 (4)
Sleep better after night shifts	36 (6)
Sleep better whilst travelling	29 (5)
Examples of Side effects [‡]	
Headache	92 (17)
Dizziness	50 (9)
Nausea	28 (5)
Drowsiness	92 (17)
Fatigue	92 (17)
Abdominal cramps	11 (2)
Tremor	19 (3)
Myalgia	31 (6)
Depression	52 (9)
Anxiety	42 (8)
Nightmares	46 (8)

[‡] Multiple response variable (n > 536).

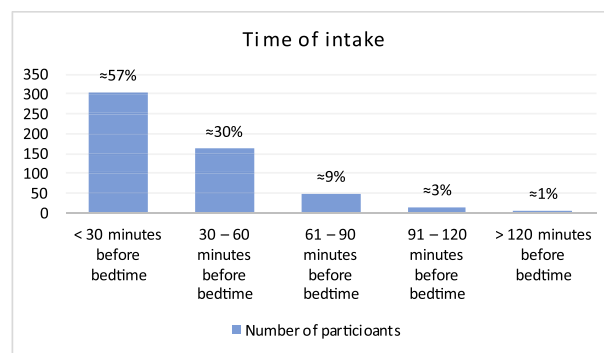


Fig. 2. Self-reported time of intake of melatonin before sleep among the survey participants.

participants reported being very unsatisfied. Figs. 2 and 3 show the time of intake and dosages of melatonin among consumers, respectively.

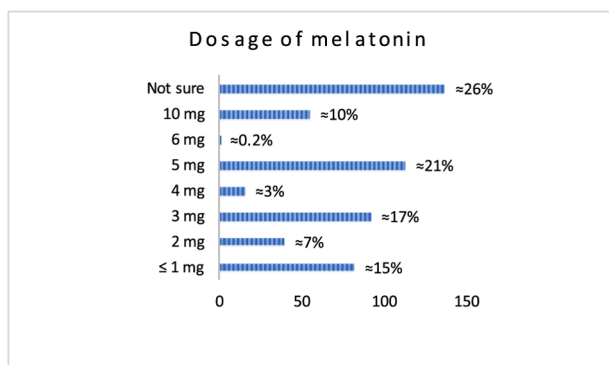


Fig. 3. Self-reported dosage of the melatonin consumed by the survey participants.

3.3. Multivariable logistic regression analyses of predictors for melatonin usage

The multivariable analyses showed that older age (Adjusted OR = 1.01, 95 % CI = 1.01–1.02, p = 0.002), being a male (Adjusted OR = 1.76, 95 % CI = 1.46–2.14, p = 0.001), individuals with a doctorate degree or an equivalent (adjusted OR 2.37 95 % CI = 1.35–4.17, p = 0.003), perceived poor sleep quality (Adjusted OR = 1.52, 95 % CI = 1.10–2.11, p = 0.01), higher levels of perceived psychological stress (Adjusted OR = 1.09, 95 % CI = 1.04–1.13, p = 0.001), being diagnosed with a sleep disorder (Adjusted OR = 2.55, 95 % CI = 2.04–3.18, p = 0.001), and trouble with daily activities due to lack of sleep (adjusted OR 1.71, 95 % CI = 1.25–2.35, p = 0.001), were all associated with increased likelihood of sleep-related melatonin usage (Table 3).

Table 3

Unadjusted and adjusted binary logistic regression analyses of predictors for melatonin usage.

Predictors	Unadjusted model			Adjusted model		
	OR	96 % CI	P-value	OR	95 % CI	P-value
Age	1.0	1.00–1.01	0.008	1.01	1.01–1.02	0.002
Sex						
Males	1.59	1.32–1.90	<0.001	1.76	1.46–2.14	<0.001
Females	Ref			Ref		
Educational attainment						
High school	Ref			Ref		
Diploma	1.04	0.71–1.52	0.82	0.94	0.64–1.40	0.78
Bachelors' degree	1.45	1.16–1.83	0.001	1.45	1.14–1.83	0.002
Master's degree	2.00	1.30–3.06	0.001	1.46	0.92–2.30	0.10
Doctorate or equivalent	3.06	1.80–5.18	<0.001	2.37	1.35–4.17	0.003
Perceived sleep quality						
Very bad	2.13	1.60–2.84	<0.001	1.52	1.10–2.11	0.01
Fairly bad	1.51	1.21–1.88	<0.001	1.23	0.97–1.56	0.07
Moderate	Ref			Ref		
Fairly good	0.58	0.44–0.78	<0.001	0.70	0.52–0.93	0.01
Very good	0.52	0.35–0.78	0.001	0.69	0.45–1.05	0.09
Perceived psychological stress	1.13	1.09–1.17	<0.001	1.09	1.04–1.13	<0.001
Sleep disorders						
No	Ref			Ref		
Yes	3.15	2.55–3.89	<0.001	2.55	2.04–3.18	<0.001
Trouble with daily activities						
No trouble	Ref			Ref		
Less than once a week	1.34	1.00–1.78	0.04	1.18	0.88–1.60	0.26
Once or twice a week	1.64	1.26–2.12	<0.001	1.33	1.00–1.77	0.04
>Three times a week	2.75	2.12–3.15	<0.001	1.71	1.25–2.35	0.001

4. Discussion

This survey study assessed the prevalence and patterns of sleep-related melatonin usage across all administrative regions of Saudi Arabia. The primary finding was that 1 in 10 adults self-reported using melatonin for sleep-related reasons. Higher melatonin consumption rates were reported by older adults, males, and those with higher educational levels. Higher melatonin consumption was also associated with perceiving sleep quality as very bad, sleeping fewer hours, experiencing trouble with daily activities due to lack of sleep, and having higher levels of perceived psychological stress.

In the current survey, the prevalence of sleep-related melatonin usage was estimated at 10 % of the adult population in Saudi Arabia, which is significantly higher than the estimates from international data. A study from the US reported that melatonin usage in 2018 was around 2 %, which had increased from 0.4 % in 1999–2000 (Li et al., 2022). The methodology used in the US study was more rigorous since the data were collected as part of the National Health and Nutrition Examination Survey (NHANES) surveillance in more than 55,000 adults (Li et al., 2022). Another study was conducted in Denmark stated that the prevalence of melatonin rose from 2.4 to 3.9 per 1000 persons during the period of 2012–2019. The study was a nationwide cohort including all melatonin users (43,652) aged from 0 to 24. However, melatonin is accessible solely through a prescription in Denmark (Bliddal et al., 2023). In the current survey, which included predominantly younger participants, substantially higher consumption rates were reported. Thus, while we have no prior data from Saudi Arabia to allow for comparison, these three studies could be reconciled by postulating rising melatonin usage among younger adults, and perhaps exaggerated by self-report bias. Although melatonin is not approved by the US Food and Drug Administration (FDA) for any clinical use (Savage et al., 2023), in Europe, the European Food Safety Authority (EFSA) approved the use of melatonin supplements for some indications including jet lag (Leuschner et al., 2010). On the other hand, in Saudi Arabia, melatonin is considered as a dietary supplement by the Saudi Food and Drug Authority (SFDA) and it can be purchased over-the-counter (OTC) from any community pharmacy without any restrictions (Tobaiqy et al., 2023).

Although several studies reported the misuse of dietary supplements and OTC medication, details about melatonin misuse have not been reported (Algaed et al., 2019; Tobaiqy et al., 2023; Yasmeen et al., 2023). However, the observable increase in usage led to the issuance of a warning against excessive use of melatonin supplements by the SFDA (Saudi Food and Drug Authority [Internet], 2022), probably as a response to the increased volume of sales in recent years (Euromonitor [Internet], 2023). Moreover, the SFDA advises that the use of melatonin should be under medical supervision and the importance of recognizing the side effects before using it, including headache, dizziness, and nausea (Saudi Food and Drug Authority [Internet], 2022).

In this survey, there was a noticeable difference in perceived sleep quality between those who self-reported using melatonin and those who did not. While some studies have shown a significant improvement in overall sleep quality after melatonin consumption (Chan and Lo, 2022; Fatemeh et al., 2022; Xu et al., 2020), other studies suggested that melatonin had no significant effect on sleep when compared to placebo (Buscemi et al., 2005; Rose et al., 1999). Melatonin consumers in our survey rated their sleep quality as poor and they had trouble with daily activities more than once a week, compared to non-consumers. A possible explanation could be that melatonin consumers may be suffering from symptoms of an undiagnosed sleep disorder such as insomnia. Melatonin is, therefore, used as a self-help method to manage these symptoms. This has been shown to be effective in previous studies including a systematic review and meta-analysis (Auger et al., 2015; Carriedo-Diez et al., 2022; Costello et al., 2014; Ferracioli-Oda et al., 2013).

As with any self-reported data, the data of this survey is prone to reporting bias which may affect the precision of the data obtained

through the survey (Bauhoff, 2014). Moreover, the majority of participants in this study were younger adults and, therefore, the results may not be generalized in other age groups. However, in Saudi Arabia, young adults aged between 30 and 34 years represent 44 % of the general population (GASTAT Portal [Internet], 2022).

The findings of this nationwide survey study shed light on the prevalence and patterns of self-reported melatonin usage in Saudi Arabia, offering valuable insights into specific characteristics associated with higher sleep-related melatonin consumption. With a notable prevalence of 10 % among the adult general population, melatonin usage was more common in older adults, males, and those with higher educational levels. These findings highlight the need for implementing public policies and health initiatives to regulate sleep-related melatonin usage and improve public awareness. Future research should investigate the underlying reasons behind the high prevalence of melatonin usage, and the data arising from these investigations would then inform the development of tailored interventions and targeted educational efforts for those with higher consumption rates.

Ethics approval

The questionnaire and methodology for this study were reviewed and approved by the Institutional Review Board at Imam Abdulrahman bin Faisal University (IRB-2023-03-025).

Consent to participate

Informed consent was obtained from all participants.

Consent to publish

Not applicable.

Authors' contribution

All authors contributed equally to the study conception and design. All authors read and approved the final manuscript.

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Competing interests

The authors have no competing interests to disclose.

CRedit authorship contribution statement

Yousef D. Alqurashi: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Mohammed Alhaddad:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Amar Albahrani:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Ali Alfajri:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Ahmed Abdulwahab:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Hussain Albahrani:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Abdullah Alhajri:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Saad Alshareef:** Writing – review & editing, Methodology, Investigation. **Sulaiman S. Alsaif:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Khalid AlHarakan:** Writing – review & editing, Writing – original draft, Supervision,

Investigation, Formal analysis. **Michael I. Polkey:** Writing – review & editing.

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References

- Alaska, Y.A., AlYahya, B., AlFakhri, L., AlHarbi, B., Alkattan, F., Alhayaza, R.M., 2022. Emergency medicine personnel's preparation, performance and perception of their night shifts: A cross-sectional study from Saudi Arabia. *Adv. Med. Educ. Pract.* 31 (13), 167–175. <https://doi.org/10.2147/amep.s339063>.
- Alateeq, D., Alsubaie, M.A., Alsaifi, F.A., Alsulaiman, S.H., Korayem, G.B., 2022. The use of dietary supplements for mental health among the Saudi population: A cross-sectional survey. *Saudi Pharm. J.* 30 (6), 742–749. <https://doi.org/10.1016/j.jps.2022.03.017>.
- Algaheed, H.A., AlJaber, M.I., Alwehaibi, A.I., AlJaber, L.I., Arafah, A.M., Aloyayri, M.A., et al., 2019. General public knowledge and use of dietary supplements in Riyadh, Saudi Arabia. *J. Fam. Med. Prim. Care* 8 (10), 3147–3154. [10.4103%2Fjfmcp.jfmcp.511_19](https://doi.org/10.4103%2Fjfmcp.jfmcp.511_19).
- Auger, R.R., Burgess, H.J., Emens, J.S., Deriy, L.V., Thomas, S.M., Sharkey, K.M., 2015. Clinical Practice Guideline for the Treatment of Intrinsic Circadian Rhythm Sleep-Wake Disorders: Advanced Sleep-Wake Phase Disorder (ASWPD), Delayed Sleep-Wake Phase Disorder (DSWPD), Non-24-Hour Sleep-Wake Rhythm Disorder (N24SWD), and Irregular Sleep-Wake Rhythm Disorder (ISWRD). An update for 2015: an American Academy of Sleep Medicine Clinical Practice Guideline. *J. Clin. Sleep Med. JCSM Off. Publ. Am. Acad. Sleep Med.* 11 (10), 1199–1236. <https://doi.org/10.5664/jcsm.5100>.
- Bauhoff, S., 2014. Self-report bias in estimating cross-sectional and treatment effects. *Encyclopedia of Quality of Life and Well-Being Research* [Internet]. Springer Netherlands, Dordrecht, pp. 5798–5800. https://doi.org/10.1007/978-94-007-0753-5_4046.
- Bliddal, M., Kildegaard, H., Rasmussen, L., Ernst, M., Jennum, P.J., Mogensen, S.H., et al., 2023. Melatonin use among children, adolescents, and young adults: a Danish nationwide drug utilization study. *Eur. Child Adolesc. Psychiatry* 32 (10), 2021–2029. <https://doi.org/10.1007/s00787-022-02035-1>.
- Buscemi, N., Vandermeer, B., Hooton, N., Pandya, R., Tjosvold, L., Hartling, L., et al., 2005. The efficacy and safety of exogenous melatonin for primary sleep disorders a meta-analysis. *J. Gen. Intern. Med.* 20 (12), 1151–1158. <https://doi.org/10.1111/j.1525-1497.2005.0243.x>.
- Carriedo-Diez, B., Tosoratto-Venturi, J.L., Cantón-Manzano, C., Wanden-Berghe, C., Sanz-Valero, J., 2022. The effects of the exogenous melatonin on shift work sleep disorder in health personnel: A systematic review. *Int. J. Environ. Res. Public Health* 19 (16), 10199. <https://doi.org/10.3390/ijerph191610199>.
- Chan, V., Lo, K., 2022. Efficacy of dietary supplements on improving sleep quality: A systematic review and meta-analysis. *Postgrad. Med. J.* 98 (1158), 285–293. <https://doi.org/10.1136/postgradmedj-2020-139319>.
- Claustrat, B., Brun, J., Chazot, G., 2005. The basic physiology and pathophysiology of melatonin. *Sleep Med. Rev.* 9 (1), 11–24. <https://doi.org/10.1016/j.smrv.2004.08.001>.
- Costello, R.B., Lentino, C.V., Boyd, C.C., O'Connell, M.L., Crawford, C.C., Sprengel, M.L., et al., 2014. The effectiveness of melatonin for promoting healthy sleep: A rapid evidence assessment of the literature. *Nutr. J.* 7 (13), 106. [10.1186%2F1475-2891-13-106](https://doi.org/10.1186%2F1475-2891-13-106).
- Euromonitor [Internet], 2023 [cited 2024 Feb 3]. Sleep Aids in Saudi Arabia. Available from: <https://www.euromonitor.com/sleep-aids-in-saudi-arabia/report>.
- Fatemeh, G., Sajjad, M., Niloufar, R., Neda, S., Leila, S., Khadijeh, M., 2022. Effect of melatonin supplementation on sleep quality: A systematic review and meta-analysis of randomized controlled trials. *J. Neurol.* 269 (1), 205–216. <https://doi.org/10.1007/s00415-020-10381-w>.
- Ferracioli-Oda, E., Qawasmi, A., Bloch, M.H., 2013. Meta-analysis: Melatonin for the treatment of primary sleep disorders. *PLoS One* 8 (5), e63773. <https://doi.org/10.1371/journal.pone.0063773>.
- GASTAT Portal [Internet], 2022 [cited 2024 Feb 23]. Population Summary Report. Available from: https://portal.saudicensus.sa/static-assets/media/content/20230531_GASTAT_Population_Report.pdf?crawlerSite=gastat-portal.
- General Authority for Statistics [Internet], 2017 [cited 2024 Jan 13]. Population Characteristics surveys 2017. Available from: <https://www.stats.gov.sa/en/5655>.
- Leuschner, R.G.K., Robinson, T.P., Hugas, M., Cocconcelli, P.S., Richard-Forget, F., Klein, G., et al., 2010. Qualified presumption of safety (QPS): a generic risk assessment approach for biological agents notified to the European Food Safety Authority (EFSA). *Trends Food Sci. Technol.* 21 (9), 425–435. <https://doi.org/10.1016/j.tifs.2010.07.003>.
- Li, J., Somers, V.K., Xu, H., Lopez-Jimenez, F., Covassin, N., 2022. Trends in use of melatonin supplements among US adults, 1999–2018. *J. Am. Med. Assoc.* 327 (5), 483–485. [10.1001%2Fjama.2021.23652](https://doi.org/10.1001%2Fjama.2021.23652).
- Rose, D., Chase, J., Blajez, E., Kahan, T., 1999. Effects of exogenous melatonin on sleep quality in healthy college students. *Psi Chi J. Undergrad. Res.* 4 (1), 3–8. <https://scholarcommons.scu.edu/psych/104>.

- Saudi Food and Drug Authority, X (formerly Twitter) @Saudi_FDA [Internet], 2022 [cited 2024 Jan 14]. [Tweet]. Available from: https://twitter.com/Saudi_FDA/status/1524766345740668929.
- Savage, R.A., Zafar, N., Yohannan, S., Miller, J.M.M., 2023. Melatonin. StatPearls [Internet]. StatPearls Publishing, Treasure Island (FL). <http://www.ncbi.nlm.nih.gov/books/NBK534823/>.
- Tobaiqy, M., AlZahrani, F.A., Hassan, A.S., Alirbidi, A.H., Alraddadi, O.A., AlSadah, O.A., et al., 2023. Community pharmacists' knowledge, attitudes and the perceived safety and effectiveness of melatonin supplements: A cross-sectional survey. *Pharmacy* 11 (5), 147. <https://doi.org/10.3390/pharmacy11050147>.
- Xu, H., Zhang, C., Qian, Y., Zou, J., Li, X., Liu, Y., et al., 2020. Efficacy of melatonin for sleep disturbance in middle-aged primary insomnia: A double-blind, randomised clinical trial. *Sleep Med.* 1 (76), 113–119. <https://doi.org/10.1016/j.sleep.2020.10.018>.
- Yasmeen, A., Syed, M.H., Alqahtani, S.S., Kashan Syed, N., Meraya, A.M., Wazaify, M., et al., 2023. Suspected inappropriate use of prescription and non-prescription drugs among requesting customers: A Saudi community pharmacists' perspective. *Saudi Pharm J. SPJ* 31 (7), 1254–1264. <https://doi.org/10.1016/j.jsp.2023.05.009>.