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Sleep Quality of the College Students Based on Their Nutrition and Internet Usage: A Web-Based Cross-Sectional Study

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ABSTRACT

Background: Excessive utilization of electronic media may affect the individuals' health and quality of sleep. This study aimed to investigate sleep quality of the college students based on their diets and duration of time spent on the internet. **Methods:** In this cross-sectional web-based study, 385 students were selected randomly from the Qazvin University. Data was collected by a self-administered online questionnaire designed in Google-drive. The questionnaire included demographic information, Petersburg sleep quality, duration of time spent on the internet, food habit, health status, physical activity, and anthropometric characteristics. A total of 229 students filled out the questionnaire completely. To analyze the data, SPSS version 22 was used. Paired *t-test*, ANOVA, ANCOVA, and Pearson correlation coefficient were applied for statistical analyses. **Results:** The mean time spent on the internet was 28.83 ± 20.89 hours/week, which showed a significant relationship with the students' health status (P = 0.005), sleep quality score (P = 0.048), components of sleep quality (P = 0.029), and sleep disorder (P = 0.01). The mean score of Petersburg sleep quality index demonstrated a significant relationship with marital status (P = 0.029), Body mass index (P = 0.008), as well as consumption of some food groups like fruits, sausage and salami, and canned foods (P = 0.048, 0.05, 0.01). **Conclusions:** Students who used the internet a lot had poor-quality sleep and unhealthy food choices. This was a reciprocal relation. Consequently, a healthier life style and minimum duration of time on the Internet can lead to physical health and better quality asleep.

Keywords: *Sleep habit; Good; Food habits; Internet; Eating habits*

Introduction

Overutilization of the electronic media such as Television, computers, tablets, and smart phones, especially at night, affects the health and sleep quality of individuals. Recent studies have addressed the impact of electronic devices on children and teenagers, although few studies

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investigated this topic among college students (Demirci *et al.*, 2015, Mesquita and Reimão, 2010). Nowadays, most adolescents spend several hours on the net surfing (night or day) or checking social networks. This can alter the sleep length and quality. Research shows that light radiated by electronic devices disrupts the circadian rhythm and deteriorates the sleep quality (Duffy and Czeisler, 2009). Moreover, excessive sitting and net surfing may affect the physical activities (Buman *et al.*, 2015) and lead to obesity (Wuertz *et al.*, 2012).

Sleep is known as a physical and mental resting condition, in which the sleeping person is relatively unaware of his/her surroundings. The goals and mechanisms of sleep are fairly known (España and Scammell, 2011). Sleep is one of the main components of the circadian cycle and a major part of life is dedicated to rehabilitate the mental and physical potent (Kaplan and Sadock, 1988). Insomnia is a chronic dissatisfaction or complaint about sleeping length or quality accompanied by symptoms like difficulty in sleeping, retaining sleep, or getting up easily (as well as difficulty in going back to sleep). All of the above may lead to remarkable clinical conditions or disruptions in daily activities (Webb *et al.*, 2018). This affects the daily chores, mood, memory, and educational performance (Kang and Chen, 2009). Recently, the correlation between diet and duration of time spent on the Internet was investigated (St-Onge *et al.*, 2016, Wong *et al.*, 2013).

Cross-sectional (Imaki *et al.*, 2002) and epidemiologic (Haghighatdoost *et al.*, 2012) studies showed a significant correlation between diet and sleep length. Sleep deprivation may change the choice of food. Reduction in sleeping time and insomnia led to obesity (Kaur *et al.*, 2015). On the one hand, sleep adequacy correlates with healthy behaviors such as more healthy eating (Safiri *et al.*, 2016). On the other hand, outbreak of obesity was also highlighted, since it was found to develop noncontagious diseases such as cardiovascular disease, cancer, and diabetes. Considering the few studies on the relationship between the Internet use and the quality of sleep, insufficient sleep was associated with the health of people. Consequently, we aimed to assess the quality of sleep and nutrition on the college students using the Internet as a web-based cross-sectional study.

Materials & Methods

Study design and setting: This was a descriptive and web-based cross-sectional study conducted among students of Qazvin University of Medical Sciences (QUMS) in Iran in the academic year 2017-2018. Data were collected using a self-administered questionnaire. Students consented to complete an online questionnaire via Google-drive. Our questionnaire was designed based on other valid questionnaires derived from the literatures. When the questions were finalized, a questionnaire was designed in Google-drive. Later, the students were provided with the link of the online questionnaire on slips of paper. The link was also sent to the participants' emails. The items were adopted from scientific texts and dissertations, as well as Petersburg Sleep Quality, Eating Behavior and Food Frequency (De Garine, 1972), Family Eating Behavior (Lesani *et al.*, 2016b), and Physical Activity Questionnaires. The validity and reliability of the above-mentioned questionnaires were well-established in the literature. When the questionnaire was constructed, it was sent to a number of authorities for the required adjustments. Later, the finalized questionnaire was designed in Google drive and administered to a group of students in the Health School as a pilot study to review the answering procedure and tackle the possible difficulties.

Participants: A total of 385 students from QUMS were invited to participate in the study. All students were internet users, were 18 to 40 years, and consented to take part in this study. The host students of Qazvin University were eliminated. The exclusion criteria were uncompleted questinnare, regular consumption of the prescription druges that affected the sleep quality, and ages of less than 18 years or more than 40 years.

*Measurements***:** All items of the questionnaire used in this study were derived from scientific texts and experts' opinions. The questionnaire included items to collect demographic data, Petersburg Sleep Quality questionnaire as well as some items about the participants' number of days and amount of time spent on the Internet, daily consumption of various food groups (processed food, fast food, and restaurant food), patterns of cooking and food preparation, health status and possible diseases, physical activity, weight, height, and marital status. It took 15–20 min to complete the questionnaires. All participants were encouraged to provide honest responses.

Validating students' online self-reported heights and weights: To validate the students' self-reported heights and weights, Bland-Altman Plot, a graphical technique to compare two different measurement methods, was used. Initially, students of a class were asked to self-report their heights and weights. Later, a calibrated weighing scale and a meter were used to measure their weights and heights, respectively. Results of the Bland-Altman Plot confirmed that the self-reported weights and heights could be reasonably used in the questionnaire (Standard Deviation = 1.96) (**Figure 1**).

Assessing sleep quality: In the present study, Petersburg sleep quality index (PSQI) was used to assess the participants' sleep quality. It includes 9 questions devoted to investigate the respondents' sleep quality, required time to sleep, sleep duration, amount of useful sleep, sleep disorders, sleeping pills intake, and impact of insomnia on daily activities. The minimum and maximum scores for each item vary from 0 (no problem) to 3 (sever problem). The scores for different items were summed up to obtain a total score (0-21). The higher scores showed poorer sleep quality (Buysse *et al.*, 1989).

Rapid assessment of physical activity (RAPA): Physical activity was measured by the rapid assessment of RAPA questionnaire (Strath *et al.*, 2013). Physical activity refers to any movement and activity that increases the heart rate compared to the rest condition. This questionnaire includes two sections. The first section is comprised of 7 questions to measure intensity of the aerobic activities. A positive answer to the first question receives 1 score and a positive answer to the 7th question gets 7 scores. The highest attainable score for each person is considered as his/her total score. The second section contains 2 questions to evaluate the flexibility. Positive answers to the first and second questions receive 1 and 2 scores, respectively. The total score for this section is 3. Later, the scores achieved from the first and the second sections are added. The total score may range from 1 to 10; where, 1 shows the least level of physical activity, scores of 2-3 refer to less active people, scores of 4-5 indicate insufficient (subnormal) physical activity, and scores of 6 or above represent sufficient physical activity and an active life style. The validity and reliability of the Persian version of this questionnaire were confirmed in a recent previous study (Lesani *et al.*, 2016a)

Data analyses: The SPSS (Version 22) was used to analyze the data. A paired t-test was run to investigate the correlation of such binary variables as gender, marital status, and health status with variables like Petersburg sleep quality Index, duration of time spent on the Internet, and age. To study the relationship between the quantitative variables (sleep quality index, Internet usage, and age), qualitative variables (BMI, physical activity, and daily consumption of dairy products, fruits, and vegetables, sweets and candy, sausage and salami, canned food, restaurant food, and numbers of meals each day), and socio-cultural conditions, the independent t-test was used. The one-way ANOVA was also utilized to study the relationship among sleep quality, Internet usage, and quantitative variables. A logistic regression was applied to determine the impact of sleep quality on consumption of fruits, vegetables, canned food, sausage, and salami, as well as the participants' BMI, physical activity, and Internet usage while controlling the confounding factors.

Ethical considerations: All procedures performed in studies involving human participants were in accordance with the ethical standards of

the institutional and/or national research committee, the 1964 Helsinki declaration and its later amendments, or comparable ethical standards. This manuscript was the main part of a research supported by Qazvin University of Medical Sciences. It was also approved by Ethics Committee/ Institution review boards (IRB) (IR.QUMS.REC.1397.003).

Results

Of 385 emails sent to the participants, 229 students filled the online questionnaire completely (73.4% females and 26.6% males), which shows a response rate of 59.48%. The mean of participants' age was 27.68 ± 5.55. According to the findings, they spent from 8 min to 15 hours a day (28.83 ± 20.89 hours/week) on the internet, which had a significant correlation (P = 0.005) with the participants' health condition.

Internet usage had no significant relationship with marital status, gender, or age. The average Petersburg sleep quality score for users was 4.19 ± 1.99 (minimum and maximum scores were 1 and 13.5, respectively). The independent t-test showed a significant relationship between the marital status and users' sleep quality score. The average scores for sleep quality of the married and single users were 3.95 ± 1.75 and 4.26 ± 2.08 (P = 0.029), respectively. Moreover, the mean time duration on the internet among married people was 3.62 ± 2.82 hours/day, while it was 4.35 ± 3.33 in the single students. Of course, sleep quality scores had no significant difference with gender or health status. The mean BMI index of the Internet users was 23.25 ± 3.94 (minimum 16.41 and maximum 38.2) and a significant relationship was found between BMI and sleep quality score (P = 0.008). No significant relationship was observed between the participants' BMI and the time spent on the Internet. The independent t-test results showed a significant relationship between BMI and gender (BMI averages are 25.26 ± 4.89 and 22.54 ± 3.34 for males and females, respectively) (**Table 1**).

Pearson test showed a positive and significant relation between sleep quality and time spent on the Internet (r = 0.190, P = 0.004). The ANOVA analysis showed a significant relationship between sleep quality and time spent on the Internet (P = 0.048, **Table 2**).

According to the findings, 67.2% of the students (both genders) had good sleep quality, while 32.8% suffered from poor sleep quality. The poor sleep quality and good sleep quality in males were 29.5% and 70.5% and this figures in females were 33.9% and 66.1%, respectively.

The ANCOVA indicated a significant and negative correlation between sleep quality and consumption of foods like fruits, canned food, sausage, and salami, adjusted based on Internet usage, marital status, BMI, and physical activity (**Table 4**).

Table 1. Demographic data of participants

Variables	Number	Percentage
Gender		
Male	168	73.4
Female	61	26.4
Marital status		
Single	158	69.0
married	71	31.0
Health status		
Healthy	191	83.4
Illness	38	16.6
Number of family member		
Less than 3	87	27.9
4-5	127	55.5
More than 6	15	6.6

Table 2. Relation between the sleep quality scores and time spent on the internet

Internet usage	N	%	Mean ± SD of Sleep Quality[b]	P- value
< 30 minutes	14	6	3.93 ± 1.33	0.048[a]
30 m-2h	62	27	3.93 ± 2.19	
2h-4h	70	31	3.98 ± 1.79	
4h-8h	62	27	4.24 ± 2.03	
8h<	21	6	4.16 ± 1.93	

[a]: The Tukey Test showed that scores of sleep quality for students with 30 min to 2 hours and 2-4 hours of Internet surfing differed significantly from scores of those with more than 8 hours of Internet usage; **[b]:** The average scores were adjusted for marital status, BMI, physical activity, as well as consumption of fruits, canned food, sausage, and salami.

Table 3. Relationship between components of sleep quality, sleep disorder, and daily internet usage

Components	N	Mean ± SD time on the internet (hours/day)[a]	P-value
Sleep Quality (First Component)			0.029
Very Good	29	4.37 ± 3.142	
Fairly Good	143	3.68 ± 3.13	
Fairly Bad	44	4.92 ± 3.32	
Bad	13	2.58 ± 2.74	
Sleep Disorder (Fourth Component)			0.01
Never in the past month	0		
< Once a week	86	3.96 ± 2.73	
Once or twice a week	130	4.01 ± 3.28	
Three times or more in a week	13	7.10 ± 4.48	

[a]: The mean for health is adjusted.

Table 4. Relationship of sleep quality with consumption of some foods, physical activity, and BMI variables

Foods	N	%	Mean ± SD of weekly internet usage (hours/week)	Mean ± SD of Sleep Score	P-value
Fruits					
Daily	190	83.0	27.43 ± 22.20	3.96 ± 1.87	0.01 [a]
Weekly	34	14.8	35.65 ± 21.16	5.29 ± 2.38	
Seldom	5	2.3	38.40 ± 28.89	4.20 ± 0.84	
Vegetables					
Daily	104	45.4	27.67 ± 21.55	4.02 ± 1.93	0.05
Weekly	104	45.4	29.58 ± 23.12	4.24 ± 2.08	
Seldom	21	9.2	31.52 ± 23.61	4.47 ± 1.80	
Dairies					
Daily	185	80.8	28.70 ± 22.77	4.02 ± 1.93	0.07
Weekly	36	15.7	29.19 ± 19.95	4.22 ± 1.80	
Seldom	8	3.5	31.87 ± 26.50	5.00 ± 2.07	
Sweets and Candy					0.08
Daily	36	15.7	28.95 ± 26.46	3.96 ± 2.13	
Weekly	120	52.4	27.70 ± 18.48	3.96 ± 1.77	
Seldom	73	31.9	30.80 ± 26.03	4.60 ± 2.20	
Sausage and Salami					0.05[b]
Never	57	24.9	27.67 ± 22.67	3.23 ± 1.82	
Sometimes	165	72.1	29.88 ± 22.55	4.34 ± 2.03	

Often	7	3.0	15.57 ± 10.92	4.43 ± 1.72	
Restaurants					0.06
Never	40	17.5	27.17 ± 17.72	3.90 ± 1.96	
Sometimes	179	78.2	29.58 ± 23.48	4.25 ± 2.01	
Often	10	4.3	28.89 ± 22.39	3.60 ± 1.99	
Canned food					
Never	57	24.9	27.67 ± 22.67	3.63 ± 1.82	0.04[c]
Sometimes	165	72.1	29.88 ± 22.55	4.34 ± 2.03	
Often	7	3.0	15.57 ± 10.92	4.43 ± 1.99	
Body mass index					
Thin	15	6.5	32.40 ± 30.45	3.20 ± 1.01	0.008[d]
Norm	153	67.7	30.62 ± 22.76	4.06 ± 1.93	
Overweight	43	18.8	26.18 ± 19.62	4.44 ± 1.99	
Obese	16	7.0	18.03 ± 14.37	5.47 ± 1.99	
Physical activity					0.008[e]
Inactivity	31	13.5	29.74 ± 22.47	5.24 ± 2.74	
Light	56	24.5	24.81 ± 17.00	4.10 ± 1.57	
Insufficient	76	33.2	30.33 ± 26.19	3.81 ± 1.92	
Sufficient	66	28.8	28.89 ± 22.60	4.10 ± 1.84	

[a]: Tukey Test showed a significant relationship between sleep quality of students who intake fruits every day and those who occasionally intake fruit; [b]: Tukey Test showed a significant association between sleep quality of students who never ate sausage & salami and those who occasionally ate them; [c]: Tukey Test showed a significant association between sleep quality of students who never ate canned foods and those who occasionally ate them. [d]: Tukey Test showed a significant relation between sleep quality of students with normal BMIs and those who suffered from obesity. [e]: Tukey Test showed a significant relation between sleep quality of students who suffered from limited mobility and those who have sufficient or insufficient light physical activities.

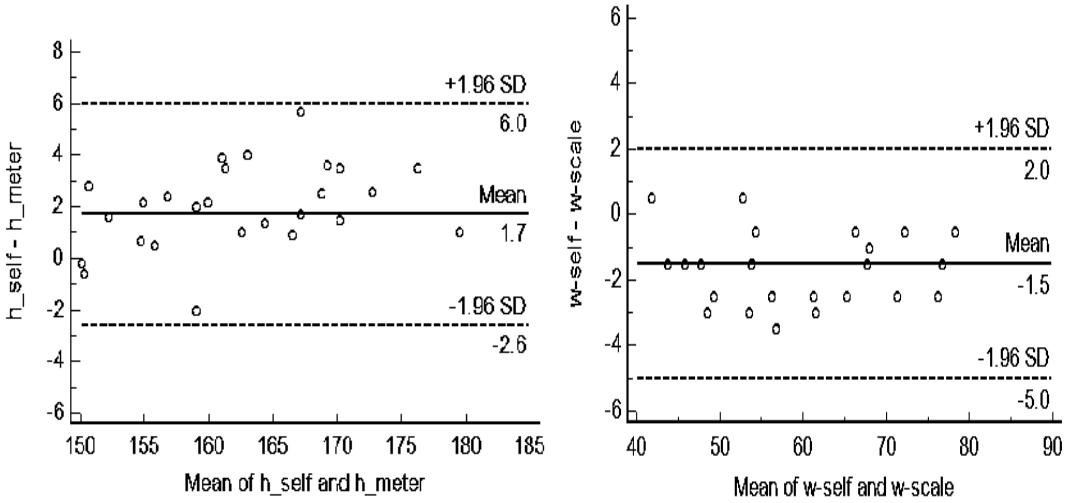

Figure1. Bland-Altman Plot for height and weight reported by participants and measured using scale and meter

w- self = weight self-reported; h-self= height self- reported; w-scale= weight measured by scale; h- scale=height measured by meter

Discussion

We found that the duration of time spent on the Internet usage was significantly correlated with the average scores of Petersburg sleep quality index, sleep quality (first component), and sleep disorder (fourth component). Sleep quality was significantly different between the married and single students. A study of 710 students showed that poor sleep quality was significantly correlated with the internet usage from 19:00 P.M. to 24:00 P.M. However, no significant correlation was observed between sleep quality and watching TV during the same hours (Mesquita and Reimão, 2010). Another study showed that smartphone addiction was significantly correlated with some components of sleep disorder, disruption in daily performance, Petersburg sleep quality index, anxiety, and depression in students (Demirci *et al.*, 2015). In another research, addiction to social networks, as one of the major Internet applications, was significantly correlated with poor sleep quality and cognitive disruptions during the day. A significant correlation was observed between excessive use of the internet and sleep deprivation (Xanidis and Brignell, 2016). Internet addiction in adults was also significantly related to sleep problems, disruption of the daily activities, and suicide commitments. Moreover, psychological and mental disorders and anxiety were significantly associated with poor sleep quality among the Internet addicts (Kim *et al.*, 2017). Mild to moderate insomnia was associated with internet addiction and circadian cycle disruption in children and teenagers (Chen and Gau, 2016). Poor sleep quality was significantly related to long hours of Internet surfing for leisure (Kim *et al.*, 2018). The light of computers or similar electronic equipment affects the mind, delays the sleep time, and alters the circadian cycle (Duffy and Czeisler, 2009).

The present study showed that some dietary items or food groups played an important role in sleep quality index. In other words, daily consumption of fresh fruits and avoidance of the canned food, sausage, and salami improved the sleep quality significantly. No significant relationship was found between sleep quality and consumption of vegetables, milk, dairies, sweets, candy, and grains. Canned food, sausage, and salami were excluded from previous studies on the sleep quality. A study showed that macro-nutrients (like carbohydrates, fat, and proteins) and micro-nutrients (like vitamin-B group) affect synthesis of serotonin from tryptophan and melatonin, influences discretion of such hormones as insulin, ghrelin, and neuropeptide Y, and causes sleep and wake-up cycle consequently (Dockray, 2009). A study of Iranian females showed that an increase in the energy intake was significantly correlated with sleep inadequacy. Some types of food increase the synthesis of serotonin and melatonin as a result improved sleep quality. However, inadequate sleep increases the risk of over-eating, psychological and mental stress, inability to avoid eating extra food, willingness to receive more energy than the required rate to stay awake and aware, and appetite alterations in Iranian students due to discretion of the hormones (St-Onge *et al.*, 2016). Moreover, a significant correlation was observed between sufficient sleep and consumption of more carbohydrates and vegetables in adults (Imaki *et al.*, 2002). Of course, this observation was not supported by our findings. Another study demonstrated that proteins and amino-acids improved sleep quality and mood through elevating the level of serotonin (Silber and Schmitt, 2010). In the literature, consumption of some fruits like sour cherries and kiwi improved sleep quality through increasing the melatonin (Lin *et al.*, 2011, Pigeon *et al.*, 2010).

A significant negative correlation was found between BMI and sleep quality in students who used the Internet. In addition, duration of time spent on the Internet and BMI showed a direct significant correlation, which is similar to the results obtained a study in China (Wuertz *et al.*, 2012). A significant relationship was also observed between obesity and sleep disorder, so that sleep disorder was an effective factor on overweigh in adolescents (Vargas *et al.*, 2014). In another study, poor sleep quality had a significant relationship (based on Petersburg sleep quality index) with overweight and obesity in young students (Quick

et al., 2014). A study on 18-65 year-old adults showed that poor sleep quality was significantly correlated with obesity in males; whereas, such a relationship was not observed in females (Krističević *et al.*, 2018). In a recent research over three different weight gain groups of students, a negative significant relationship was observed between weight gain and sleep quality during 4-5 months (O'Donovan *et al.*, 2010). On the contrary, we found no significant relationship between the participants' BMI and the time spent on the Internet. In this regard, a census in the USA explained that an extra hour of internet surfing increased the risk of sleep deterioration, but it did not affect other parameters. Interestingly, an extra hour of watching TV increased the risk of sleep deterioration, sleep disorder, shorter sleep duration, and drowsiness during the day (Buman *et al.*, 2015).

According to the literature, physical activity has numerous physical (O'Donovan *et al.*, 2010), psychological, and mental benefits (Ludy *et al.*, 2018). A significant relationship was observed between the Internet users' sleep quality and their physical activities. In other words, increase of the students' physical activity improved their sleep quality. Another study showed that female students with poor sleep quality had significantly less physical activity than their counterparts (Wuertz *et al.*, 2012). In Chinese students, computer and TV utilization had a significant and positive correlation with the levels of anxiety, depression, and poor sleep quality (Feng *et al.*, 2014). The physical activity also demonstrated a significant and negative correlation with poor sleep quality (Wu *et al.*, 2015). Physical activity and sleep showed a complicated and reciprocal correlation, so that more physical activity improved the sleep quality (Chennaoui *et al.*, 2015).

Our study was web-based; consequently, students needed high speed Internet to fill out and send the questionnaires. Some of participants complained about low speed of the Internet and frequent disconnections while completing the questionnaires, which ended in data loss. Some of them had to refill the questionnaires even several times. As a result, 40% of the students did not participate in the study, which may have affected the results. Another issue is that no cause and effect relation can be established based on the correlations and the present study dealt with correlation of various factors with sleep quality. The investigated relationship can be reciprocal, so that a healthier life style can end in higher quality sleep and high-quality sleep leads to healthier behavioral patterns.This study evaluated the medical and paramedical students at Medical Science University of Qazvin. The same evaluation can be applied on students in non-medical faculties. A comparison of results can be useful in determining the factors relevant to sleep. The same research scheme can be conducted for other groups' population such as students, pregnant women, senior citizens, etc.

Conclusions

Sleep quality demonstrated a positive and significant relationship with Internet usage, physical activity, BMI, eating fruits and not consumption of the canned food, sausage, and salami. Healthy life style is associated with healthier choices of food, more physical activity, more desirable BMI, and higher sleep quality. So, in order to have a healthier life style, high-quality sleep, regular physical activity, ideal body weight, and healthy diet are recommended. In this regard, the duration of time spent on the Internet should be restricted and the Internet should not be used at night.

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Conflict of interest

The authors declare no conflict of interests.

Authors' Contribution

Sharafi F, Lesani A, and Javadi M designed the research; Sharafi F, Lesani A, and Javadi M conducted the research; Lesani A analyzed the data; Sharafi F and Lesani A wrote the paper. Lesani A had the primary responsibility for the

final content. All authors read and approved the final manuscript.

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