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What are predictors for a continuous positive airway pressure machine purchasing in obstructive sleep apnea patients?

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Abstract

Obstructive sleep apnea (OSA) is a disease which causes or relates to several health and societal conditions. Even though continuous positive airway pressure (CPAP) machine has several benefits for OSA treatment, not all OSA patients purchase it for nightly use. Two studies from Israel found that both physical and phychological factors were related to purchasing of CPAP significantly. However, these studied have not evaluate marketing factors in regarding the CPAP purchasing. Therefore, this study aimed to assess if any predictors related to marketing factors on CPAP purchasing in OSA patients. This study conducted at Sleep Clinic, Srinagarind Hospital, Khon Kaen, Thailand. We enrolled OSA patients who used to perform a CPAP trial for 3-consecutive nights. A self-reported questionnaire, comprised of factors associated with purchasing CPAP, was used in this study. Factors associated with CPAP purchase were computed by using logistic regression analysis. In total, there were 53 patients in the analysis; categorized as did not purchase CPAP group (12 patients; 22.64%) and purchased CPAP group (41 patients; 77.36%). There were two factors remaining in the final model to predict CPAP purchasing. Of those, only one factor was independently associated with purchasing CPAP in OSA patients; insomnia from CPAP. The adjusted odds ratio (95% confidence interval) of this factor was 0.341 (0.149, 0.775). In conclusion, marketing factors were not significantly associated with CPAP purchasing. But, insomnia or poor sleep from CPAP did.

Keywords: insomnia, marketing factors, predictors

1. Introduction

Obstructive sleep apnea (OSA) is a disease which causes or relates to several health and societal conditions [1]. It increases risk of stroke by 3.8 times, death by 3.8 times, hypertension by 2.9 times, vehicle accident by 2.4 times, heart failure by 2.4 times, diabetes by 1.6 times, and depression by 1.4 times [1]. A previous study found that OSA, causing sleepiness [2], may be a cause of 810,000 motor vehicle crashes with 1,400 deaths and cost 15.9 billion USD [3]. Treatment with a continuous positive airway pressure (CPAP) machine, a treatment of choice, may reduce several risks [4-6]. A study from Sweden found that CPAP reduces motor vehicle accidents from 7.6 to 2.5 accidents/1,000 drivers/y [7].

Even though CPAP, a pneumatic splint treatment for OSA, has several health and non-health benefits, not all OSA patients purchase it for nightly use [8]. Only 32% of OSA patients decided to purchase the CPAP. Two studies from Israel found that both physical and phychological factors were related to purchasing of CPAP significantly [8, 9]. High body mass index and higher socioeconomic status tended to purchase the CPAP with coefficient of 0.36 (p value 0.02) and odds ratio of 1.23 (p value 0.03). However, these studied have not evaluate other marketing factors in regarding the CPAP purchasing. Therefore, this study aimed to assess if any predictors related to marketing factors on CPAP purchasing in OSA patients.

2. Materials and Methods

This study conducted at Sleep Clinic, Srinagarind Hospital: a university hospital of Khon Kaen University, Khon Kaen, Thailand. The study period was between March and April, 2018. The inclusion criteria were adult patients (age over 18 years), diagnosed as OSA by polysomnography, used to perform a CPAP trial, and willing to participate the study. We excluded patients with pregnancy or unable to read or understand Thai.

All eligible patients were requested to fill out a self-reported questionnaire. The questionnaire comprised of 119 questions from 12 parts including baseline characters (7 items), co-morbid diseases (7 items), symptoms of OSA (9 items), persons that influenced CPAP purchasing (6 items), CPAP features (22 items), CPAP price (3 items), selling channels (9 items), marketing promotions (5 items), post marketing services (2 items), salesperson (10 items), medical personnel (18 items), and effects of CPAP trial (21 items). The latter eight parts were a 5-level Likert scale with a maximum score of 5 (strongly agreed).

A CPAP machine trial was scheduled for three consecutive nights after the diagnosis of OSA. Doctor and staff gave instructions of CPAP use, treatment effects of CPAP, and side effects of CPAP. The trial CPAP was auto-CPAP machine by Philips Respironics; model system one with nasal CPAP mask. The patients were instructed to wear auto-CPAP for three night as much as possible and at the same sleep routine. The auto-CPAP automatically adjusts the CPAP pressure according to patients' apnea. The auto-CPAP machine has record on duration of use, AHI, and system leakage.

Statistical analyses. Sample size calculation. A study from Israel found that 32% of OSA patients decided to purchase CPAP machine [8]. There is currently no report from Thailand regarding CPAP purchasing rate in OSA patients. From a pilot observation, the CPAP purchasing rate in this clinic was approximately 50%. With a confidence of 90% and power of 80%, the required sample size was 32 patients.

All eligible patients were categorized by history of CPAP purchase. Descriptive statistics were used to compare factors between both groups. Factors associated with CPAP purchase were computed by using logistic regression analysis. Those factors with a p value of less than 0.20 by univariate logistic regression analysis were subsequently put into the stepwise multivariate logistic regression analysis. A Hosmer-Lemeshow chi square was used to evaluate a goodness of fit of the final model. Results were presented as odds ratios and 95% confidence interval (CI). All statistical analyses were calculated by STATA software, version 10.1 (College Station, Texas, USA).

3. Results

There were 59 OSA patients participated the study; six patients were excluded due to no CPAP trial (5 patients) and incomplete information on the outcome (1 patient). In total, there were 53 patients in the analysis; categorized as did not purchase CPAP group (12 patients; 22.64%) and purchased CPAP group (41 patients; 77.36%). Baseline characters, co-morbid diseases, symptoms of OSA, and factors associated with purchasing CPAP were shown in Table 1. The patients in the purchased CPAP group had significantly higher proportions of being government officer (43.90% vs 8.33%), presence of apneic events (50.00% vs 0%), and having excessive daytime sleepiness (31.71% vs 25.00%) than did not purchase CPAP group (Table 1). And, doctors also had influenced on purchasing CPAP significantly (90.24% vs 58.33%; p value 0.020). Other factors between both groups were comparable.

Regarding factors associated with purchasing CPAP, there were only four significant factors between both groups. All factors were in the part of effects of CPAP trial as follows: insomnia from CPAP, feeling tightness from CPAP mask, cough from CPAP, and irritation from CPAP mask (Table 1). After adjusted, there were two factors remaining in the final model (Table 2). Of those, only one factor was independently associated with purchasing CPAP in OSA patients; insomnia from CPAP. The adjusted odds ratio (95% CI) of this factor was 0.341 (0.149, 0.775). The goodness of fit of the final model by Hosmer-Lemeshow had a chi-square value of 3.08 (p value 0.378).

4. Discussion

OSA and insomnia are closely related; OSA may be found in patients with insomnia at the highest prevalence of 69% [10]. In contrast, OSA patients may present with insomnia symptom (maximum of 84%). In this study, we added knowledge that OSA patients may not purchase the CPAP machine if the patients develop disrupted sleep or insomnia while using the machine (Table 2). The chance to purchase CPAP if the patients have poor sleep from CPAP reduces by 65.9%. Additionally, baseline insomnia resulted in poor CPAP use at six months compared with those without baseline insomnia (68 vs 237 minutes; p value 0.04) [11]. While using CPAP, if the patients developed insomnia particularly difficulty maintaining sleep significantly reduced CPAP adherence with a coefficient of -0.22 (p value 0.02) [12]. These insomnia or poor sleep may occur from CPAP pressure intolerance [13].

Table 1. Factors of patients with obstructive sleep apnea (OSA) categorized by purchasing a continuous positive airway pressure (CPAP) machine or not.

Factors	Did not purchase CPAP n = 12	Purchasing CPAP n = 41	p value
Baseline characters			
Age, years	54.58 (17.9)	56.80 (14.30)	0.832
Male sex, n (%)	6 (50.00)	27 (67.50)	0.317
Body mass index, kg/m^2	30.92 (10.29)	29.75 (6.86)	0.881
Education higher than college, n (%)	6 (50.00)	31 (75.61)	0.150
Occupation: government officer, n (%)	1 (8.33)	18 (43.90)	0.038
Income over 500 USD, n (%)	6 (50.00)	32 (80.00)	0.063
Insurance type: government, n (%)	6 (50.00)	32 (78.05)	0.076
Co-morbid diseases			
Hypertension, n (%)	8 (66.67)	31 (75.61)	0.711
Diabetes, n (%)	6 (50.00)	10 (24.39)	0.150
Congestive heart failure, n (%)	2 (16.67)	2 (4.88)	0.217
Cardiac arrhythmia, n (%)	3 (25.00)	2 (4.88)	0.217
Coronary artery disease, n (%)	0	2 (4.88)	0.070
Stroke, n (%)	1 (8.33)	4 (9.76)	0.999
GERD, n (%)	0	7 (17.07)	0.329
Symptoms of OSA			
Apnea, n (%)	0	18 (50.00)	< 0.001
Excessive daytime sleepiness, n (%)	3 (25.00)	13 (31.71)	0.023
Nocturia, n (%)	3 (25.00)	21 (52.50)	0.060
Wake up during the night, n (%)	3 (25.00)	21 (52.50)	0.188
Persons influenced CPAP purchasing *			
Doctor, n (%)	7 (58.33)	37 (90.24)	0.020
Salesperson, n (%)	0	10 (24.39)	0.093
CPAP features*			
Several options of CPAP model	3.36 (0.81)	3.79 (1.10)	0.092
CPAP price**			
Reasonable price	3.80 (1.14)	4.23 (0.71)	0.265
Selling channels**			
Available product when place an order	3.80 (0.92)	4.19 (0.88)	0.189
Marketing promotions**			
Pay by installments	3.40 (1.42)	3.24 (1.34)	0.728
Post marketing services**			
Available service center	3.50 (1.35)	3.65 (1.32)	0.703
Salesperson**			
Salesperson gives adequate information	4.10 (0.99)	4.42 (0.64)	0.391
Medical personnel**			
Doctor advise on treatment	4.50 (0.70)	4.76 (0.48)	0.210
Effects of CPAP trial*			
Insomnia from CPAP	3.60 (0.96)	2.21 (1.13)	0.002
Feeling tightness from CPAP mask	3.90 (0.73)	2.54 (1.23)	0.002
Cough from CPAP	3.30 (0.82)	2.21 (1.08)	0.004
Irritation from CPAP mask	3.20 (1.31)	2.02 (1.21)	0.006
Refreshed sleep by CPAP	3.50 (1.26)	4.23 (0.97)	0.063
Dry throat from CPAP	3.30 (0.94)	2.74 (1.09)	0.154

Note. 1 USD is approximately 30 Baht; reimbursement: insurance right for CPAP reimbursement; *factors with a p value by a univariate logistic regression analysis of less than 0.20; **lowest p value by a univariate logistic regression analysis in the category; *,** used a five-level Likert scale: five indicated strongly agreed; data presented as mean (SD) unless indicated otherwise.

Several studies found that income was significantly related with CPAP purchase [8, 9, 14, 15]. High income patients had higher chance of CPAP purchasing by 2.4 times (95% CI 1.2, 4.6) [15]. In this study, even though in purchased CPAP group had higher proportion of patients with income over 300 USD than those who did not

purchase CPAP (80% vs 50%), this factor was not statistically significant (p value 0.063) as shown in Table 1. Additionally, income did not remain in the final model of the multivariate logistic regression analysis (Table2). Unlike the studies from the Western countries [8, 9, 14, 15], income or insurance with a right for reimbursement was not statistically significant in this study (Table 1). Another factor remaining in the final model for CPAP purchasing by the stepwise method was doctor advice but not statistically significant (Table 2). These findings may imply that Thai OSA patients are respect to the doctor's suggestion or advice and may be over the problem of financial or income on purchasing CPAP therapy.

Government officer had higher chance to buy CPAP machine than those who were not the government officer (43.90% vs 8.33% ; p value 0.038) as shown in Table 1. But, the government insurance was not significantly higher in CPAP purchasing group in than those who did not have the government insurance group (8.05% vs 50.00%; p value 0.076). These factors were not included in the final model for prediction of CPAP purchasing (Table 2). The results may indicate that insurance type may not affect patients'decision for CPAP purchasing. As previously discussed above, patients in the Western countries tend to buy CPAP if they have reimbursement right for CPAP [9, 14, 16]. In contrast, Thai patients may concern more on effects of CPAP than CPAP reimbursement rights (Table 2).

Table 2. Factors associated with purchasing a continuous positive airway pressure machine in patients with obstructive sleep apnea.

Factors	Unadjusted odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Insomnia from CPAP	0.330 (0.150, 0.725)	0.341 (0.149, 0.775)
Doctor advice	6.607 (1.412, 30.916)	4.258 (0.512, 35.377)

There are some limitations in this study. First, the studied variables were limited to only those appeared on the questionnaire. Further studies may be needed to confirm the results of this study. Second, the results of this study were evaluated after the three-day CPAP trial. The duration of CPAP trial in this study was shorter than the previous study which had the CPAP titration or trial of 2-week maximum [8]. Finally, the duration from CPAP trial to participation of the study was not studied. However, only insomnia from CPAP was the only significant predictor for CPAP purchase after CPAP trial with no time limit from CPAP trial. These findings may imply that the predictor may not affect by the duration from CPAP trial to study participation.

In conclusion, marketing factors were not significantly associated with CPAP purchasing. But, insomnia or poor sleep from CPAP did.

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