



## The Correlation Between Smoking Degree and Gastroesophageal Reflux Disease Using GERDQ

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### ABSTRACT

Gastroesophageal Reflux Disease (GERD) is a pathological condition caused by the reflux of stomach contents into the esophagus. The main symptoms are heartburn, acid regurgitation, dysphagia, chest pain, and nausea. It can be caused by several factors, one of which is smoking. Smoking may decrease the lower esophageal sphincter tone which causes the contents of the stomach to refluxes into the esophagus. The study was aimed to prove the correlation between the degree of smoking and Gastroesophageal Reflux Disease based on the Gastroesophageal Reflux Disease Questionnaire (GERDQ). There were 66 subjects selected by using non-probability sampling and accidental sampling methods. Data analysis was performed using the chi-square test. There were 72.7% of subjects who experienced GERD symptoms based on GERDQ and 27.3% of smokers did not develop GERD symptoms. Analysis on the smoking degree and GERD status show that 93.8% were heavy smokers, 83.3% were moderate smokers, and 50% were mild smokers group. The data analysis showed that there was a significant correlation ( $p < 0.003$ ) between smoking degrees and GERD based on GERDQ. The study concluded that there is a correlation between the degree of smoking and Gastroesophageal Reflux Disease based on GERDQ.

**Keywords:** Smoking degree, Heartburn, Reflux, Regurgitation, GERDQ.

### Introduction

Gastroesophageal Reflux Disease (GERD) is one of the most common gastrointestinal diseases in the world which may affect the quality of life and productivity of the patients.<sup>1</sup> GERD is a pathological condition caused by gastric reflux into the esophagus due to poor closure of the lower esophageal sphincter (junction between the stomach and esophagus).<sup>2</sup> The main symptoms of GERD are heartburn (burning sensation in the epigastric area), acid regurgitation, dysphagia (difficulty in swallowing), chest pain, and nausea. Serious complications caused by GERD are Barrett's esophagus, strictures, and adenoid carcinoma in the esophagus.<sup>3,4</sup>

To date, limited data are available regarding GERD in Indonesia. The results of a study conducted by the Gastroenterology Division of the Department of Internal Medicine, Faculty of Medicine, Universitas Indonesia, showed that the prevalence of esophagitis in patients undergoing endoscopic examination was 22% of all patients who had undergone endoscopic examination based on dyspepsia indications.<sup>5</sup> There are various factors of lifestyle which may increase the risk of GERD, one of which is smoking.<sup>6-8</sup> Smoking may predispose to GERD as it can reduce the tone of the lower esophageal sphincter (LES) so that it stimulates reflux from stomach contents to the esophagus and reduce bicarbonate from saliva which normally

neutralizes stomach acid.<sup>9</sup> Smoking every day for more than 20 years, the risk for developing GERD symptoms is 1.7 compared to the non-smoker.<sup>10</sup> A smoking habit begins during adolescence. According to data from WHO, from 2007 to 2010 smoking behavior begins at the age of 17.6 years old. In that period, the number of smokers increased, especially during adolescence, which was around 18.8 million to 20.3 million people aged 15-19 years old and at the age of 20-24 years was around 32.8 million to 33.8 million people.<sup>11</sup> The percentage of active smokers in Indonesia was about 32.2% at 30-34 years old and 32.0% at 35-39 years old. The percentage of male smokers was about 47.3% and 1.2% of female smokers.<sup>12</sup> The number of smokers in Indonesia now reaches 70% of the total population and about 60% of them are included in low-income population groups. Aceh is recorded to be in the top ten provinces with the highest percentage of smokers in Indonesia by an average number of cigarettes smoked per day (16 cigarettes/day). Aceh Province is also in the highest percentage of the proportion of age at first smoking (15-19 years), which is about 61.7%.<sup>12</sup> The study aimed to establish the correlation between smoking degrees and Gastroesophageal Reflux Disease based on GERDQ.

### Materials and Methods

This was an observational analytic study with a cross-sectional design. The research was conducted at Internal Medicine Department, dr. Zainoel Abidin Hospital, Banda Aceh in October 2019. All subjects met the inclusion criteria. The inclusion criteria were age  $\geq 18$  years old, active smokers, patients who complained of heartburn or regurgitation, or chest pain, or nausea. The exclusion criteria were patients who had been diagnosed with GERD by esophagogastroduodenoscopy (endoscopy), obese, patients who had received PPI therapy or using drugs such as anticholinergic, theophylline, diazepam, opiates, calcium antagonists, agonists of beta-

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adrenergic, progesterone. The sampling technique was non-probability sampling with an accidental sampling method. The number of subjects was calculated using the Lemeshow formula with a confidence interval of 95%, the proportion of GERD in the previous study was 22%, and a precision of 10%. The sample size was 66 subjects. The study has been approved by the Health Research Ethics Committee of Medicine Faculty at Universitas Syiah Kuala and Dr. Zainoel Abidin General Hospital (RSUZA), Banda Aceh (KEPPKN Registration number: 1171012P; No. 243/EA/FK-RSUDZA/2019).

Gastroesophageal Reflux Disease Questionnaire (GERDQ) was used to assess GERD. The result of measurements would be classified as not suffering from GERD if GERDQ points are  $\leq 7$  while suffering from GERD if GERDQ points are 8-18. The assessment of smoking degrees used the Brinkman Index, which is the result of multiplying the length of smoking with the average number of cigarettes smoked per day with results consisting of light smokers  $\leq 200$ , moderate smokers: 201- 600, and heavy smokers: $> 600$ .

#### Statistical analysis

The data were analyzed by using SPSS version 16 (Chicago, IL, USA) was used for descriptive (mean, percentages) and analytic statistics. Chi-square test was used to analyze the correlation between smoking degree and GERD symptoms,  $p < 0.05$  was considered significant.

## Results and Discussion

Respondent characteristics included age, gender, occupation, education, GERD status, and smoking level are shown in Table 1. The most common respondent was people between the age of 26-35 years old (18 respondents, 27.3%), all of them were male (66 respondents, 100%). The private sector was the most common occupational background (34 respondents, 51.5%) and senior high school was the highest proportion of educational background. The more active smokers are in the 26-35 years age range (27.3%). This is in accordance with data from the 2018 Basic Health Research which stated that the most active smokers are in the 30-34 year age range (32.2%). Based on gender, it was found that all respondents were male (100%). This is because most active smokers in Banda Aceh are male. This is also in line with data from Basic Health Research in 2018 where the highest number of active smokers were male with a percentage (47.3%) while female active smokers had a percentage of (1.2%).<sup>12</sup> Based on occupation, the private sector was the most common occupation of the subjects (51.5%), then followed by farmers 16.7%. This is a little bit different from Basic Health Research data in 2018 where the most active smokers were fishermen (63.7%), second place is other work (41.6%), third is farmers (40.4%) and the fourth place is private sector (36%).<sup>12</sup> Meanwhile, based on education, the results showed that the most active smokers are subjects with high school education backgrounds (45.5%). This is in accordance with Basic Health Research data in 2018 where active smokers were the people with a higher education level (28.7%).<sup>12</sup> Based on GERD status, there were 72.7% (48 respondents) who experienced GERD symptoms according to GERDQ. The proportion of mild and moderate smokers were comparable, which were 39.4% and 36.4% respectively.

#### GERD percentage based on age

The proportion of GERD subjects based on age are presented in Table 2. The most common age group who experienced GERD symptoms was 36-45 years old (21.2%), and there was a downward trend in GERD incidence in both the youngest and oldest age groups.

The study found that the most common age of respondents who experienced GERD were in the age range 36-45 years 21.2%. This is in line with the research conducted by Karina *et al.*<sup>13</sup> where it was found that more people with GERD were aged  $> 40$  years (54.45%) and subjects from the age range of 26-40 years were in the second place (34.65%). This is also in line with a study conducted by Darnindro *et al.*, where GERD patients aged 30-39 years (25.5%) are the second-largest GERD sufferers after the age of 50-59 years (29.4%).<sup>5</sup> From the previous studies, it was found that the prevalence of reflux esophagitis increases with age.<sup>5</sup> The incidence of GERD increases because increasing age is a risk factor for a person to

experience GERD which is influenced by lifestyle factors, one of which is smoking.<sup>1</sup> Apart from lifestyle factors, with increasing age there are physiological changes, namely by decreasing the production of bicarbonate of saliva which causes increased exposure to acid reflux in the esophagus due to slow acid clearance. In the elderly, people with GERD can also experience a failure of reflux episodes perception, which is due to a disturbance in the visceral sensory mechanism that causes prolonged and continuous exposure to the esophagus to reflux acid.<sup>13</sup>

#### The intensity of smoking frequency

The intensity of smoking frequency based on age was presented in Table 3. The heavy smokers were people age 56-65 years old (9.1%). Meanwhile, those in the age of 26-45 were categorized as moderate smokers (25.7% cumulatively), and those from the youngest age group (18-35 years old) were categorized as mild smokers.

Subjects who were categorized as mild smokers were the most respondents in this study (39.4%), then followed by moderate smokers in the second place (36.4%) and the last were heavy smokers (24.2%). This is in accordance with research conducted by Amelia *et al.*,<sup>14</sup> where it was found that the most subjects in her study were mild smokers (41.5%,  $n = 27$ ), the second was moderate smokers (32.3%,  $n=21$ ), and the last one was heavy smokers (26.2%,  $n = 17$ ). This occurs because the respondents were taken from various age groups and it affects the length of smoking of the respondents which causes the degree of smoking to be almost even in each category. The degree of smoking according to the Brinkman Index is the result of multiplying the duration of smoking by the average number of cigarettes smoked per day. If the results obtained are less than 200 then it is said to be a light smoker, if the results obtained are between 200-600 then it is said to be a moderate smoker, and if the results obtained are more than 600 then it is a heavy smoker.

**Table 1:** Characteristic of the subjects

	Characteristic	Frequency (n)	Percentage (%)
Age (years)	18-25	8	12.1
	26-35	18	27.3
	36-45	15	22.7
	46-55	13	19.7
	56-65	9	13.6
	>65	3	4.5
Gender	Male	66	100
	Female	0	0
Occupation	Students	6	9.1
	Government Employee	9	13.6
	Farmer	11	16.7
	Private sector	34	51.5
	Retired	6	9.1
Education	Elementary	7	10.6
	Junior High School	8	12.1
	Senior High School	30	45.5
	Higher Education	21	31.8
GERD	GERD	48	72.7
Status	No GERD	18	27.3
	Mild	26	39.4
Smoking Degree	Moderate	24	36.4
	Heavy	16	24.2

**Table 2:** GERD percentage based on age

Age (years)	GERD				Total	
	GERD		No GERD		N	%
	n	%	N	%		
18-25	4	6.1	4	6.1	8	12.1
26-35	10	15.2	8	12.1	18	27.3
36-45	14	21.2	1	1.5	15	22.7
46-55	8	12.1	5	7.6	13	1.7
56-65	9	13.6	0	0	9	13.6
>65	3	4.5	0	0	3	4.5
Total	48	72.7	18	27.3	66	100

**Table 3** Intensity of Smoking Frequency

Age (years)	Smoking Intensity						Total	
	Mild		Moderate		Heavy		n	%
	n	%	n	%	N	%		
18-25	7	10.6	1	1.5	0	0	8	12.1
26-35	11	16.7	7	10.6	0	0	18	27.3
36-45	2	3	10	15.1	3	4.5	15	22.7
46-55	4	6	4	6	5	7.6	13	19.7
56-65	2	3	1	1.5	6	9.1	9	13.6
> 65	0	0	1	1.5	2	3	3	4.5
Total	26	39.4	24	36.4	16	24.2	66	100

**Table 4** Smoking Degree and GERD Status

Smoking Degree	GERD Status				Total		P- Value
	GERD		No GERD		N	%	
	N	%	n	%			
Mild	13	50	13	50	26	100	0.003
Moderate	20	83.3	4	16.7	24	100	
Heavy	15	93.8	1	6.3	16	100	
Total	48		18		66	100	

If a person smokes for a long time and the number of cigarettes smoked is increasing, then his smoking degree will be heavier.<sup>14</sup> Nicotine is one of the substances found in cigarettes where nicotine has an addictive effect that can cause smokers to become dependent. The nicotine in cigarettes can activate the dopamine reward pathway in the brain that encourages a person to smoke continuously.<sup>15</sup> A smoker will get psychological effects such as pleasure and therefore if someone dependent is stopped suddenly it will cause a stressful effect on that person. This is the cause of someone dependent on smoking for decades.

#### *The smoking degree and GERD status*

Table 4 shows the smoking degree and GERD status of the people studied. The results showed that 72.7% of smokers experienced GERD symptoms with the highest proportion coming from heavy smokers (93.8%). In moderate smokers, 83.3% of them showed GERD symptoms. Meanwhile, in the mild smoker group, the GERD symptoms were experienced by half of the subjects (50%). The analysis of this data showed that there was a significant correlation between smoking degrees and GERD based on GERDQ.

Based on the results of the study, there was a significant correlation between the degree of smoking and Gastroesophageal Reflux Disease (GERD). There is also a decrease in chronic Lower Esophageal Sphincter (LES) as a complication of long-term smoking.<sup>1</sup> Another study conducted by Etemadi *et al.* in Southern Iran also found that smoking was associated with several reflux diseases,<sup>16</sup> likewise the HUNT study in Norway showed a correlation between smoking and the onset of GERD symptoms, and also the results show that quitting smoking can provide good benefits for GERD.<sup>17</sup> This study is also in line with the study conducted by Albayati<sup>2</sup> where the results showed an obvious correlation between smoking and the degree of esophageal injury in which erosive esophagitis was found more common in smokers than non-smokers. According to another study conducted by Jensen *et al.*<sup>18</sup> based on a cohort study of 29,610 people that quitting smoking can reduce symptoms of severe reflux in normal-weight individuals with medical treatment compared to people who continued to smoke daily.

There are two main mechanisms associated between smoking and GERD. The first is smoking can reduce the tone of the lower esophageal sphincter (LES) which causes stomach contents reflux to the esophagus. The second mechanism that causes GERD in people who smoke is a reduction in the secretion of bicarbonate of saliva which can neutralize stomach acid.<sup>19</sup> Smoking also induces a systemic inflammatory pathway that can affect the progression of GERD which subsequently progresses to Barrett's esophagus.<sup>20</sup>

#### **Conclusion**

There is a significant correlation between smoking degree and Gastroesophageal Reflux Disease (GERD) based on GERDQ ( $p < 0.003$ ).

#### **Conflict of Interest**

The authors declare no conflict of interest.

#### **Authors' Declaration**

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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