ORIGINAL RESEARCH

Assessing the Frequency and Risk Factors Associated with Gastroesophageal Reflux Disease (GERD) in Southern Punjab, Pakistan

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Purpose: Gastroesophageal reflux disease (GERD) is a highly prevalent gastrointestinal disorder with modifiable risk factors and it is associated with considerable health and economic burden. The current study was conducted to assess the frequency and risk factors related to GERD in the previously unstudied population of Southern Punjab, Pakistan.

Methods: A cross-sectional study was conducted for assessing the frequency and risk factors of GERD by using a self-administered questionnaire. The gastroesophageal reflux disease questionnaire (GerdQ) was utilized to detect the presence of the disease.

Results: The study included 308 participants; among them, 55.2% were female and 44.8% were male. The participants diagnosed with GERD (GerdQ score ≥8) were 26.6%. The various risk factors like higher BMI, past disease and smoking history, frequent use of NSAIDs, soft drinks, pickles, and spicy foods were significantly associated with GERD.

Conclusion: The present study showed that GERD is prevalent in Southern Punjab and is associated with various modifiable risk factors. The ascendance of GERD can be prevented by public health education and awareness campaigns.

Keywords: gastroesophageal reflux, GERD, risk factors, Southern Punjab

Introduction

Gastroesophageal reflux disease (GERD) is the most commonly reported disorder of the upper part of the gastrointestinal tract (GIT) and it is defined as a condition, which develops when the acid reflux from the stomach occurs into the esophagus and causes troublesome symptoms.[1,2] Heartburn and regurgitation are the most common symptoms of GERD.[3] These symptoms can potentially affect the quality of life of patients.[4] If left untreated, GERD may cause serious complications, morbidities, and economic burdens that may further necessitate lifestyle modifications, long-term management regimens, and surgical interventions.[5] Moreover, Barrett's esophagus, esophageal stricture, and esophageal adenocarcinoma are the serious complications associated with GERD.[6]

GERD has multifactorial pathophysiology that involves gastroesophageal junction.[7] The clinical picture and pathology of GERD are mainly induced by the following factors that include increased pressure and compliance on the junction, leading to pathological regurgitation of stomach acidic content.[8] In addition to that, various genetic and environmental risk factors are reported likely to be associated with the development of disease. The different lifestyle factors like consumption of soft drinks, coffee/tea, and alcohol, smoking, body mass index (BMI), usage of

nonsteroidal anti-inflammatory drugs (NSAIDs), and sleeping position are also considered to be associated with GERD.[9]

GERD has an estimated high prevalence globally with a wide range of variability among different populations because of differences in the risk factors. The worldwide prevalence of GERD reported in the recently published meta-analysis that analyzed 96 studies from 37 countries around the globe was 13.98%.[9] The prevalence rate of GERD was high among the western world, ie, North America (19.55%) and Europe (14.12%) as compared to Asia (12.92%), while in Asia prevalence rate also varied, as it was highest in Iran (18.43%) and lowest in China (4.16%).[9]

The prevalence of GERD was 22.2% to 24.0% as reported by a few hospital-based studies in Pakistan.[10–12] Due to limited data availability, a recently published global review did not provide the prevalence of GERD in Pakistan.[9] No reported data regarding the prevalence of GERD was available from Southern Punjab, which is 52% of the total area of province Punjab with 34.7 M population.[13] Therefore, if a study is conducted in Pakistan that can assess the frequency and risk factors associated with GERD it would have many implications.

The present study was conducted to investigate the frequency of GERD and its associated risk factors in Southern Punjab, Pakistan.

Materials and Methods
Study Design and Population

A cross-sectional study was conducted by using a self-administered, structured questionnaire at the Tehsil Headquarter (THQ) Hospital, Kot Addu, Southern Punjab. All the patients visiting the outpatient department from November 2019 to May 2020 were recruited for the study. The patients having age ≥10 years old with GIT symptoms, who were willing to participate, were included in the study. The individuals having any comorbidity, unable to understand the questionnaire, or who had not completed the questionnaire were excluded. A sample size of 280 participants was calculated by using Daniel's formula[14] based on the previously reported prevalence of GERD in Pakistan[10] with the precision of ±5% and a confidence interval of 95%.

Data Collection and Questionnaire

To achieve the required sample size, the simple convenient sampling technique was utilized to collect data from patients with GIT symptoms who agreed to participate.

The data was collected by using a self-administered questionnaire under the supervision of a trained data collectors' team. First, participants were provided with a brief introduction to the study and guidelines regarding filling out the questionnaire. Participants who felt difficulty in filling the questionnaire were assisted.

The questionnaire is comprised of three parts detailed in Supplementary Table S1. The first part consisted of questions about demographic data of patients, the second part was about the lifestyle and risk factors for the development of GERD and the third part was a diagnostic tool for GERD i.e., gastroesophageal reflux disease questionnaire (GerdQ). The GerdQ has 65% sensitivity and 71% specificity for the diagnosis of GERD.[15] The participants having a GerdQ score of ≥8 were considered to have the disease.

Ethical Approval

The written informed consent was received from each participant or from the parent or the legal guardian of the participant under the age of 18 years before the administration of the questionnaire. The study was conducted in accordance with the Declaration of Helsinki. The current study was approved by the ethics committee of the Department of Pharmacy Practice, Faculty of Pharmacy, Bahauddin Zakariya University Multan, Pakistan against reference number Acad/PRAC/18-20/06.

Statistical Analysis

The descriptive and inferential analysis was performed by utilizing a statistical package for the social sciences (SPSS) version 21.0 (IBM SPSS Statistics, New York, USA). The frequencies and percentages were used to present the categorical variables in descriptive analysis. While the association of lifestyle factors and risk factors with the presence or absence of GERD was analyzed by using the Chi-square (χ^2) test or Fisher's exact test as per need. To identify the possible predictors of GERD, univariate logistic regression analysis was performed. The odds ratios (ORs) with 95% confidence interval (CI) were used to express the results of the regression analysis. The significantly associated variables from the χ^2 test were only included in the regression analysis. An alpha value of <0.05 was considered statistically significant.

Results
Sociodemographic Characteristics

A total of 489 questionnaires were distributed among the individuals who agreed to participate, out of which only

315 questionnaires were collected back and lead to a response rate of 64.4%. Seven questionnaires were excluded from the final analysis due to doubling in the GerdQ part of the questionnaire. Out of 308 participants, 170 (55.2%) were female while among them 188 (61.0%) had ages ranging from 30 to 39 years. More than half of the participants (59.7%) were living in urban areas and the majority (46.8%) had a university degree. The sociodemographic characteristics of the participants are presented in Table 1.

Frequency of Gastroesophageal Reflux Disease

The participants were diagnosed with GERD based on the GerdQ score of ≥8. Among the 308 participants, 82 (26.6%) were diagnosed with symptomatic GERD while 226 (73.4%) had a GerdQ score of less than eight. The participants with GERD had statistically significant differences in sociodemographic characteristics (gender, living place, and social life) except age and education level as compared to those without GERD.

Risk Factors and Lifestyle Characteristics Related to GERD

The researcher team calculated the body mass index (BMI) of the participants that were categorized as normal weight

(18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese (≥30 kg/m^2). Out of 308 participants, 77 (25.1%) were normal weight, while 171 (55.7%) and 59 (19.2%) were overweight and obese, respectively. There was a significant difference (p=0.008) between GERD-diagnosed individuals across BMI groups. The history of GIT disease was also significantly associated (p<0.001) with the presence or absence of GERD. The details of the difference between GERD and No GERD patients across different risk factors and lifestyle characteristics are presented in Table 2.

There were significant differences in the majority of lifestyle factors (i.e., smoking history, chew pan masala, frequently use NSAIDs, frequently use soft drinks, frequently eat pickles, or frequently eat spicy meals) of GERD and no GERD participants. Among the GERD participants, the majority consume soft drinks (61.0%) and ate spicy meals (59.8%) frequently.

The Predictors Associated with GERD

The variables having a significant difference between the GERD and No GERD participants were selected for logistic regression analysis to assess the potential predictors. The selected variables were statistically significant predictors of GERD as shown in Table 3. The male participants were 1.73 times more prone to GERD as compared to

Table 1 Socio-Demographic Characteristics of the Study Participants

Characteristics		Total (N=308)		GERD (N=82)		No GERD (N=226)		*P*-value
		N	**%**	**N**	**%**	**N**	**%**	
Gender	Male	138	44.8	45	32.6	93	67.4	**0.032**
	Female	170	55.2	37	21.8	133	78.2	
Age (years)	10–19	24	7.8	06	25.0	18	75.0	0.585
	20–29	22	7.1	06	27.3	16	72.7	
	30–39	188	61.0	49	26.1	139	73.9	
	40–49	35	11.4	08	22.9	27	77.1	
	50–59	35	11.4	13	37.1	22	62.9	
	≥60	4	1.3	00	0.0	04	100.0	
Living place	Urban	184	59.7	62	33.7	122	66.3	**0.001**
	Rural	124	40.3	20	16.1	104	83.9	
Education level	Primary/Middle	40	13.0	09	22.5	31	77.5	0.227
	Secondary/Intermediate	124	40.3	28	22.6	96	77.4	
	University degree	144	46.8	45	31.3	99	68.8	
Social life	Living alone	50	16.2	27	54.0	23	46.0	**<0.001**
	With family	258	83.8	55	21.3	203	78.7	

Note: Bold fonts indicate the statistical significant *p*-value (<0.05).
Abbreviation: GERD, gastroesophageal reflux disease.

Table 2 Comparison of Risk Factors and Lifestyle Characteristics Among GERD and No GERD Participants

		Total (N=308)		GERD (N=82)		No GERD (N=226)		P-value
		N	%	N	%	N	%	
BMI groups	Normal weight	77	25.1	13	16.9	64	83.1	**0.008**
	Overweight	171	55.7	45	26.3	126	73.7	
	Obese	59	19.2	24	40.7	35	59.3	
Past GIT disease history	Yes	42	13.6	38	90.5	4	9.5	**<0.001**
	No	266	86.4	44	16.5	222	83.5	
Smoking history	Yes	32	10.4	26	81.3	6	18.8	**<0.001**
	No	276	89.6	56	20.3	220	79.7	
Chew pan masala	Yes	10	3.2	8	80.0	2	20.0	**<0.001**
	No	298	96.8	74	24.8	224	75.2	
Frequently use NSAIDs	Yes	20	6.5	12	60.0	8	40.0	**<0.001**
	No	288	93.5	70	24.3	218	75.7	
Frequently use CCB/Nitrate	Yes	46	14.9	13	28.3	33	71.7	0.785
	No	262	85.1	69	26.3	193	73.7	
Frequently use soft drinks	Yes	148	48.1	50	33.8	98	66.2	**0.006**
	No	160	51.9	32	20.0	128	80.0	
Frequently consume tea	Yes	258	83.8	68	26.4	190	73.6	0.810
	No	50	16.2	14	28.0	36	72.0	
Frequently use of fried food	Yes	269	87.3	70	26.0	199	74.0	0.531
	No	39	12.7	12	30.8	27	69.2	
Frequently eat pickles	Yes	92	29.9	33	35.9	59	64.1	**0.017**
	No	216	70.1	49	22.7	167	77.3	
Frequently eat spicy meals	Yes	152	49.4	49	32.2	103	67.8	**0.028**
	No	156	50.6	33	21.2	123	78.8	

Note: Bold fonts indicate the statistical significant p-value (<0.05).
Abbreviations: GERD, gastroesophageal reflux disease; BMI, body mass index; GIT, gastrointestinal tract; NSAIDs, non-steroidal anti-inflammatory drugs; CCB, calcium channel blocker.

females. The GERD was 4.33 times more common among the participants living alone as compared to those who were living with their families. The participants with past GIT disease and smoking history were 47.93 and 17.02 times more diagnosed with GERD as compared to other participants. The frequent use of NSAIDs and soft drinks predicted with GERD 4.67 and 2.04 times more than its non-users.

Discussion

To the best of our knowledge, the current study for the very first time determined the frequency of GERD in Southern Punjab, Pakistan, along with various factors associated with the development of disease. Based on the results of GerdQ, 26.6% of the participants were diagnosed with GERD. A similar rate of 24.0% was reported

by a study from Pakistan published in 2005.[12] A systematic review has reported the prevalence rates of 5.2–8.5% and 6.3–18.3% for GERD in Eastern Asia and Western and Southeast Asia.[16] While a recent review based on 102-studies reported a global prevalence of GERD around 13.98%, which ranges highest from Turkey 22.40% to the lowest in China 4.16%.[9]

The results of the current study indicated that GERD was more common among the male participants, which is consistent with previous studies from Pakistan.[12,17,18] Similar results were also reported by the studies from other Asian countries.[19–21] Our study also revealed the significant difference in the occurrence of GERD across the residential areas of the participants (Urban > Rural) which is consistent with a previous report from Pakistan.[18] A review of different studies around the Globe also

Table 3 The Logistic Regression Analysis to Assess Important Predictors of GERD

Predictors		B	SE	Wald	*P* -value	OR	Lower	Upper
Gender	Male–Female	0.55	0.26	4.53	**0.033**	1.73	1.04	2.89
Living place	Urban–Rural	0.97	0.29	11.25	**0.001**	2.64	1.49	4.66
Social life	Living alone–with family	1.46	0.32	20.74	**<0.001**	4.33	2.30	8.14
BMI groups	Overweight–Normal Obese–Normal	0.56 1.22	0.35 0.40	2.50 9.09	0.107 **0.003**	1.76 3.38	0.89 1.53	3.49 7.44
Past GIT disease history	Yes–No	3.87	0.55	49.33	**<0.001**	47.93	16.28	141.12
Smoking history	Yes–No	2.83	0.47	35.31	**<0.001**	17.02	6.68	43.35
Chew Pan masala	Yes–No	2.49	0.80	9.67	**0.002**	12.10	2.51	58.29
Frequently use NSAIDs	Yes–No	1.54	0.47	10.45	**0.001**	4.67	1.83	11.89
Frequently use soft drinks	Yes–No	0.71	0.26	7.34	**0.007**	2.04	1.21	3.41
Frequently eat pickles	Yes–No	0.64	0.27	5.65	**0.017**	1.90	1.12	3.24
Frequently eat spicy meals	Yes–No	0.57	0.26	4.78	**0.029**	1.77	1.06	2.96

Note: Bold fonts indicates the statistical significant *p*-value (<0.05).
Abbreviations: GERD; Gastroesophageal Reflux Disease, BMI; Body Mass Index, GIT; Gastrointestinal Tract, NSAIDs; Non-Steroidal Anti-Inflammatory Drugs, SE; Standard Error, OR; Odds Ratio

revealed a higher prevalence of GERD among participants living in urban areas.[9] The unhealthy dietary habits and physical inactivity among the urban population may be linked to the high prevalence of GERD in participants living in urban areas.[22] The frequency of GERD among the overweight and obese study participants was high. Similar findings are reported by the different studies.[9,20,23–25] Pathophysiological changes like lower esophageal sphincter abnormalities, esophageal motor disorders, and increased intragastric pressure due to obesity are the reasons for high prevalence among individuals with higher BMI.[26] The GERD symptoms were more prevalent in participants with a history of GIT disease. These results are consistent with a previously published report in which the majority of participants had a previous history of dyspepsia, GERD, and peptic ulcer disease.[10]

Lifestyle characteristics play an important role in the development of GERD. Different lifestyle factors like smoking history, chewing of pan masala, frequent use of NSAIDs, soft drinks, pickles, and spicy meals were significantly associated with the occurrence of GERD in the current study. The high prevalence of GERD in pan masala chewers has been reported previously in studies from South-East Asia.[27,28] The pan masala is also a form of chewable tobacco that contains betel leaf, tobacco, lime, and sometimes Katha paste also. These ingredients may reduce the pressure of the lower esophageal sphincter during chewing, which could be the reason for the association of pan masala with the development of GERD.[28] Previous studies from Pakistan also reported the frequent use of NSAIDs and spicy fried meals as significant factors related to the development of GERD.[12,18] A recently published review also reported a high global prevalence rate of GERD in smokers and frequent users of NSAIDs and carbonated drinks.[9] Smoking causes the reduction in lower esophageal sphincter pressure,[29] while carbonated drinks increase the gastric acid volume, which causes acid reflux.[30]

The current study identified various modifiable risk factors of GERD, which may be the cause of the high frequency of GERD in the studied population. Pakistan is the ninth most obese nation in the world while these numbers are still growing.[31] The prevalence of tobacco use is increasing day by day in the Pakistani population, which is also a major risk factor to the development of diseases including GERD.[32] Keeping in view the increasing trend of risk factors associated with GERD in Pakistan, it is expected that its frequency will increase in coming years.

Strength and Limitation

The study utilized GerdQ for the diagnosis of GERD, which is a well-validated and reliable tool with reported

high sensitivity and specificity,[15] which can be accounted as its strength. The assessment of participants in the study was done on a symptoms-based approach and a relatively small sample size was used which may be a potential limitation of this study.

Conclusion and Recommendations

This study revealed that GERD is highly prevalent in Southern Punjab, Pakistan. The current study also identified many modifiable risk factors that can considerably affect the ascendance of the disease. The burden of disease can be reduced by managing these risk factors through public awareness and health education campaigns. In the future, detailed studies with a larger portion of the population are required for a more descriptive analysis of risk factors and prevalence of the disease.

Abbreviations

GERD, gastroesophageal reflux disease; BMI, body mass index; GIT, gastrointestinal tract; NSAIDs, non-steroidal anti-inflammatory drugs; CCB, calcium channel blocker; OR, odds ratio; SE, standard error.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Hungin APS, Molloy-Bland M, Scarpignato C. Revisiting Montreal: new insights into symptoms and their causes, and implications for the future of GERD. *Am J Gastroenterol*. 2019;114(3):414. doi:10.1038/s41395-018-0287-1
2. Vakil N, Van Zanten SV, Kahrilas P, Dent J, Jones R. The Montreal definition and classification of gastroesophageal reflux disease: a global evidence-based consensus. *ACG*. 2006;101(8):1900–1920.
3. Estores DS. Symptom predictability in gastroesophageal reflux disease and role of proton pump inhibitor test. *Gastroenterol Clin*. 2014;43 (1):27–38. doi:10.1016/j.gtc.2013.11.002
4. Isshi K, Furuhashi H, Koizumi A, Nakada K. Effects of coexisting upper gastrointestinal symptoms on daily life and quality of life in patients with gastroesophageal reflux disease symptoms. *Esophagus*. 2021;18(3):684–692. doi:10.1007/s10388-020-00801-1
5. Guan XL, Wang H. Quality of life scales for patients with gastro-esophageal reflux disease: a literature review. *Int J Nurs Sci*. 2015;2 (1):110–114. doi:10.1016/j.ijnss.2015.02.003
6. Fontan FM, Carroll RS, Thompson D, Lehmann RK, Smith JK, Nau PN. Current management of gastroesophageal reflux disease in the obese population-a review of the literature. *Mini Invasive Surg*. 2020;4:29.
7. Menezes MA, Herbella FA. Pathophysiology of gastroesophageal reflux disease. *World J Surg*. 2017;41(7):1666–1671. doi:10.1007/s00268-017-3952-4
8. Samo S, Qayed E. Esophagogastric junction outflow obstruction: where are we now in diagnosis and management? *World J Gastroenterol*. 2019;25(4):411. doi:10.3748/wjg.v25.i4.411
9. Nirwan JS, Hasan SS, Conway BR, Ghori MU. Global prevalence and risk factors of gastro-oesophageal reflux disease (GORD): systematic review with meta-analysis. *Sci Rep*. 2020;10(1):1–14. doi:10.1038/s41598-020-62795-1
10. Butt AK, Hashemy I. Risk factors and prescription patterns of gastroesophageal reflux disease: HEAL study in Pakistan. *J Pak Med Assoc*. 2014;64(7):751–757.
11. Riaz H, Kamal SW, Aziz S. Students' Corner Gastroesophageal reflux disease (GERD) in students of a government medical college at Karachi. *JPMA*. 2010;60(2):147.
12. Jafri N, Jafri W, Yakoob J, et al. Perception of gastroesophageal reflux disease in urban population in Pakistan. *JCPSP*. 2005;15 (9):532–534.
13. PBS. Population Census. Available from: https://www.pbs.gov.pk/content/final-results-census-2017. Accessed August 10, 2021.
14. Daniel WW, Cross CL. *Biostatistics: A Foundation for Analysis in the Health Sciences*. Wiley; 2018.
15. Jones R, Junghard O, Dent J, et al. Development of the GerdQ, a tool for the diagnosis and management of gastro-oesophageal reflux disease in primary care. *Aliment Pharmacol Ther*. 2009;30 (10):1030–1038. doi:10.1111/j.1365-2036.2009.04142.x
16. Jung HK. Epidemiology of gastroesophageal reflux disease in Asia: a systematic review. *J Neurogastroenterol Motil*. 2011;17(1):14. doi:10.5056/jnm.2011.17.1.14
17. Karim S, Ali H, Zehra SN, Faryal A, Khalid T, Mujtaba G. Anthropometric modification can be useful for gastro-esophageal reflux disease symptoms; which parameter should be targeted most? In a Tertiary Care Hospital at Karachi. *Natl Editor Advisor Board*. 2019;30(8):59.
18. Warsi I, Ahmed J, Younus A, et al. Risk factors associated with oral manifestations and oral health impact of gastro-oesophageal reflux disease: a multicentre, cross-sectional study in Pakistan. *BMJ Open*. 2019;9(3):e021458. doi:10.1136/bmjopen-2017-021458
19. Alrashed AA, Aljammaz KI, Pathan A, et al. Prevalence and risk factors of gastroesophageal reflux disease among Shaqra University students, Saudi Arabia. *J Fam Med Prim Care*. 2019;8(2):462. doi:10.4103/jfmpc.jfmpc_443_18
20. Halawani H, Banoon S. Prevalence and determinants of gastroesophageal reflux disease and the risk factors among adult patients attending Al-Iskan primary health care center in Makkah, 2020. *Cureus*. 2020;12(9):e10535.
21. Chowdhury SD, George G, Ramakrishna K, et al. Prevalence and factors associated with gastroesophageal reflux disease in southern India: a community-based study. *Indian J Gastroenterol*. 2019;38 (1):77–82. doi:10.1007/s12664-018-00931-6
22. City, Better Life, and E. Assessment. Urbanization and health. *Bull World Health Organ*. 2010;88(4):245–246.
23. Kariri AM, Darraj MA, Wassly A, et al. Prevalence and risk factors of gastroesophageal reflux disease in Southwestern Saudi Arabia. *Cureus*. 2020;12(1):e6626.

24. Alkhathami AM, Alzahrani AA, Alzhrani MA, Alsuwat OB, Mahfouz MEM. Risk factors for gastroesophageal reflux disease in Saudi Arabia. *Gastroenterol Res.* 2017;10(5):294. doi:10.14740/gr906w

25. Kim O, Jang HJ, Kim S, et al. Gastroesophageal reflux disease and its related factors among women of reproductive age: Korea Nurses' Health Study. *BMC Public Health.* 2018;18(1):1–8. doi:10.1186/s12889-018-6031-3

26. Chang P, Friedenberg F. Obesity and GERD. *Gastroenterol Clin.* 2014;43(1):161–173. doi:10.1016/j.gtc.2013.11.009

27. Ahmed S, Jamil S, Shaikh H, Abbasi M. Effects of Life style factors on the symptoms of gastro esophageal reflux disease: a cross sectional study in a Pakistani population. *Pak J Med Sci.* 2020;36(2):115.

28. Wang H-Y, Leena KB, Plymoth A, et al. Prevalence of gastro-esophageal reflux disease and its risk factors in a community-based population in southern India. *BMC Gastroenterol.* 2016;16(1):1–6. doi:10.1186/s12876-016-0452-1

29. Kahrilas P, Gupta R. Mechanisms of acid reflux associated with cigarette smoking. *Gut.* 1990;31(1):4–10. doi:10.1136/gut.31.1.4

30. Johnson T, Gerson L, Hershcovici T, Stave C, Fass R. Systematic review: the effects of carbonated beverages on gastro-oesophageal reflux disease. *Aliment Pharmacol Ther.* 2010;31(6):607–614. doi:10.1111/j.1365-2036.2010.04232.x

31. Siddiqui M, Hameed R, Nadeem M, et al. Obesity in Pakistan; current and future perceptions. *J Curr Trends Biomed Eng Biosci.* 2018;17:001–004.

32. Basit A, Younus BB, Waris N, Fawwad A. Prevalence of tobacco use in urban and rural areas of Pakistan; a sub-study from second National Diabetes Survey of Pakistan (NDSP) 2016–2017. *Pak J Med Sci.* 2020;36(4):808. doi:10.12669/pjms.36.4.1705