Original Research Article

Prevalence of xerostomia and associated systemic risk factors in Riyadh, Saudi Arabia: A cross-sectional study

ABSTRACT

Purpose

The present cross-sectional study investigated the prevalence of xerostomia among Saudi population and explore the possible risk factors associated with this condition.

Methods

Demographic data (Age, gender) and complete medical history were obtained from participants. All participants were requested to fill the Xerostomia-Inventory (XI) questionnaire in their native language. Comparisons between mean scores of XI-inventory and categorical variables like gender, comorbid conditions were made with students t-test or Wilcoxon test. Chi-square or Fischer's Exact test were used for comparison between categorical variables like gender and responses to XI-items (No/Yes). P value of <0.05 was considered significant. All analysis was done on JMP-version-12.

Results

Total 418-participants with mean age (41.1 ± 12.8 years) were included in the study in which 302-participants (72.2%) were female and 116-participants (27.8%) were male. Xerostomia's prevalence was 24.7% and it was higher in males (34%) as compared to females (21%). A statistically-significant association was found between xerostomia and participant's age ($P < 0.0001$). The participants with systemic illness showed a significantly higher mean Xerostomia Inventory (XI) score as compared to the healthy patients. In our study population common comorbid conditions were hypertension and diabetes.

Conclusion

The xerostomia prevalence in the current study population was 24.7% i.e. about one in four people is suffering from xerostomia. The prevalence of xerostomia increases with increasing age and it has strong positive co-relation with chronic systemic diseases such as hypertension, diabetes and neuro-psychological disorders

Keywords: Dry mouth, Xerostomia, Systemic diseases, Prevalence

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INTRODUCTION

Xerostomia is the subjective feeling of dry mouth[1]. Individuals having xerostomia do not have sufficient amount of saliva to keep their mouth moist and wet. Saliva is a clear, watery fluid secreted by major (parotid, submandibular, and sublingual) and minor salivary glands [2]. Saliva has many functions like maintenance of oral homeostasis, lubrication of oral mucosa, swallowing, speaking and digestion along with antimicrobial and antifungal properties[3] . Diminished salivary flow causes increase rate of dental caries, gingivitis, dysgeusia, oral infections resulting in mucosal lesions, oral halitosis and burning mouth syndrome [4, 5]. Salivary flow rates are commonly affected by systemic diseases, medications, radiotherapy, chemotherapy, stress, anxiety and depression [6-9]. Autoimmune disorders such as Sjogren syndrome, sarcoidosis and local factors like sialolithiasis, sialadenitis and has been strongly associated with xerostomia. As per recent literature the two variables such as age and salivary flow rate are independent of each other in healthy individuals [10]. Epidemiological studies have estimated the prevalence of xerostomia between 1% and 62 % depending on the population age, health characteristics, study designs and xerostomia measurement methods [11]. The prevalence varies according to gender lying between 13–26% in men and approximately 20–46% in women [12].

Hyper or hyposalivation has a negative impact on individual's quality of life causing numerous clinical and social problems [13] . Diagnosis for dry mouth is based on detailed patient's history, clinical examination and required investigations. As xerostomia is the subjective feeling of dry mouth, so it can be assessed simply by asking few simple questions [14].

The xerostomia inventory (XI) is a validated and frequently used questionnaire, that can help in the diagnosis of dry mouth (Xerostomia) in the clinical setting [15]. This questionnaire consists of 11 items, each on a 5-point Likert scale.

Many studies in the past has mentioned, xerostomia as frequently encountered problem and has measured its prevelance globally and shows variation among different areas and age groups [16]. Moreover, studies have a disparity in the inclusion criteria and methodologies for assessment. To our knowledge few studies have been conducted in Saudi Arabia exploring different aspects of xerostomia. There is still much to discover about dry mouth and its related problems. Therefore, the present study was conducted with an aim study to investigate the prevalence of xerostomia among patients presented to our oral medicine and oral maxillofacial surgery clinics and analyze the possible risk factors associated with this condition.

MATERIALS AND METHODS:

This cross-sectional study was conducted after approval from hospital ethical committee at King Salman Hospital, department of dentistry, Ministry of Health, Riyadh, Saudi Arabia. The sample size was calculated by using the Research Advisors- 2006; with a confidence interval of 95%, a margin of error of 5% and an estimated proportion of the population suffering from xerostomia to be (p=0.5). By using Cochrane's sample size formula, the calculated minimal sample size was 385. To allow for attrition and missing data we inflated the sample size by 10%.

Data was collected from patients, presented to the diagnostic clinics, dental OPD, referral patients from primary health center of Riyadh region, patients through tanseeq system and referral patients from other spatiality clinics within the hospital between December 2016 to December 2019. Patients having a history of radiotherapy or chemotherapy were not included in the study. All patients who gave the consent to participate in the study were included. Demographic information such as age and gender were obtained from participants. A complete medical history of the participants was also recorded. Participants were divided into four age groups based on the quantile distribution and is depicted in Figure 1.

Data was collected on eight possible comorbid conditions based on previous literature search [17]. These included hypertension, diabetes, renal disease, respiratory symptoms, joint pains, liver disease, psychiatric symptoms or oral pain during eating. Only those who were on medication and suffered from chronic diseases were designated as having that particular medical condition. All patients were requested to fill the Xerostomia Inventory (XI) questionnaire in their native language. Xerostomia Inventory (XI) is an 11-item summated rating scale and Individuals were asked to choose a response to Xerostomia Inventory based on their last six weeks experience (Table-1). Five-point Likert scale with a score of 1= Never, 2= Hardly ever, 3= Occasionally, 4=Fairly often, and 5=Very often was utilized to evaluate participants perception regarding dry mouth (Table-1). The combined total score was calculated from all responses, a high total score represented the severity of the underlying xerostomia.

Statistical analysis

Mean and standard deviation were reported for continuous variables like age while frequency and percentages were reported for categorical variables like gender. Responses to questions of xerostomia inventory were reported as frequency of response and percentage to each of the 5 possible Likert scale options. For the purpose of further comparison “Fairly often” and “Very often” were combined as “Yes” and “Never”, “Occasionally” and “hardly ever” were combined as “No”. Comparisons between mean scores of XI inventory and categorical variables like gender and comorbid conditions was made with students t-test or Wilcoxon test where assumptions were violated. Chi-square or Fischer’s Exact test were used for comparison between categorical variables like gender and responses to XI items (No/Yes). P value of <0.05 was considered significant. All analysis was done on JMP version 12, SAS Institute INC.

Results:

A total of 467 participants were examined and 442 participants agreed to contribute in the study. Out of 442 participants, 24 were excluded from the study due to incomplete questionnaire. Total 418 participants were included in the study in which 302 participants (72.2%) were female and 116 participants (27.8%) were male.

The age range was from 21-74 and mean age of the participants was 41.1 ± 12.8 years. Patients were divided into four age groups based on the quantile distribution, 112 participants (26.8%) were in group 1 (20-31 years); 103 participants (24.6%) were in group 2 (32-39 years); 108 participants (25.8%) were in group 3 (40-51 years); and 95 participants (22.7%) group 4 (>51 years).

The data on the distribution of responses to Xerostomia Inventory (XI) is presented in Table 1. For purpose of analysis, “fairly often” and “often” responses to the standard question “Does your mouth feel dry?” were combined together as “Yes” shown in Table 2. The prevalence of xerostomia (response “Yes”) was 24.7% (103 participants; 64 females and 39 males) and presented in Table-2. Prevalence of xerostomia was higher in males (34%) as compared to females (21%). The prevalence of xerostomia increased with increasing age and statistically significant association was found between xerostomia and participant’s age ($P < 0.0001$). The relationship between xerostomia and participant’s age is depicted in Table-3 and Figure 1.

In the present study population, the distribution of associated comorbid conditions is depicted in Figure-2a. The distribution of systemic disease among participants with Xerostomia is presented in Figure-2b. In the present study population, 34% of patients had hypertension, 27% of patients were diabetic, and 6% of patients had depression/stress/anxiety. Approximately 5% of the study population reported Sarcoidosis; 4 % renal disease; 1% hepatitis C and 1% Sjogren Syndrome respectively. Only 2% patient had demonstrated local causes of xerostomia. In our study population most common reason for multifactorial

etiology is hypertension and diabetes. The participants with systemic illness showed a significantly higher mean Xerostomia Inventory (XI) score as compared to the healthy patients (Table-4).

Discussion

Saliva plays an essential role in the oral cavity to establish homeostasis, act as a lubricant, form a protective layer over oral mucosa and protect it from thermal or mechanical trauma, toxins, carcinogens and ulcerations [18]. The lack of salivary flow can cause difficulty in function, chewing and eating [19] therefore, has an effect on the quality of life of the patient [20-22]. These patients are also prone to dental caries [23, 24], halitosis [25] and other oral complications [18]. In addition to oral problems, xerostomia might have an effect on the general well-being of the sufferer and it sometimes result in loss of appetite, malnutrition, impaired social interactions, and possibly even depression, therefore negatively influencing the daily routine of patients [20, 21]. It is important that medical and dental practitioners take comprehensive medical history of all patients and establish early assessment of dry mouth and identify the associated systemic risk factors of xerostomia [18].

In view of above mentioned, the present cross-sectional study was carried out to estimate the prevalence of xerostomia in Saudi population and associated systemic risk factors and give the clinicians an overall estimate of patient presenting with the signs and symptoms of xerostomia. First of all, Knowledge of prevalence is vital for clinicians in order to have a thorough understanding of the condition in their patient population and secondly to decide whether any intervention is required or not and awareness of all possible preventive measures and effective as well as efficient treatment options [26].

In epidemiological studies, a case definition is necessary before planning any estimation of the prevalence of a condition. Xerostomia is defined as the subjective feeling of dry mouth. It has been suggested that it can only be estimated by directly asking questions to the study population. With respect to

study design, the present cross-sectional study is a descriptive epidemiological study of xerostomia. According to Thomson et al. 2005 [26], a cross-sectional study design (questionnaire) should be used for this type of study which specify a description of the occurrence of a condition (i.e., the prevalence of xerostomia in the present study) in a study population and other contributing elements that may be involved. Many studies have used a single item (absence or presence) to evaluate the xerostomia among their study population. Fox et al. (1987)[14] had described the four-question model to classify individuals with both xerostomia and salivary gland hypofunction. Thomson et al. (1999b) [15] established the 'Xerostomia Inventory' (XI), it is an 11-item assessment which combines the responses to 11 individual items into a single summated score which represents the severity of xerostomia in contrast to the battery of items which are eventually analysed separately. The essential items represent the experiential as well as behavioural aspects of the xerostomia. The xerostomia inventory' (XI) score XI provides a continuous score which allows more accurate differentiation between individuals regarding the severity and presence of symptoms of xerostomia. It reduces the possibility for misinterpretation which might happen when only single item approach is utilized (normal vs. xerostomia) to define the condition. The XI scale was also further endorsed in another a study in which two groups of participants were evaluated over a time span of 6 months. The first group consisted of cancer participants who were receiving radiotherapy for head/neck region and the second group was a control group of elderly volunteers (≥60 years of age) [27]. The major drawback of this method is that no cut-off values for xerostomia inventory are reported in the literature. Therefore, it was suggested that, if the XI score is to be employed, it should be used along with at least one of the other single- item measures to further validate the xerostomia inventory' (XI) score [26]. Therefore, in the present study, single item (answer to question 1) as well as xerostomia inventory' (XI) score were utilized for analysis. The strong co-relation was found between the positive answer to question one (Q1) and XI score. The individuals with a positive response to the Q1 exhibited significantly

higher XI score (36.2±9.0) as compared to the individual who answered no to the Q1 (17.0±4.7).

The xerostomia prevalence in the current study population was 24.7%. A recent meta-analysis of population-based studies has estimated the overall prevalence of dry-mouth to be 23.0% (95%CI; 18.0-28.0%) with high heterogeneity among different studies [11]. Another systematic review reported the prevalence of xerostomia from epidemiological studies of older populations range from 12 to 39% [26]. The high variability in xerostomia estimates has been credited to differences in study design, assessment methodology, study population, and the age of the participants [26]. Different studies have utilized different tools to assess the prevalence of dry mouth e.g., self-reported questionnaires [28, 29], stimulated or un-stimulated salivary flow rate [30, 31]. Even in the studies who have done the xerostomia assessment through self-report, different methods of measurements are employed such as some studies report only presence or absence of xerostomia [32-34], some studies evaluate the frequency of a sensation of dry mouth [21, 22, 35] and others have used Xerostomia Inventory (XI).

Increasing age has been stated as a one of risk indicator for xerostomia [11, 15, 33, 35]. In the present study, the prevalence of xerostomia was 0% in group 1 (20-31 years); 5% in group 2 (32-39 years); 29% group 3 (40-51 years); and 71% in group 4 (>51 years). In our study population ageing seems to be determinant of occurrence of xerostomia. Many studies have shown similar results and have demonstrated an increase in the prevalence of Xerostomia with increasing age [12, 36]. Most of the studies carried out in older population and only a few studies conducted in both populations of young adults and elderly individuals. Thomson et al. [37] observed 20% xerostomia prevalence in elderly people as compared to only 10% in an adult population [38]. Similar observation was reported by Benn et al. [21] in a nationally based study population, in which the prevalence of xerostomia was 5% in the younger age group (18-24) and 26% in the individuals aged 75 years or older, however, no consistent age gradient was reported [21].

There is enough evidence that the association of xerostomia with age is not merely due to the aging process itself. Old age is associated with significant increases in comorbid chronic systemic conditions which consequently result in increase of use of medications in elderly population. Chronic diseases such as diabetes, autoimmune diseases, especially Sjogren's Syndrome [34], hypertension, renal disease, respiratory symptoms, joint pains, liver disease, psychiatric symptoms [38-40] and polypharmacy [29, 41, 42] are recognized as major predisposing factors for xerostomia. In the present study, 30% of the patients with diabetes had xerostomia. The positive co-relation was found between Xerostomia and diabetes. Narhi et al. [43] also reported a relationship between xerostomia and diabetes. Shirzaiy et al. 2016 [44] has observed 66.7% of the diabetic patients had xerostomia. In another study, Sreebny et al. [45] found that 40%- 80% of patients with diabetes suffer from xerostomia.

In the present study the highest percentage (100%) of xerostomia was observed in patients suffering from depression/anxiety and using medication for this purpose. Similar to our finding, several studies had reported the higher occurrence of xerostomia in patients with neuro-psychological disorders [20]. In addition, other studies have shown that the use of tranquilizers and antidepressant drugs in patients with phycological disorders might result in worsening of the symptoms of xerostomia [38-40] by reduction in salivary secretion and consequent decrease in moisture of mucous membrane of the oral cavity [20].

In the present study no association was found between gender and xerostomia. Our results are were consistent with the results of Orellana et al. [12], Murray et al. [20] and Farsi et al. [39] studies who could not find any relationship between these two variants i.e. gender and xerostomia. Conversely, Shirzaiy et al. 2016 [44]; Fox et al. study [14] and Nederfors et al. [36] demonstrated the prevalence of Xerostomia higher in Women as compared to men. This might be explained by the fact that in current study population, 35.3% of males and only 17.8% females were in group 4 (age>51 years).

The present study has included participants with wide age range including young as well as elderly individuals, healthy as well participants with one or more than one systemic disease. However, the limitation of the present cross-sectional study was that participants were recruited from a dental hospital who came to the hospital with some dental problems. Therefore, the results of the present study might represent an overestimate of the prevalence of xerostomia. There is a substantial need to carry out further Population-based studies.

Conclusion

The xerostomia prevalence in the current study population was 24.7% i.e. about one in four people is suffering from signs and symptoms of xerostomia. The prevalence of xerostomia increases with increasing age and it has strong positive co-relation with chronic systemic diseases such as hypertension, diabetes and neuro-psychological disorders. In some cases, no predisposing factors for xerostomia were reported and therefore, it is necessary to perform further investigations in these patients to rule out any local or systemic causes of this condition. In addition, dental and medical practitioners should carefully take the patients' medical history as well as dental history and should ask xerostomia-related questions especially in elderly population and in patients with history of polypharmacy. Health care providers have a responsibility of early detection of xerostomia and providing appropriate prevention and treatment advice to their patients.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge.

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Table 1: Distribution of responses to Xerostomia Inventory (XI). Score of **Response to each Question; Never =1; Hardly ever = 2; Occasionally= 3; Fairly often= 4 and Very often=5**

Questions	Never		Hardly ever		Occasionally		Fairly often		Very often		Mean ± SD
	N	%	N	%	N	%	N	%	N	%	
My mouth feels dry	93	22.2	107	25.6	115	27.5	66	15.8	37	8.8	2.63±1.24
I have difficulty in eating dry foods	133	31.8	108	25.8	106	25.4	51	12.2	20	4.7	2.32±1.18
I get up at night to drink	226	54.1	82	19.6	75	17.9	23	5.5	12	2.8	1.83±1.08
My mouth feels dry when eating a meal	166	39.7	95	22.7	82	19.6	60	14.3	15	3.5	2.19±1.21
I sip liquids to aid in swallowing food	163	39.0	118	28.2	77	18.4	38	9.1	22	5.2	2.13±1.18
I suck sweets or cough lolies to relieve dry	237	56.7	83	19.9	61	14.6	30	7.2	7	1.6	1.77±1.05

mouth											
I have difficulties swallowing certain foods	166	39.7	96	23	92	22.0	47	11.2	17	4.0	2.17±1.19
The skin of my face feels dry	247	59.1	102	24.4	38	9.1	23	5.5	8	1.9	1.67±0.98
My eyes feel dry	253	60.5	108	25.8	44	10.5	6	1.4	7	1.6	1.58±0.86
My lips feel dry	147	35.2	179	42.8	49	11.7	29	6.9	14	3.3	2.00±1.02
The inside of my nose feels dry	319	76.3	50	12	34	8.1	10	2.4	5	1.2	1.40±0.83

*Wilcoxon test [#]Yes= (Fairly often + very often)

Table 2: Modified Responses to Standard Question for diagnosis of Xerostomia

My mouth feels dry	**N**	**%**	**Mean XI score ± SD***
Yes[#]	103	24.7	36.2±9.0
No	315	75.3	17.0±4.7

*Wilcoxon test [#]Yes= (Fairly often + very often)

Table 3. Association of age with Xerostomia score

Age category Years	Number	Mean XI score	Std Dev	p-value*
<32	112	13.2679	1.6107	<0.0001
32-39	103	16.9126	4.2127	
40-51	108	23.5648	7.2192	
>51	95	34.7789	10.0076	

*Annova was done

Table 4: Relationship of Xerostomia with Systemic illness

	My mouth feels dry		***p-value®***	**XI score**		***p-value$^{\beta}$***
	No N (%)	**Yes N (%)**		**Mean**	**Std Dev**	
Hypertension						
No	238 (56.9)	39 (9.3)	0.03	19.45	9.7	<.0001
Yes	109 (26.1)	32 (7.7)		26.1	9.8	
Hepatitis C						
No	346 (82.8)	67 (16)	0.003*	21.51	10.1	0.003
Yes	1 (0.24)	4 (0.96)		38.4	9.2	
Diabetes						
No	268 (64.11)	37 (8.8)	<0.0001	19.3	9.05	<0.0001
Yes	79 (18.90)	34 (8.1)		28.23	10.5	
Sjogren Syndrome						
No	346 (82.8)	67 (16)	0.003*	21.44	10.0	0.0006
Yes	1 (0.24)	4 (0.96)		44	7.2	
Sarcoidosis						
No	332 (79.4)	66 (15.8)	0.03	21.4	10.2	0.002
Yes	15 (3.6)	5 (1.2)		27.4	10.3	
Renal diseases						
No	336 (80.4)	64 (15.3)	0.02*	21.3	10.1	0.001
Yes	11 (2.6)	7 (1.7)		28.77	11.6	
Depression/ Anxiety/Stress						
No	334 (79.9)	58 13.9)	<0.0001	21.04	9.8	<0.0001
Yes	13 (3.1)	13 (3.1)		31.8	10.9	
Local Causes						
No	342 (81.8)	67 (16)	0.05	21.51	10.2	0.001
Yes	5 (1.2)	4 (0.96)		30.6	7.3	

®chi-square test *Fischer's exact test $^{\beta}$ Wilcoxon test

Figure-1

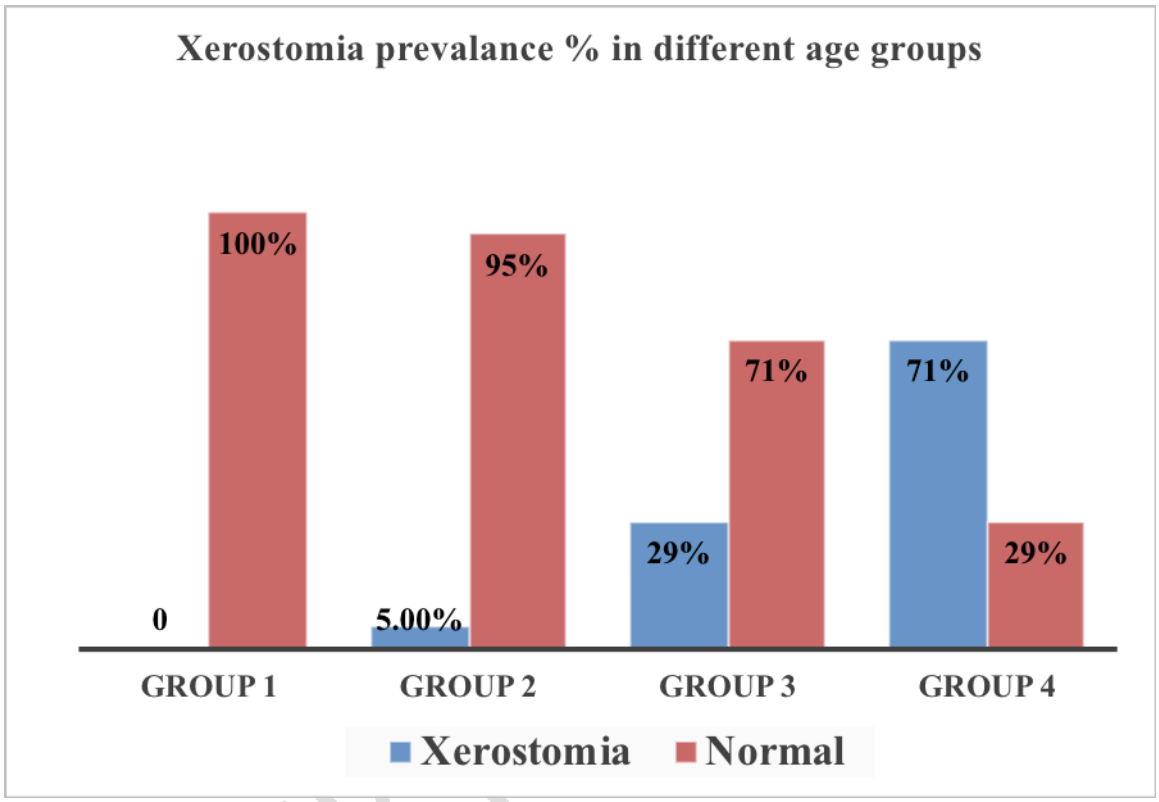
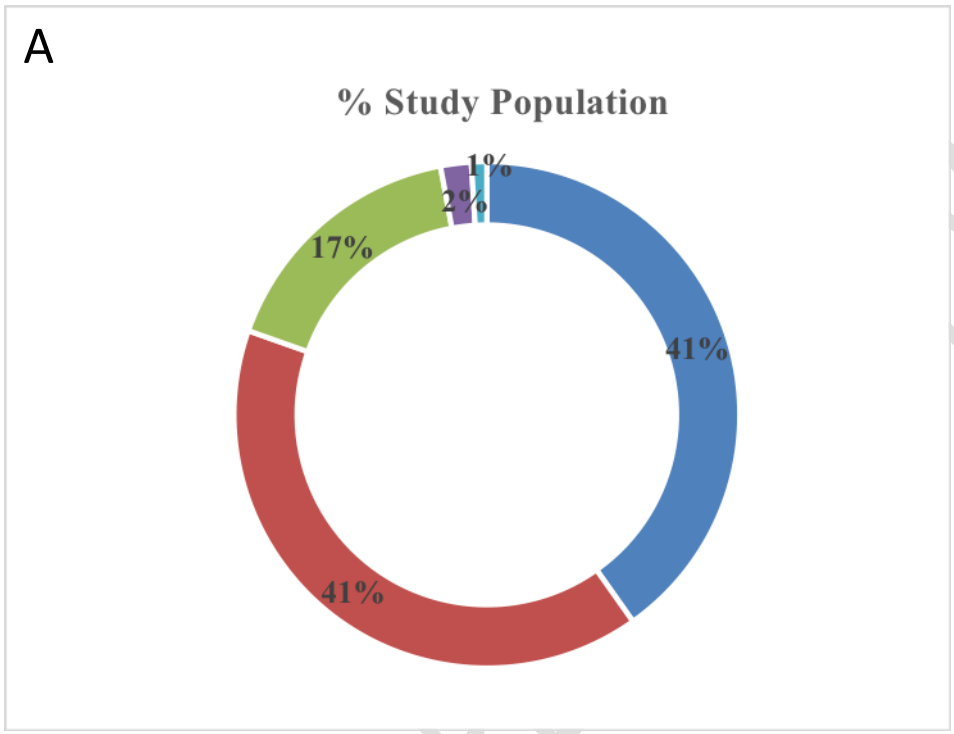


Figure 2



B