Original Article

Relationship between tinnitus and headache in Riyadh, Saudi Arabia

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Abstract

Objective: Our aim was to estimate prevalence rates of different headache forms among tinnitus patients in Arabia, to investigate whether there is a relationship between tinnitus laterality and headache laterality in patients with unilateral tinnitus and unilateral headache, to explore the relationship between tinnitus and headache over time, and to know the effect of headache pain medications in tinnitus in Riyadh, Saudi Arabia. **Method:** The study is a quantitative observational cross-sectional study with a convenient sample by data from patients with tinnitus. The participants received a self-administrated electronic questionnaire measuring demographics, prevalence of an associated headache, and the relationship between tinnitus and headache. **Results:** A total of 226 patients enrolled themselves into the study, and all of them came from the capital city Riyadh of Saudi Arabia. 58% were females, and the remainder of them were males. Females reported significantly more ear tinnitus than males, and patients aged 51 years or older were significantly less inclined to report ear tinnitus compared to those younger; however, those aged 20–31 years were found to be significantly more inclined to report ear tinnitus. There was a statistically significant association between patients experiencing headaches and those experiencing ear tinnitus. Surprisingly, patients who take medications of any type to alleviate their headaches were significantly less inclined to report ear tinnitus than those who do not take medications. However, patients with ear tinnitus experienced longer headache duration in years than those who had no history of tinnitus. Moreover, those people who experienced right-sided tinnitus tended to report significantly more right-sided headaches, and the same goes for left-sided headaches. **Conclusion:** Our results showed that there is a relationship between headaches and tinnitus. Painkillers also showed a protective effect against tinnitus. High awareness about the relationship between headaches and tinnitus among physicians and patients may lead to early recognition and lead to early implementation of primary prevention, which is the cornerstone of family medicine practice, and treatment without referring to other specialties. However, the pathophysiology is still not clear. Further studies should be performed to know the pathophysiology.

Keywords: Headache, migraine, tinnitus

Introduction

Tinnitus is a phenomenon where the individual hears a sound while there is absence of external sounds.[1]

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It is agreed that the etiology of tinnitus might be idiopathic or indirectly related to possible factors such as gender, age, hearing loss, noise exposure, middle ear pathology, neurological or psychological changes, arthritis, or thyroid disease.[2] Moreover, tinnitus severity was investigated and showed a positive indirect relation to the hearing loss as well as to noise exposure,[3] and the possibility of genetic factors contributing to the development of tinnitus has not been well explored.[4] Additionally, they found an association of unilateral tinnitus

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to accumulated cerumen in the ear canal.[5] The motioned risk factors will be considered during the current study among migraine participants.

Migraine is the most common neurological cause of disability in the world.[6] There are some pathologies that can combine these two together, such as traumatic brain injury, arteriovenous malformations, intra-cranial hypo- or hypertension,[7] and carotid artery dissections.[8,9] However, in an epidemiological study of elderly people, it has been identified that a history of migraine is a risk factor for the development of tinnitus.[10] Moreover, in some other studies, it has been shown that patients with tinnitus who also suffer from headaches are between 26 and 47%.[11,12] In other studies conducted in Sweden and China, it has been suggested that headaches could contribute to tinnitus distress and potentially its severity.[13-15] There are no studies conducted about this topic in Saudi Arabia. In this study, our aim is to test the relationship between these two factors.

Methods

Setup, sampling, and process

This quantitative, observational, cross-sectional approach was carried out in Riyadh City, Saudi Arabia between September 2019 and October 2019. A self-administrated questionnaire was distributed in paper-based and electronic formats to Saudis in the Primary care and ENT/NEUROLOGY clinics in Riyadh City. Ethical approval for the study was obtained from the College of Medicine Research Center, King Saud University, Riyadh, Saudi Arabia. The sentence "completion of the following questionnaire will be taken as an indication of your consent to participate and please fill the questionnaire once" was added at the top of the questionnaire form as a method of obtaining consent and to avoid duplication of data and to ensure that every participant fills up the questionnaire once.

A quantitative observational cross-sectional study was performed. The adopted questionnaire was based on the translated version of "Tinnitus and headache," with the translation following the guidelines detailed in "translation, adaptation, and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline"

A sample size estimation was carried out using a single proportion sample size formula, $n = z^2p\ (1–p)/d^2$, with a 95% confidence level and 5% margin of error. This indicated the minimum sample size for estimating significance to be 205. Allowing for a 10% rate of uncompleted surveys, the required sample size was deemed to be 226. Data were analyzed by using Statistical Package for Social Studies (SPSS 22; IBM Corp., New York, NY, USA). Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as percentages. The t-test and one-way ANOVA were used for continuous variables. A P value <0.05 was considered statistically significant.

Results

A total of 226 patients enrolled themselves into the study, and all of them came from the capital city Riyadh of Saudi Arabia. 58% were females, and the remainder of them were males. The analysis findings also suggested that 23.5% of the patients were aged between 21 and 30 years, 33.2% were aged between 31 and 40 years, 18.1% of them were aged between 41 and 50 years, and the remainder of the patients were aged 51 years or older. The patients past medical neurologic and ear risk factor analysis showed that 40.2% of them had a positive history of ear pain, 40.9% had a positive history of mid-ear pathology, and 5.2% of the patients had brain pathology; nonetheless, 43.7% of the patients had a history of hearing loss and/or difficulty with 40.8% diagnosed with excess ear wax or subjected to the recurrent ear-dewaxing procedure, and 48.9% of them had a history of positive psychological stress [Table 1].

88.5% of the patients had a history of headaches, and 81.9% of them had a history of ear tinnitus that is associated with the headaches. Most of them (47.5%) experienced pain on the sides of their heads.

Regarding the pain location, 49.6% had bilateral headaches that usually appear on both sides of their heads.

15.4% of them report that their pain usually is located on the right side; 20.8% of them however reported headaches on the left side of the head usually [Table 2].

Moreover, the patients were asked to indicate with (No/Yes) whether they take pain killers of any type for their headaches; 59.3% of them agreed and 40.7% disagreed. Most of the patients (64.8%) take paracetamol, and 18.8% used non-steroidal anti-inflammatory drugs (NSAID) like ibuprofen and diclofenac sodium pills [Table 3].

There was a statistically significant correlation between patients' gender and experience of ear tinnitus; females reported

Table 1: Descriptive statistics of the respondents' demographic and past medical history

	Frequency	Percentage
Gender		
Female	131	58
Male	95	42
Age group-years		
21-30 Years	53	23.5
31-40 Years	75	33.2
41-50 Years	41	18.1
>=51 Years	57	25.2
Neurologic and auditory past medical history , *n*=176		
Ear pains	70	40.2
Mid-ear pathology	71	40.87
Brain pathology	9	5.2
Hearing loss/difficulty	76	43.7
Excess wax/de-waxing	71	40.8
Psychological stress	85	48.9

significantly more ear tinnitus than males, $P < 0.001$, according to the Chi-squared test of association. Also, another Chi-squared test of association showed that the patient's age was significantly correlated with the experience of ear tinnitus, $P = 0.002$; those patients aged 51 years or older were significantly less inclined to report ear tinnitus compared to those younger, but those aged 20–31 years were found to be significantly more inclined to report ear tinnitus compared to the other age groups. The patients with a positive history of hearing loss/difficulty were significantly more inclined to report ear tinnitus than those with a negative history of hearing loss, $P < 0.001$. Also, the patients with a positive history of psychological stress were significantly more inclined to report tinnitus than those with a negative history of psychological stress. There was a statistically significant association between patients experiencing headaches and those experiencing ear tinnitus, $P = 0.023$. Also, those who reported left-sided headaches are significantly more inclined to experience ear tinnitus than those who had right headaches or bilateral headaches or those who were uncertain [Tables 4 and 5].

Table 2: Descriptive statistics of patients' past medical history of headaches and tinnitus

	Frequency	Percentage
Have you experienced headaches?		
No	26	11.5
Yes	200	88.5
Were those headaches associated with tinnitus?		
No	41	18.1
Yes	185	81.9
Describe the location of those headaches		
All of the head	6	3
Posterior eyeball pain	51	25.5
Back of head pains	56	28
Above eyebrow pains	78	39
Sides of the head	95	47.5
Top of head pain	4	2
Half of face pain	1	0.5
Where does your headache/migraine usually locate		
None/cannot remember	32	14.2
Right side	35	15.5
Left side	47	20.8
Bilateral head	112	49.6
Are you taking any pain medication because of your headaches?		
No	92	40.7
Yes	134	59.3
Is your headache predominantly unilateral?		
No	83	36.7
Yes	108	47.8
No headaches	35	15.5
Is your experienced ear tinnitus predominantly unilateral?		
No	36	15.9
Yes	149	65.9
No tinnitus/unsure	41	18.1
Which ear is predominantly affected by tinnitus?		
No tinnitus/cannot remember	80	35.4
Right	67	29.6
Left	79	35
Which symptom started earlier than the other, tinnitus or headache?		
Cannot remember/not sure	23	10.2
Tinnitus	80	35.4
Headaches	123	54.4
Duration (years) of headaches, median (IQR), *n*=127		9 (12)
Duration (years) of ear tinnitus, median (IQR), *n*=143		3.5 (8)
Is there a relationship between headaches and tinnitus over time?		
Unsure/Cannot decide	30	13.2
No	145	64.2
Yes	51	22.6

There was a statistically significant association between those who experienced headaches and tinnitus locations; those people who experienced right-sided tinnitus tended to report significantly more right-sided headaches; similarly, those who experienced left-sided headaches were predicted to report significantly more left tinnitus too, and those people who reported no tinnitus experience tended to report significantly more bilateral headaches [Table 6].

Discussion

This study was conducted on a cohort reporting headache associated with tinnitus. The study outcome measures provided scope on the following: the prevalence rates of headache types and relationships of both the laterality and severity of headache and tinnitus for this cohort. In addition, the study aimed to investigate the effect of painkillers' medication on tinnitus.

Starting with the first aim, the prevalence rates of migraine and tension-type headache forms were studied by Deleu e*t al.* (2001)[13] on a larger sample of 403 medical students in Oman (age range: 18 to 23 years). A unilateral headache had the highest rate among other headache forms by showing 43.9%, followed by the frontal headache recording 30.2%. The current study recorded different rates of headache forms in Riyadh City by showing the highest rate (47.5%) of the headache form that was on sides of the head, followed by the headache form above the eyebrows recording 39%. This difference might be attributed to the wider range of our participants' age (age range: 21 to >51 year-old).

Table 3: Descriptive statistics of the patients who used painkillers for headaches

	Frequency	Percentage
Paracetamol	83	64.8
NSAID (diclogesic and ibuprofen)	24	18.8
Other drugs	16	12.5
Solpadeine-codeine	15	11.7
Paracetamol + caffeine	12	9.4
Migrinine	4	3.1
Betaserc	2	1.6

Table 4: Bivariate analysis of the associations between patients' demographic and past medical history characteristics with ear tinnitus

	Tinnitus		test statistic	*P*
	No=41	Yes=185		
Gender				
Female	36 (87.8)	95 (51.4)	χ^2 (1)=18.3	<0.001
Male	5 (12.2)	90 (48.6)		
Age group-years				
21-30 Years	10 (24.4)	43 (23.2)	χ^2 (3)=14.9	<0.002
31-40 Years	10 (24.4)	65 (35.1)		
41-50 Years	2 (4.9)	39 (21.1)		
>=51 Years	19 (46.3)	38 (20.5)		
Neurologic and auditory past medical history, n=176				
Ear pains				
No	31 (75.6)	125 (67.6)	χ^2 (1)=1.02	0.314
Yes	10 (24.4)	60 (32.4)		
Mid-ear pathology				
No	31 (75.6)	124 (67)	χ^2 (1)=1.15	0.284
Yes	10 (24.4)	61 (33)		
Brain pathology				
No	40 (97.6)	177 (95.7)	χ^2 (1)=0.014	0.907
Yes	1 (2.4)	8 (4.3)		
Hearing loss/difficulty				
No	37 (90.2)	113 (61.1)	χ^2 (1)=12.8	<0.001
Yes	4 (9.8)	72 (38.9)		
Excess wax/de-waxing				
No	31 (75.6)	124 (67)	χ^2 (1)=1.15	0.284
Yes	10 (24.4)	61 (33)		
Psychological stress				
No	34 (82.9)	107 (57.8)	χ^2 (1)=9.0	0.003
Yes	7 (17.1)	78 (42.2)		

In addition, in a large youth group (5729 participants) in a French University, a cross-sectional study was conducted and focused on the relationship between tinnitus and migraine from many aspects including the following: health, lifestyle, family history, and alcohol consumption (Guichard *et al.* (2016).[14] Authors found an association between tinnitus and migraine, particularly the migraine with aura.

On the other hand, Langguth *et al.* (2015)[12] conducted a study with a similar sample size (193 patients) to the current study and an age range of 18 to 90 years. The authors recorded a higher rate of migraine (44.6%) compared to other tension-type headaches (13%), and the remaining sample had non-classifiable headache (33%).

The laterality of both headache and tinnitus was also measured by Langauth *et al.* (2015).[12] Authors concluded a statistically significant relationship between headache and tinnitus laterality and expected that they are pertained to a pathophysiological cause. This outcome was consistent with our study results. It was surprising that the laterality of headache and tinnitus was higher for the left side in both Langguth and current studies. However, the underlying pathophysiological cause was not investigated, and instead, the history of other associated conditions was considered and revealed the highest rates of the following: psychological stress and hearing loss (48.9% and 43.7%, respectively).

Further investigation was carried out by Langguth e*t al.* (2017)[15] on a sample of 193 participants suffering from tinnitus linked with headache and compared the headache laterality and headache type to another group of 765 patients who reported tinnitus without any associated condition. The study revealed a worse quality of life in a group of people with tinnitus associated with headache more than people who reported tinnitus without co-morbid headache. Particularly, the left-side migraine alongside the tinnitus showed a lower score in quality of life. In addition, vertigo was reported with all headache sides (left, right, and bilateral), which was not considered in the current study. Severity of tinnitus showed no significant relation to the headache, which was correlated to our findings in the current study.

Regarding the pain killer medication in tinnitus, Deleu *et al.* (2001)[13] have shed light on this concern and revealed that the majority of the sample who suffered from headache took a non-prescribed pain killer (72.9%), whereas the least depended on a traditional remedy (2.5%). However, their study was applied on cohorts reporting headache without tinnitus. On the other hand, the group of people with headache (left-sided and bilateral) associated with tinnitus were mostly managed in a psychology clinic (Langguth *et al.*, 2017).[15]

Implication of findings

- Referring patients suffering from tinnitus to both audiology and psychology clinics in order to rule out any hearing loss or psychological stress would probably manage the possible underlying causes, subsequently decreasing the tinnitus.
- Painkiller medication might lessen the tinnitus in the case of association with headache.

Future directions

- Overlapping symptoms of migraine, vestibular migraine, and Meniere's disease suggest a vestibular test to confirm the diagnoses.

Limitations

- Self-reporting including recall bias.
- Uncertainty, that is, some participants could not remember the predominant side/duration/onset of either headache or tinnitus.
- Some participants might have had middle ear pathology yet not diagnosed clinically.
- The episode of vertigo was not included in the questionnaire to rule out Meniere's disease.

Conclusion

Our results showed that there is a relationship between headaches and tinnitus. Painkillers also showed a protective effect against tinnitus. High awareness about the relationship between

Table 5: Bivariate analysis of the associations between patients who experienced headache with ear tinnitus

	Tinnitus		test statistic	*P*
	No=41	Yes=185		
Have you experienced headaches?				
No	0	26 (14.1)	χ^2 (1)=5.2	0.023
Yes	41 (100)	159 (85.9)	Yates	
Where does your headache/migraine usually locate?				
None/cannot remember	2 (4.9)	30 (16.2)	χ^2 (3)=14.90	0.002
Right side	7 (17.1)	28 (15.1)		
Left side	2 (4.9)	45 (24.3)		
Bilateral head	30 (73.2)	82 (44.3)		
Are you taking any pain medication because of your headaches?				
No	10 (24.4)	82 (44.3)	χ^2 (1)=5.53	0.019
Yes	31 (75.6)	103 (55.7)		
Is your headache predominantly unilateral?				
No	23 (56.1)	60 (32.4)	χ^2 (2)=8.13	0.017
Yes	14 (34.1)	94 (80.8)		
No headaches	4 (9.8)	31 (16.8)		
Which symptom started earlier than the other, Tinnitus or headache?				
Cannot remember/not sure	14 (34.1)	9 (4.9)	χ^2 (2)=53.80	<0.001
Tinnitus	0	80 (43.2)	LR	
Headaches	27 (65.9)	96 (51.9)		
Duration (years) of headaches, median (IQR), *n*=127	16 (10.5)	7 (13)	*U* (127)=607.7	0.041
Is there a relationship between headaches and tinnitus over time?				
Unsure/Cannot decide	16 (39)	14 (7.6)	χ^2 (2)=36.4	<0.001
No	25 (61)	120 (64.9)		
Yes	0	51 (27.6)		

Table 6: Bivariate association between head locations of people who experienced headaches and tinnitus. *n*=226

	Headache location			
	None/cannot remember	Right side	Left side	Bilateral head
Tinnitus location				
No tinnitus	6 (18.8%)	12 (34.3%)	9 (19.1%)	53 (47.3%)
Right	10 (31.2%)	17 (48.6%)	6 (12.8%)	34 (30.4%)
Left	16 (50%)	6 (17.1%)	32 (68.1)	25 (22.3)

headaches and tinnitus among physicians and patients may lead to early recognition and lead to early implementation of primary prevention, which is the cornerstone of family medicine practice, and treatment without referring to other specialties. However, the pathophysiology is still not clear. Further studies should be performed to know the pathophysiology.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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