

Epidemiological study of snoring from a random survey of 1075 participants

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ABSTRACT

Snoring is a common complaint, the prevalence of which has been documented to be anything from 24% to 50% of males. Most studies have concentrated on male populations but there is an increasing number of females reporting that they snore. The aim of this study was to ascertain prevalence of snoring among males and females in order to extrapolate global figures for the UK population. From a suburban community 1075 men and women were invited to provide information about their snoring in a 'snore survey' questionnaire. From the results it was estimated that 43.75% of the middle aged (30 - 69 years) UK population snore and 41.5% of the UK adult population snore. The male to female ratio is approximately 2:1, with 29% of males and 12.5% females snoring. An approximate total 14.9 million adults snore with approximately 10.4 million males and 4.5 million females.

INTRODUCTION

Snoring is reported to be a common condition. 30 years ago snoring was regarded as a social nuisance that was harmless to the snorer, but the gradual recognition of snoring as a matter of medical importance has increased our interest, especially as it is reported to give rise to adverse health consequences. Estimates of prevalence of snoring range from 50% of males ⁽¹⁾, 24 - 50% of men ⁽³⁾, 14 - 30% of women ⁽³⁾ to 16 - 89% of the general population ⁽¹²⁾. These widely ranging estimates are probably due to differences in the populations studied, study design, investigations performed, age and sex of the subjects.

Epidemiological studies to date have tended to focus on male prevalence but anecdotally there is a growing number of women who are reporting that they are suffering from this troublesome complaint. Additionally the number of parents who are calling the British Snoring & Sleep Apnoea Association help-line about snoring in their children is also increasing. An extensive literature search offered a plethora of information on prevalence of sleep apnoea, but this was not the case for snoring.

Table 1 demonstrates how the studies on snoring prevalence have tended to be biased

towards middle aged males with limited studies on other population groups. From a literature search of 15 articles, it was found that 58.3% (n=7) of 12 studies were confined to males only, 41.6% (n=5) of the studies being middle aged males, 25% (n=3) both males and females, one of which had an age range of 15 - 100 years, 8.3% (n=1) females, 8.3% (n=1)

Table 1 - Summary of study populations, gender and age groups

Reference	Population	Sample size (n) Sex & criteria	Mean age years (range)	
Camelli et al (2002)	self-reported snoring patients	1,560 male-male twin pairs	74.2	elderley males
Nugent et al (2000)	electoral register	2,364 males	46 (18-91)	males
Lindberg et al (1998)	habitual snorers	2,668 males (1984) 2,097 males (1994)	(30 - 69)	males middle aged
Lindberg et al (1998)	population registry	3,100 males	(30 - 69)	males middle aged
Lindberg et al (1998)	population registry	4,021 males	(30 - 69)	males middle aged
Loth et al (2001)	snoring patients	42 males	'middle aged'	males middle aged
Stradling & Crosby (1991)	GP register	890 males	35 - 65	males middle aged
Ohayon et al (1997)	telephone interview survey	2,078 males 2,894 females	(15 - 100)	males/females
Young et al (1993)	employee workforce	602 males & females	30 - 60	males/females
Olson et al (1995)	random	441 males & females	35 - 69	males/females
Ah-See et al (1998)	medical staff & patients	24 female snorers 16 female controls	40 (17 - 73) 37 (23 - 53)	females
Stoohs et al (1998)	college students older subjects	155 students 134 others	19.9 64.1	not specified
Jones & Swift (2002)	-	-	-	not specified
Stradling (1995)	-	-	-	not specified
Lindberg & Gislason (2000)	-	-	-	not specified

elderly males. 3 of 15 articles were not specific and were not study based. Considering that snoring is still presumed to be predominantly a male complaint these figures are not surprising.

From a patient’s perspective, what constitutes a serious problem for one snorer or their partner, or both, may not necessarily be a problem for others. Additionally, both in interview and written questionnaires it has been demonstrated that patients are not wholly accurate in their assessment of their own problems and therefore discrepancies may occur⁽¹³⁾. Lindberg & Gislason (2000) also suggest that interpretation of symptoms and signs of snoring are defined differently in epidemiological studies. They state: “The most frequently used method for estimating snoring is by questionnaires and the snoring prevalence is usually rated on a frequency scale with words like ‘never’, ‘often’ or the number of nights per week. The loudness of the snoring is sometimes stressed and sometimes the disturbance for others. Although there

were 1798 citations on snoring on Medline in May 2000, there is no standard and uniformly accepted technique for objective measurement. To the extent that there is no ‘Gold Standard’ for objective measurements, the validation of such questionnaires also remains a problem”.

Table 2 (results from a study by Stoohs et al 1998) shows the relationship between self-reported snoring and objectively-measured snoring in students and older subjects from a one-night recording. It demonstrates how self-reporting understates the problem. For example, in the student population, 51.7% reported that they never snore. On polysomnography it was found that the Continuous Snoring Index (CSI) for those same students was in fact 20.3%, i.e., they snored for 20.3% of their total sleep time. It can be seen that the Snoring Index (1-5) correlates well with the CSI in the student population, but this is not the case with the older population.

**Table 2. Relationship between subjective self-reported snoring and the objectively-measured continuous snoring index (Stoohs RA *et al* 1998).
Snoring index measured: 1 = never snore, 2 = rarely snore, 3 = occasionally snore, 4 = often snore, 5 = always snore.**

Subject group	Snoring Index and Self-reported snoring %	Continuous snoring index % (of total sleep time)
Students n = 155	1 = 51.7	20.3 ± 20.9
	2 = 30.9	23.9 ± 22.5
	3 = 11.4	23.7 ± 18.1
	4 = 3.4	39.2 ± 30.2
	5 = 2.7	45.7 ± 33.3
Older n = 134	1 = 17.8	15.6 ± 14.5
	2 = 17.8	13.7 ± 12.8
	3 = 32.6	15.5 ± 15.4
	4 = 22.5	16.3 ± 13.9
	5 = 9.3	20.4 ± 12.2

Ohayon et al (1997) conducted a telephone survey of a sample from the UK population with the results being similar to those of Stoohs et al (1998). From the Ohayon study, 23% of young people aged 15 - 24 self-reported a tendency to snore, which closely matched the results of the student population from the Stoohs et al (1998) study, wherein self-reported snoring indices 3 - 5 totalled 17.5%. However, in the UK telephone survey there was a greater percentage of subjects aged >65 who indicated a higher self-reporting of snoring than in the younger age groups as in the Stoohs et al (1998) study wherein self-reported snoring indices 3 - 5 totalled 64.4%.

Stoohs et al (1998) suggested that based on the objectively-measured results from their study, subjective reporting of snoring in the older age group from the UK survey may be an over estimation of the actual snoring frequency. Additionally Ohayon et al (1997) postulated that snoring may be perceived differently across different age groups based on a change in the sound frequency spectrum associated with age.

Interestingly, Stradling (1995) points out that his experience in clinic is “... that the complaint of snoring by one partner may be overstated, perhaps as a reason for leaving the marital bed. In addition, the soundness of the partner’s sleep will obviously influence the report of snoring”. It could be said that the ‘noise level’ of snoring is wholly dependent upon the “snoree’s” (the one who has to listen) tolerance threshold.

Young et al (1993) referred to by Stradling (1995) recruited 602 subjects aged 30 - 60 years for polysomnography. 355 were self-reported habitual snorers and 247 were self-reported non-habitual snorers. Polysomnographic results (PSG) showed that 76% of the habitual snorers and 64% of the non-habitual snorers had apnoea-hypopnoea scores >0 presumably with snoring. Both the Young et al (1993) and the Stradling (1995) studies demonstrate that neither self-reporting nor partners’ reports are accurate.

Nugent *et al* (2001) sent questionnaires to 3391 men (2364 responded) who were listed on the Belfast, Castlereagh, North Down & Ards District electoral register. It was reported that 32.9% (*n* = 778) of the population were habitual snorers. In another study by Lindberg (1998), of the 3100 men who responded to their questionnaire, 45% (*n* = 1402) reported snoring. The results from these two studies whose population size was comparable, are not as closely matched as those from the Ohayan (1997) and Stoohs (1998) studies.

With the majority of epidemiological studies concentrating on the middle-aged male population, figures are naturally skewed. Lindberg & Gislason (2000) cite several studies giving estimates that in the 30 - 40 year age group, 10% of men and 5% of women are habitual snorers as defined by ‘often’ or ‘very often’ or ‘every night’. They further estimate that ‘... there is an increase in prevalence reaching at least 20% for men and 15% for women in the 50 - 60 year age group, but at an older age there is a decline’.

Stradling (1995) cites several studies where subjects who reported snoring did not snore in a laboratory setting. He refers to a community survey where self-reported snoring men showed differing snoring rates

depending on whether the spouse was present at the interview. (24% when accompanied by spouse/partner as opposed to 10% when alone at interview).

It is difficult to compare prevalence accurately from recent research as the methodologies are disparate. Results of prevalence studies using self-reported snoring frequencies should be interpreted with caution.

METHOD

1075 respondents were invited to provide information about their snoring for a ‘snore survey’ questionnaire. Respondents from London, Reigate, Redhill and Dorking were recruited in the street. Time of day (between 11am and 2.30pm weekdays and 10am and Noon Saturday) was selected to gain maximum participation and to ensure a wide selection of males, females, young and older respondents. No incentive was offered to gain participation. The ‘Snore Survey’ questionnaire was designed in a manner that would ensure participants were detained for a minimum period, but such that essential information was obtained. Questions from ‘Snore Survey’ are shown in Table 3.

RESULTS

Results are shown in Table 4. The population consisted of 1075 respondents. Table 4 shows 446 (41.5%) of the respondents reported that they snore. From the snoring population, 308 (29%) were male snorers and 138 (12.5%) were female snorers. Snoring

Table 3 - ‘Snore Survey’ questionnaire		
Male	Female	Do you Snore Y/N
Category of snorer: sometimes (less than once per week) often (more than once per week) very often (every night)		
Gentle		Loud
Is snoring worse sometimes than at other times?		
If so, what makes it worse? e.g. alcohol		
If male, what is your collar size e.g. 16½		
How old are you (if not exact age range e.g. 40-50)		

frequency was categorised as ‘sometimes’, ‘often’ or ‘very often’. The modal value of snorers, 161 (36%) fell into the ‘very often’ category. This was an unquantified mix of self-reporting and partner reporting.

	Male	Female	Total	Total %
Participants	574	501	1075	100
Total snorers	308	138	446	41.5
Sometimes snore	65	64	129	12
Often snore	100	34	134	12.5
Very often snore	127	34	161	15
Don't know how often	-	-	22	2
Gentle snoring	98	92	190	17.5
Loud snoring	193	46	239	22
Don't know how loud	-	-	17	9.5

Snorers reported that conditions such as alcohol n=183 (17%), sleeping on the back n=64 (6%), very tired n=33 (3%), and smoking n=21 (2%) made their snoring worse. A range of other conditions was also noted.

Table 5 classifies snorers in age groups. The greatest number of snorers fell into the 50 - 59 years age group with 76 male and 39 female snorers. Although the population generally was predominantly in the 30 - 39 year age group. The average age of the snorers was 48.8 years. The ratio of snoring males (n=308) to snoring females (n=134) was 2.3:1. At age 60 - 69 years numbers of male snorers were about 50% less than at 50 - 59 years. Additionally on aggregate the ratio of male to female snorers reduced after age 60 to 1.64:1 but the opposite was apparent in the younger age groups (3.1:1).

Age (yrs)	Number of participants in age group	Snorers			% of snorers in age group
		Total	Male	Female	
<20	54	15	13	2	28
20 - 29	167	58	44	14	35
30 - 39	204	68	55	13	33
40 - 49	135	64	43	21	47
50 - 59	198	115	76	39	58
60 - 69	171	63	38	25	37
70 - 79	97	44	26	18	45
80 - 89	33	11	9	2	33
90 - 99	1	1	1	0	100
not given	15	7	3	4	
Total	1075	446	308	138	

Some survey participants failed to answer all the questions. It is for this reason that discrepancies in the figures appear in the tables of results. For example, total number of snorers in the survey was n=446. However, some snorers were unable to answer questions regarding how often (n=22, 2%) or how loud (n=17, 3.8%) they snore. Similarly, it is shown in Table 4 that n=308 of the snorers are males and n=138 are female. However, from the age groups of snorers shown in Table 4, there are only n=305 male snorers and n=134 females snorers, giving a total of 439 snorers. 7 snorers did not offer an age group category.

The level of noise of the snoring was categorised as being 'gentle' or 'loud'. The smaller number of snorers were reported to be in the 'gentle' category; n=190 (43%) of snorers as opposed to n=239 (54%) of snorers in the 'loud' category. Additionally the results of the survey seem to show that women have quieter and less frequent snoring than men. The ratio of male to female snorers in the 'often snore' category is 2.9:1. In category 'very often snore' the ratio of men to women is 3.7:1. With regards to the loudness of the snoring, the ratio of males to females in the 'loud snoring' category is 4.2:1.

DISCUSSION

The principle finding of this study is that from the 1075 participants who were not pre-selected from any one homogenous group 41.5% reported, or were reported to be, snorers. Of those snorers, 69% were male, 31% were female (2.2:1). 3% of the snorers were young persons under 20 years of age but of sufficient age to respond to the questionnaire. The questions used in this study were based on those routinely used in clinical practice^(5,6,7,9) and the results confirm previous findings using similar protocols^(4,14).

It must be noted that in comparing studies, differences of interpretation are made between words such as 'sometimes snore'. For example, in the present study it was intended to mean 'occasionally each week'. It is presumed that most studies followed this meaning. Stradling (1995) raises this issue as a variable between study outcomes. Stoohs et al (1998) however, based his results on a single night and his classification of 'never', 'rarely', 'occasionally' snore related to the frequency of snoring during that one night.

Most epidemiological studies have tended to focus on specifically chosen samples (see Table 1). The importance of this present study lies with the nature and diversity of the participants across age groups and gender. The only other study that closely resembles this present study is that of the Ohayon et al (1997) UK telephone survey.

In 1998 Lindberg et al (1998) published results of a 10-year follow up of their 1984 study. In 1984 they reported that 15% of the men surveyed were snorers. This figure increased to 20.4% in the follow-up study in 1994. The sample was of 4,021 men age 30 - 69 years. The main finding of both studies was that prevalence of snoring was strongly age dependent with the highest prevalence of snorers in the 50 - 59 years age group. The results from this present study replicate this finding with 58% of the total participants in that age group classified as snorers.

Olsen et al (1995) objectively studied 441 subjects aged 35 - 69 years with a population bias towards snorers and those with subjective sleep complaints. 56% of them were men. 83.4% of those studied were found to be snorers. This extraordinary result is attributed to the biased population.

Results from this present study, given the limitations of the questionnaire, were as expected. Responses to all but two questions were subjective with some participants being unable to provide a response to a few of the questions. For example, only 50% of the male population were able to respond to the question "what is your collar size", and of those who did respond, 27% (n=155) responded with the answer "<16.5", 10% (n=60) responded "16.5" and 13% (n=73) responded ">16.5". It is not known whether the snorer was the respondent or whether the spouse/partner answered the question on their behalf. Due

to the lack of data, results from this question have not been correlated.

As with the many studies that have demonstrated the relationship between collar size and snoring^(11,12), data from this study (or lack of it) has shown that men still appear to pay little or no attention to this strong indicator. It may be advantageous to promote better awareness of this predictor and be more responsive to it.

It was noted that there were many limitations to this study, for example, the geographical limitation where it is supposed that the South of England is a more affluent area than other areas of the UK.

Willingness of subjects to participate is always an issue and it would be assumed that unwilling subjects would not have participated, however it is not known whether the partner participated on their behalf. It was not recorded as to whether the participants were self-reporting snorers or partner-reporting snorers. Lack of information on collar size was a considerable disadvantage as it would have been desirable to compare results with other studies. The data for snorers is not wholly accurate since a few snorers failed to answer all of the questions. Nevertheless the main objective of the study, to differentiate snorers from non-snorers and quantify them was met.

Despite the limitations, this study has provided the basis for relatively accurate figures over an extensive age range of both males and females and has therefore been purposeful. The methodology selected for the study was thought to be the most appropriate for the information that was required. The survey was predominantly designed to obtain numbers of snorers from a wide ranging population and it was considered that a street survey would provide this information adequately.

No previous study had recruited participants in the street and it was not known how this approach would be received. The researchers had little difficulty in finding respondents who were willing to participate which we attribute to a greater understanding of snoring than in the past.

Stradling & Crosby (1991) reported that 64% of their population of males aged 35-65 years snored or were

told they snored, 'sometimes' or 'often'. In 1992 figures were extrapolated from the 'often' snorers from their study to obtain a broader figure for the UK population as a whole. Figures were originally obtained from the 1991 Government Census of the UK population which was 54,000,000. It was assumed that half the UK population was male (27,000,000), that approximately 43% of the male population were middle-aged, and that the ratio of women to men snoring was 2:3. From Stradling & Crosby (1991) it was noted that 16.9% of middle aged males 'often' snored. From these figures it was estimated that there were approximately 3,500,000 people in the UK who snore. In his later study Stradling (1995) suggested that about 20% of men over 30 years of age snore 'every night' or 'often' and the prevalence in women is about two thirds that of men.

be more aware of the causes and what treatments are available for control.

CONCLUSION

This present study reports that 41.5% of the total sample population snored, 29.0% males and 12.5% females. The male snorers to female snorers ratio was 2.3:1. From the 2001 Government Census the UK population is 59,755,700. 60% of the UK population (40% assumed to be persons under the age of 16 years) was used to extrapolate to give a total of 14.9 million snorers in the 'adult' population with approximately 10.4 million being male and 4.5 million female. From this present study it was found that 43.75% of the middle aged (30-69 years) population snore.

These figures have increased substantially since 1992 when BSSAA estimates for snorers in the UK totalled approximately 3.5 million. Reasons for the increase may be one or more of the following:

- Disparate data sets leading to poor comparability.
- Increase in mean age group of UK population.
- Increase in obesity.
- Increase in alcohol consumption (particularly amongst the young).
- Increase in awareness giving rise to acceptance of snoring as a condition and the truthfulness of the respondents.

What is important is that due to this increasing prevalence patients and health professionals should

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