

Noise and Community Response in Jeddah and Riyadh Cities

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ABSTRACT. The results of a social survey designed and conducted to evaluate community response to noise in the two major cities in the Kingdom of Saudi Arabia (Jeddah and Riyadh) show that people in Riyadh city are in a relative comfort with their sonic environment than citizens of Jeddah city. Equivalent sound levels (L_{eq}) of up to 87 dB(A) have been recorded over periods of one hour measurements in Jeddah while corresponding levels of up to 81 dB(A) have been detected in Riyadh. Measures, however, indicate that implementing outdoor noise pollution control programs is becoming an urgent necessity for more than 55% of the persons interviewed in both cities.

Introduction

Noise pollution is becoming a character of the environment both outdoors and indoors in most developing rather than industrialized nations. The sources of noise in human life are numerous ranging from the neighbor's dog barking to the shaking sound accompanying a supersonic jet fighter. The rolling of several hundreds or some few thousands of cars in an hour in the close proximity of a residential building, the chattering of footsteps on a staircase or a ceiling of one's privacy, many growling, rumbling, buzzing, humming and screaming sounds are always experienced in every day life of a city resident. No doubt, however, that living without noise, in a community, is a dream to those who have lived in the quite environment few decades ago, before industrialization and development, in the Arab World.

The community response to noise in the environment may be predicted on basis of average values of a single generalized reaction to noise exposure, usually represented by the percentage of community that have a common reaction to one of the effects of noise exposure. A variety of approaches have been conducted to

study human responses to sound, in which research has been directed exclusively to the perception of noise. The approaches used to study noise have included unobtrusive measures, social and attitudinal surveys, insitu experiments and laboratory simulation of the environments. Review papers by Borsky (1970), Kryter (1970), and Schultz (1978), suggest that social and attitudinal surveys have been used more frequently than any approaches. Elshorbagy (1984), however, reported that the most feasible procedure for obtaining a meaningful rating of noise problem is the direct interview, by means of a social survey, with people subjected to the noise. Schultz (1978), has reviewed 22 surveys conducted between 1961 and 1976 in eleven countries around the world. Experiments, either insitu or in laboratories, are much less prominent in the literature, *c.f.* Cermak (1978), Cohen *et al.*, (1980) and Elshorbagy and Zube (1983).

Human responses to noise have been categorized as psychological, behavioral and physiological, (Zube *et al.*, 1982). The most frequently cited psychological response is annoyance and the most frequently cited sources are traffic, (Kryter, 1970; McKnell, 1970, and Guski, 1977), industry, (Guski, 1977), and heavy trucks (Krause and Brown, 1994). The response to noise is mediated by beliefs and attitudes about the source of the sound and its probable health effects, (Borski, 1970 and Jones *et al.*, 1981), sensitivity to noise, (Weinstein, 1978), recent exposure, (Guski, 1977), or past experience and personality, (Guski, 1977; Weinstein, 1978 and Jones *et al.*, 1981). A range of behavioral responses to noise has been reported by Page (1977), and Cohen *et al.*, (1973, 1977 and 1980), Weinstein (1978) and Korte and Grant (1980). The reported changes in behavioral responses are concentrated in task interference. Martin (1996) reported that the World Health Organization (WHO) considers serious annoyance as a health hazard in itself. Other cited responses are decrease in helping behavior, decrease in awareness of immediate surroundings by pedestrians, increase in walking speed and a more straight ahead visual orientation during periods of high traffic noise.

Several physiological responses to noise are well documented, specifically the impairment of sleep and hearing, (Glass and Singer, 1972); Lowrance, 1976; and Raloff, 1982). Noise also acts as a stressor to the body. According to Raloff (1982), body stress continues even during sleep as there is no habituation to noise which disrupts heart beat. Other physiological responses reported include high blood pressure, (Cohen *et al.*, 1980; and Raloff, 1982), ulcers and neurological disorders, (Raloff, 1982).

The present investigation aimed at evaluating the response of urban moderate class citizens in the Kingdom of Saudi Arabia to their acoustic environments. The study covered the two major cities of the Kingdom, namely: Jeddah and Riyadh. It was based on a direct interview with individuals, social survey. Phys-

ical measurements were also conducted and analyzed to gain understanding to the relationships among responses associated with varying sound levels.

Development of The Social Survey

The social surveys were intended to assess effect of noise exposure on population proportions experiencing specified effects or holding certain attitudes. They were simply concerned with investigation of public opinion and based on the self report of a sample of respondents in both cities. The major goals considered included investigations of the annoyance due to noise, noise-sleep interference and the need for noise control in the community.

Questionnaire Development

In order to accomplish the objectives, a questionnaire of fixed response categories ("Yes" or "No") and limited set of adjectives were established. The questionnaire included seven sets of questions developed and compiled, in Arabic, to cover outdoors, indoor and work environments. The questionnaire was subjected to a "Pilot" test prior to application in the field to check awkward wording, administration time and to avoid an order of questioning that suggests a conclusion.

Sampling

The random sample technique was adopted in order to generalize conclusions to populations other than those from which respondents were chosen. A number of 200 respondents in each of Jeddah and Riyadh cities were considered, from amongst adult male citizens of each city, chosen on basis of separate geographic areas of different noise exposure levels.

Interviewing Technique

It was intended to collect very detailed and extensive information regarding the subject matter from the relatively small number of respondents in each city (N=200), and thus a direct, face to face, interviewing was implemented. The interviewers were selected from among final year students of ENS department at the Faculty of Meteorology, Environment and Arid Land Agriculture, King Abdulaziz University, Jeddah. They were Saudi citizens, to minimize speech misintelligibility due to differences in (slang) language pronunciation, in conducting interviews with Saudi subjects (respondents). The process was also liable to optimizing the interviewing expenditure.

Physical Exposure Measurements

The social survey was properly accompanied by a program of physical exposure measurements in both Jeddah and Riyadh cities. The measurements of noise exposure in the two cities, however, included the measurement of

A-weighted sound pressure levels, at different sites in both Jeddah and Riyadh cities, at different periods of the day. Additionally, statistical indices of noise exposure such as L_{10} , L_{50} , L_{90} and L_{eq} were also computed for a fixed period of exposure. The measurements and analysis were made using Bruel and Kjaer sound level meters and analyzers types B&K 2203, 2225 and 4426, in addition to Metro-loggers type db-301 and Metro-reader db-652.

Results and Discussion

Physical Accoustic Environments

The characteristics of the overall accoustic environments in Jeddah and Riyadh cities are presented in Tables 1 and 2, respectively. The results in Table 1, express enhanced values of instant sound levels at site 1 and 2 at all measuring times, moderate values at site 4 and relatively lower values at site 3, except for the spike of 100 dB which was recorded due to an overhead landing aircraft. The values of L_{90} describe the residual noise levels and those of L_{10} indicate the level of annoyance, over the measurement period of one hour. It is however noticeable that high levels of annoyance accompanied with high residual noise dominate in sites 1 and 2 whereas relatively lower satisfactory levels characterize sites 3 and 4. The results of L_{eq} , energy equivalent level, indicate an ascending sequence of dissatisfaction with the sonic environment for sites 3, 4, 1 and 2, respectively.

The results in Table 2, show that the corresponding instant sound levels and statistical indices L_{10} , L_{90} and L_{eq} in Riyadh are lower than those of Jeddah city. Both tables show clearly that the sound levels in both cities are in no way representing quiet environments. It is interesting to note that the major source of noise at all sites of both cities is due to road traffic.

Community Response to Noise

Comparisons of people's reaction to noise in both Jeddah and Riyadh cities are given in Tables 3 to 5. Table 3, shows the comparison at home, work and outdoors. The figures indicate that for both cities the outdoor noise is disturbing more than ninety percent of people. On the contrary, however, where only 43 percent of people are disturbed by noise at their homes and 45 percent are disturbed by noise at their work in Riyadh city. In Jeddah city, the corresponding figures are much higher; 62 and 51 percent, respectively.

The contribution from conventional types of noise sources to the above figures in each environment are clearly demonstrated in Table 4. The figures marked by asterisks represent cases when the percentage of disturbed people in Riyadh city is higher than the corresponding percentage in Jeddah. These cases

are however, noticed at only eight source-environment situations out of the sum of 24 investigated situations.

TABLE 1. Noise level surveys at different sites in Jeddah.

Site no.	Site description	Timing of starting measurements	Instant SPL, (dBA)		Noise indices (dBA) for one hour exposure		
			Min.	Max.	L ₁₀	L ₉₀	Leq
1.	Residential main street	8.00 a.m.	66	92	83	74	80
		2.00 p.m.	66	95	90	81	86
		7.00 p.m.	66	92	88	80	84
2.	Residential commercial traffic streets	8.00 a.m.	70	94	88	78	84
		2.00 p.m.	68	100	90	81	87
		7.00 p.m.	67	94	90	80	86
3.	Residential area close to a major airport	8.00 a.m.	50	62	60	53	58
		2.00 p.m.	52	75	66	53	65
		7.00 p.m.	45	100	78	58	84
4.	Commercial neighbouring to a residential area	9.00 a.m.	62	75	70	65	69
		2.00 p.m.	77	80	75	66	72
		7.00 p.m.	76	82	77	57	73

The relative impact of sources of noise which affect people most in the two cities are given in Table 5. The table shows that road traffic noise represents the major contributor to people's disturbance from noise in both cities, with 89% in Jeddah compared to 82% in Riyadh. It is also clear that except for constructional works noise, more people in Jeddah city are disturbed from all kinds of noise than the people of Riyadh city. It is also of interest to note that air conditioning room units come as the second most disturbing noise source to Jeddah citizens, whereas the construction works noise represent the corresponding second most disturbing source of noise to Riyadh citizens. The last line of Table 5, indicates other sources of noise which were considered by over 10 percent which include non-conventional noise sources such as dog barking, accidental sounds, sewage pumping, etc.

TABLE 2. Noise level surveys a different sites in Riyadh city.

Site no.	Site description	Timing of starting measurements	Instant SPL, (dBA)		Noise indices (dBA) for one hour exposure		
			Min.	Max.	L ₁₀	L ₉₀	Leq
1.	Residential main street	8.00 a.m.	65	86	80	65	76
		2.00 p.m.	66	82	78	68	75
		7.00 p.m.	65	111	83	72	81
2.	Residential commercial traffic streets	8.00 a.m.	62	87	75	62	72
		2.00 p.m.	60	93	78	65	75
		7.00 p.m.	60	102	79	67	77
3.	Residential area close to a major airport	8.00 a.m.	47	80	59	49	58
		2.00 p.m.	49	73	56	51	56
		7.00 p.m.					
4.	Commercial neighboring to a residential area	9.00 a.m.	49	85	67	60	64
		2.00 p.m.	52	79	63	60	62
		7.00 p.m.					

TABLE 3. People's reaction to noise at home, at work and outdoors, in Jeddah (J) and Riyadh (R) cities (N = 200 / city).

Individual's reaction to noise	Percentage of people					
	At home		At work		Outdoors	
	J	R	J	R	J	R
Those who are disturbed by noise	62	43	51	45	91	97
Those who noticed noise but are not disturbed	0	0	9	0	7	2
Total of people who notice noise	62	43	60	45	98	99
Those who do not notice noise	38	57	40	55	2	1
Total	100	100	100	100	100	100

TABLE 4. Noises which disturb people at home, and outdoors (Jeddah and Riyadh cities) (N = 200/city).

Description of noise source	Percentage of people disturbed					
	At home		Outdoors		At work	
	Jeddah	Riyadh	Jeddah	Riyadh	Jeddah	Riyadh
Road traffic	28	32*	87.5	70	16	14
Aircraft	33	26	39.5	30	12	6
Works	22.5	38*	51.5	50	10	22*
Domestic appliances	40	30	3.5	2	5.5	2
Neighbours impact	35	29	9	10	0	10
Noise (knocking, walking etc.)						
Children	41	34	18.5	22*	4.5	0
Adult voices	18.5	18	17.5	16	26	18
Radio/TV	42.5	30	8	10*	3	4*

TABLE 5. Source of noise which disturbs people most in Jeddah and Riyadh cities (N = 200/city).

Description of noise source	Percentage of people disturbed more with different noise sources	
	(In Jeddah)	(In Riyadh)
Road traffic	89	82
Factories and workshops	45.5	22
Aircrafts	40.5	28
Construction works	42.5	68
Domestic appliances	15.5	10
Room air conditioners (room units)	58	36
Other sources	12	10

Noise and Sleep Interference

The results shown in Figures 1, and 2 represent community response to noise as a cause of sleep interference to individuals. Figure 1, indicates that more than 65% of interviewed persons in Jeddah city would sometimes experience sleep-noise-interference. The corresponding percentage is only about 55% for persons of Riyadh city. The percentages of those who often wake up due to noise in

both cities are 23 and 12 percent for Jeddah and Riyadh, respectively. Figure 2, represents a qualitative analysis of the sources of noise that cause sleep interference to people of both cities. It is of interest to note that traffic noise has almost the same potential of sleep-interference effect on the people of the two cities. It is also noticeable that noise from air conditioning units represent a major invador to a comfortable night sleep for Jeddah citizens, since about 60% of interviewed persons expressed possible wake up due to this noise.

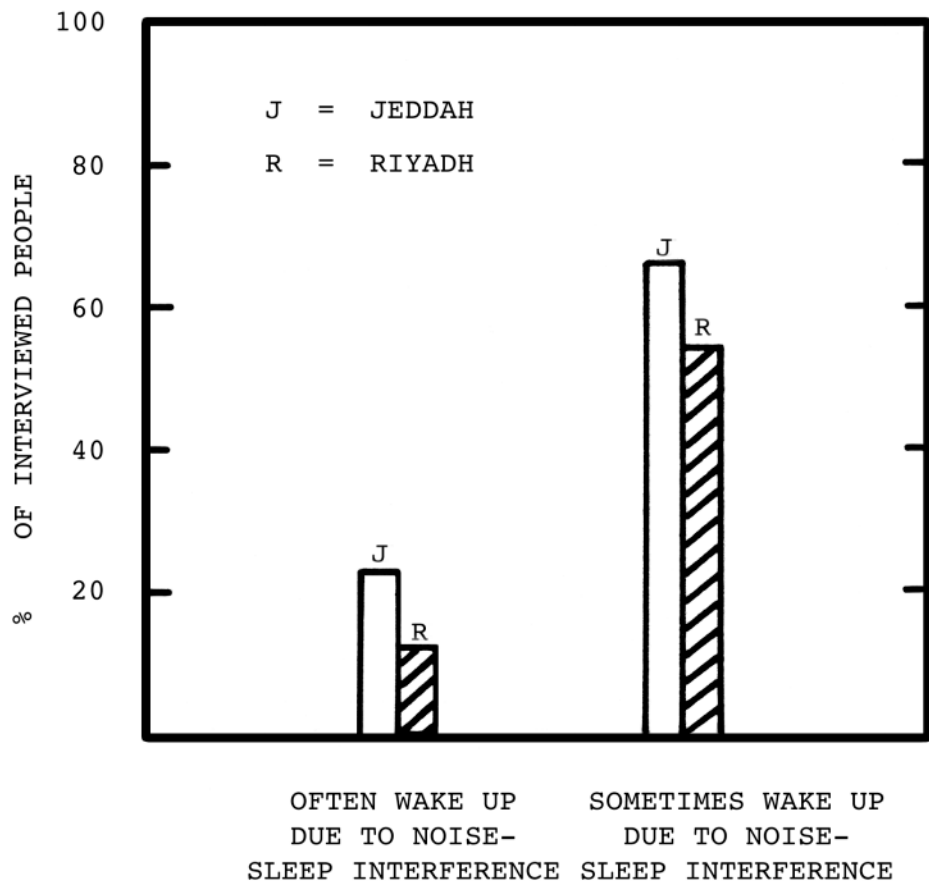


FIG. 1. Community response to noise (sleep interference).

Necessity for Improving Accoustic Environments

Figure 3, illustrates people's opinion about modifying their sonic environment in Jeddah and Riyadh cities. The lower percentages of those in Riyadh city who expressed urgent necessity for reducing sound levels (compared to those in Jeddah) indicate that people in Riyadh city live in a relative comfort with their sonic environments compared to people of Jeddah. Nevertheless, the figures show

that more than 55% of individuals in both cities have expressed an urgent need to reduce noise levels in their outdoor environments. As to indoor environment (at home) the corresponding percentages are 47% for Jeddah citizens and to 30% for Riyadh people; both are considerable percentages. The corresponding figures at work environment are 41 and 26 percent, for Jeddah and Riyadh people respectively, indicating a better environmental sonic situation compared to that of outdoors and at home (indoor) environments.

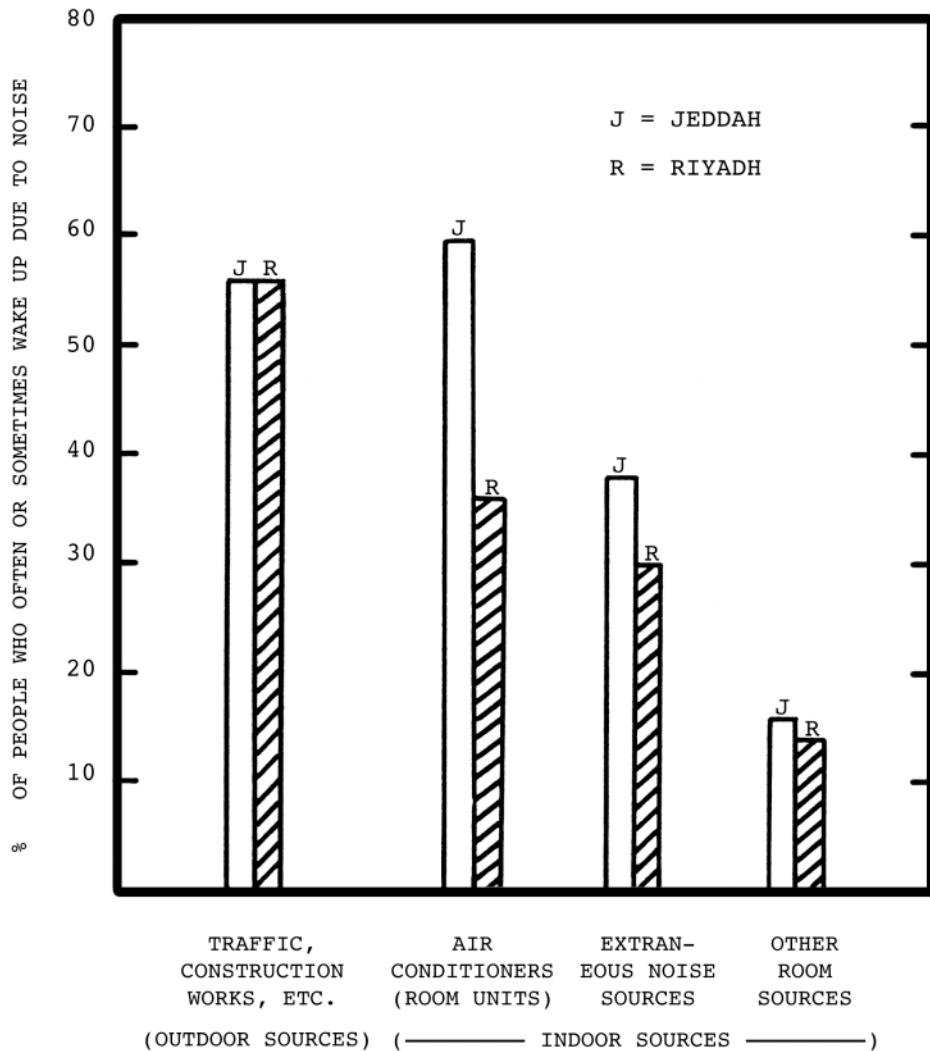


FIG. 2. Noise source/sleep interference-community reaction.

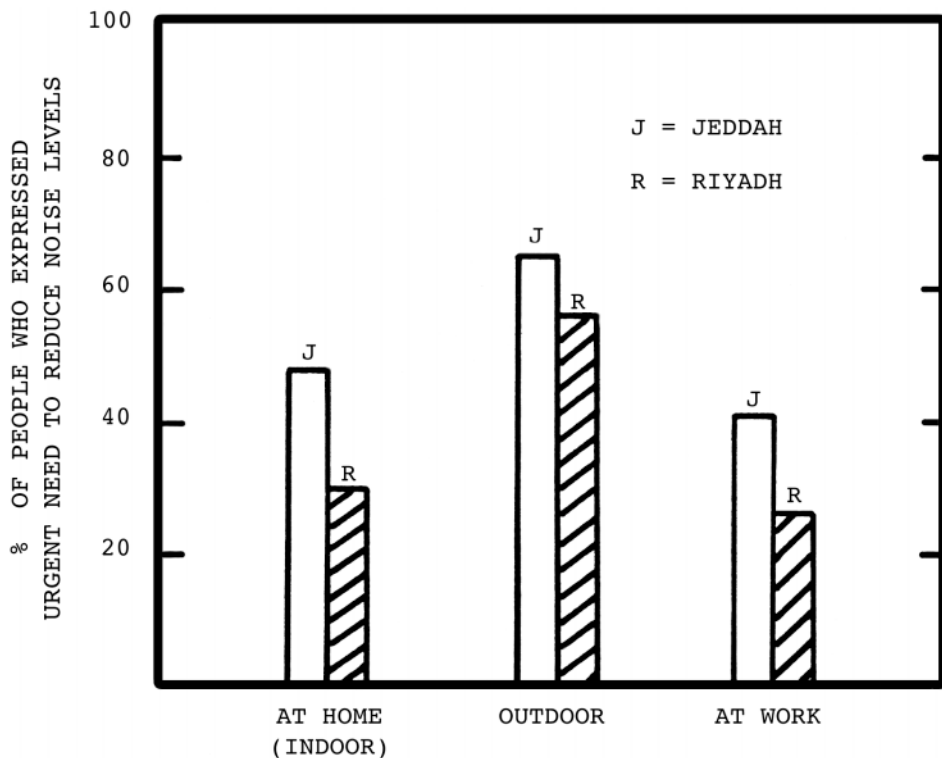


FIG. 3. People's response toward the necessity of improving their acoustic environments.

Conclusions

1. On investigating public opinion about noise in Jeddah and Riyadh cities, the results indicate that outdoor noise due to traffic represents the first major invader that threatens the acoustic quality in both cities. Noise from individual air conditioning units comes second in Jeddah city and construction works noise is second in Riyadh. However, people of Riyadh city expressed a better comfort with their environment compared to those of Jeddah.

2. Results indicate that the percentage of interviewed people who are affected by noise through the sleep interference action is higher in Jeddah than in Riyadh city.

3. The results indicate that need is urgent to reduce noise levels, particularly those due to traffic and construction works (outdoors), in Riyadh and due to traffic (outdoors), air conditioning room units (indoors) in Jeddah.

Acknowledgements

The author wishes to thank FMEALA, King Abdulaziz University, Jeddah, Saudi Arabia for providing the research facilities needed to carry out this work. Thanks are also due to late Mr. Iqbal, Mr. Ansar Jeelani for typing the manuscript. Also the effort of Mr. Mansour Alghamdi in revising and executing the final copy is very much acknowledged.

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الضوضاء والتفاعل المجتمعي في مدينتي جدة والرياض

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المستخلص . تم في هذا البحث قياس وتحليل معدلات الضوضاء في عدد من المواقع السكنية والتجارية في كل من مدينتي جدة والرياض ، واللذان يمثلان إثنين من أكبر مدن المملكة . كما تم تصميم وتطبيق استبيان اجتماعي لتقييم التفاعل المجتمعي بمشكلة التلوث الضوضائي في كل من المدينتين .

وفيما يتعلق بمعدلات الضوضاء فقد أظهرت نتائج القياس والتحليلات على فترات قدرها ساعة كاملة في كل موقع ، ارتفاع مستويات الضوضاء المكافئة (Leq) في كل من المدينتين ، حيث تصل إلى المستوى ٨٧ ديسيبل (dBA) في مدينة جدة ويناظر ذلك مستوى قدره ٨١ ديسيبل في مدينة الرياض .

هذا وقد أوضحت نتائج الاستبيان الارتياح النسبي لقاطني مدينة الرياض لبيئتهم الصوتية عن نظرائهم بمدينة جدة ، مما يبين شدة الترابط بين خصائص البيئة الصوتية والتفاعل المجتمعي بالضوضاء . كذلك فقد أظهرت نتائج القياسات العملية أن الحاجة أصبحت ماسة لتطبيق برامج للتحكم في الضوضاء خارج المنشآت ، وأكد على ذلك أكثر من ٥٥٪ ممن شملهم الاستبيان في كلٍ من المدينتين .