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# Perceptions on music and noise in the operating room: a cross-sectional study

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**ABSTRACT**

*Objectives.* Noise in operating rooms (ORs) during surgery may affect OR personnel and pose a threat to patient safety. The sources of noise vary depending on the operation. This study aimed to investigate how OR staff perceived noise, whether music was considered noise and what its perceived effects were. *Methods.* Surgeons, anaesthesiologists, residents and nurses were interviewed. iPads were placed in the ORs to gather noise-level data. *Results.* Ninety-one interviews were conducted. Most participants (60.5%) reported the presence of noise and 25% the presence of music in the OR. Noise data from iPads registered levels ranging between 59.52 and 85.60 dB(*A*). $\chi^2$ analyses yielded significant results between participants' role and the perceived effects of noise ($p = 0.02$). Responses to open-ended questions were thematically categorized. *Conclusions.* Surgeons generally chose the music played in ORs and were likely positively inclined to its effects, while anaesthesiologists and nurses minded the lack of choice and were more likely to consider it as noise.

**KEYWORDS**

music; noise; surgery; perceptions of healthcare workers; operating room

## 1. Introduction

High noise levels in operating rooms (ORs) during surgery may pose a major threat to the safety and efficiency of procedures performed [1]. Noise can be defined as 'the wrong sound at the wrong place' [2], and this definition can be applied to healthcare settings such as ORs. The recommended threshold for noise should not exceed 90 dB(*A*) over an 8-h period to prevent noise-induced hearing loss [3]. In fact, average noise levels of 45 dB(*A*) or less are recommended within hospitals [1]. Unfortunately, in 40% of surgeries, OR noise levels reach and exceed 100–120 dB(*A*), comparable to a busy highway [1]. High noise levels affect both patients and staff: patients may suffer from intraoperative hypertension and tachycardia [4], and prolonged exposure of staff to OR noise has been linked to noise-induced hearing loss [5,6], to interference with communication in the OR [7] and to decrements in surgeons' concentration and vigilance [5,8,9].

Sources of noise in the OR stem primarily from: (a) surgical instruments including high-speed pneumatic drills, chisels, hammers and saws [10]; (b) equipment such as vital sign monitors, alarms, ventilators, anaesthesia machines, waste management devices and radiological equipment [7]; (c) conversations amongst the staff [5]. Clanging, clattering or dropping metal instruments is also another source of noise [1]. In addition to the aforementioned, music is occasionally played in ORs, often requested and chosen by the operating surgeon; whether music qualifies as just more noise is debatable [6]. There have been mixed reports on the effect of music on personnel performance, concentration, communication, speed and cooperation [9,11–17]. Proponents of music claim that it masks some of the noise, has a calming effect, improves motivation, increases accuracy and reduces stress [1,12,13,15,16,18]. A review of the literature describes the effect of music as contributing to overall stress of the environment, interfering with communication and posing a threat to the safety of patients and staff as well as to task completion [6].

The literature is lacking in research on the effects of music as a distractor during operations, especially given the likelihood of unexpected stressful intraoperative complications [19]. It is not clear whether at a critical time in a race against the clock, music incentivizes the surgeon and OR staff or whether it exacerbates their stress and distracts them.

Our aim was to determine how surgeons, anaesthesiologists, residents and nurses perceived the presence of noise and music in the OR and how they thought it affected their performance, concentration and communication. The results of this study will guide the design of a follow-up study to determine the effects of music on outcomes of specific procedures.

## 2. Materials and methods

### 2.1. Study design and setting

This was an observational, cross-sectional study between January 2019 and January 2020 of OR personnel's perceptions of noise and music in the ORs at a tertiary academic institution in Beirut, Lebanon. Interviews were conducted in the privacy of the physician's lounge or in a private location within the hospital at the participant's convenience. iPads were placed in all of the centre's 10 ORs. They were placed in the corner of the ORs away from the working areas and mounted on the walls to avoid interference with the work of the staff.

This research is reported in line with the Strengthening the Reporting of Cohort Studies in Surgery (STROCSS) guideline [20].

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### 2.2. Participants

All OR staff were eligible for recruitment, including surgeons, anaesthesiologists, residents and nurses. There were no exclusion criteria per se; however, the interview had to be conducted on the day the participant was involved in a surgical operation. The study was approved by the university's Social and Behavioral Sciences Institutional Review Board (protocol number: SBS-2018-0310).

### 2.3. Sample size

The sample size was estimated at 85 participants. This value was based on a correlation sample size calculation, with a type I error rate of 0.05, a type II error rate of 0.2 and an expected correlation coefficient of 0.3. Data for this study were collected from 91 participants to err on the side of caution and to maintain heterogeneity among the different staff groups.

### 2.4. Recruitment

Participants were recruited via a scripted invitation email detailing the specifics of the study sent by the IT Academic Core Processes and Systems (ACPS) on behalf of the investigating team per ethical research conduct guidelines. Willing potential participants were asked to contact the study team for any questions and to schedule a private meeting for the interview at their convenience. Participation was entirely voluntary, and interviews were conducted following the participants' explicit written informed consent. Some interviews were audio-recorded following the participant's consent; otherwise, the interviewer took notes. Interviews lasted approximately 20 min.

### 2.5. Instruments

#### 2.5.1. Semi-structured interview guide

The investigators designed three versions of the semi-structured interview guide for each of the surgeons/anaesthesiologists, residents and nurses. All versions were subdivided into three general categories:

- participant demographics such as participant's age, years of experience, specialty and years of employment at the institution;
- participant's perceptions of noise in the OR, what they considered sources of noise, the loudness level, whether they thought this impacted their concentration, performance and communication and whether this was distracting or helpful in different stages of the operation;
- perceptions on music.

Most questions were closed-ended: effects of noise/music on concentration, performance and communication; and levels of loudness. Answers were rated on 3-point Likert scales (1 = *negatively*, 2 = *neutral*, 3 = *positively* for the former three and 1 = *low*, 2 = *moderate*, 3 = *high* for loudness). These were followed by open-ended questions referring to the potential effects of noise and music:

- At which times during surgery do you find music helpful, and why?
- At which times during surgery do you find music distracting?

Answers to these questions were reviewed and collated thematically.

#### 2.5.2. iPads

iPads installed in the ORs were placed in a thin plastic bag in the corner of each OR. This was to ensure that the iPads did not interfere with the work of the staff. The iPads were iPad Air Wi-Fi 64 GB. The application 'Sound Affects' was installed on the iPads and used to extract the noise data. The application was developed by Memac Ogilvy for the institution based on technical requirements from the Patient Affairs Unit. It uses the built-in microphone of the iPad, hence accounting for the relative loudness perceived by the human ear, which is known as the *A*-weighting value.

### 2.6. Statistical analyses

Quantitative data from interviews were entered into SPSS version 24.0 for analysis. Descriptive analyses were carried out using the number and percentage for categorical variables and the mean and standard deviation for continuous variables, analysing the noise-level data gathered from the sensors and iPads. Pearson $\chi^2$ and correlation tests were performed to test for relationships. Narrative responses to open-ended questions were categorized thematically.

## 3. Results

A total of 91 interviews were conducted. The gender breakdown was 69 (76%) males and 22 (24%) females. Among those participants, 29 (32%) were surgeons, 10 (11%) were anaesthesiologists, 26 (28.5%) were residents and 26 (28.5%) were nurses. Furthermore, all of these different medical personnel were divided across the various hospital departments as follows: 10 (11%) were in orthopaedics, 30 (33%) were in general surgery, 14 (16%) were in neurosurgery, 18 (20%) were in the ear–nose–throat department, nine (10%) were in plastic surgery and 10 (11%) were in cardiac surgery. Table 1 presents a more detailed breakdown of participant demographics by role and age, while Table 2 presents the breakdown by role and years of experience.

### 3.1. Perceptions on noise in the OR

The presence of noise was reported by 60.5% of participants: 51% perceived the source of the noise to be predominantly staff-related activities, e.g., conversations and movement; 13%

**Table 1.** Participant demographics by role and age (total number of participants = 91).

| | Number of participants (%) | | | |
|---|---|---|---|---|
| Role | Under 30 years | 30–39 years | 40–49 years | 50 years or above |
| Surgeon | 2 (6.9%) | 8 (27.6%) | 6 (20.7%) | 13 (44.8%) |
| Anaesthesiologist | 2 (20%) | 5 (50%) | – | 3 (30%) |
| Resident | 17 (65.4%) | 9 (34.6%) | – | – |
| Nurse | 10 (38.4%) | 8 (30.8%) | 4 (15.4%) | 4 (15.4%) |

**Table 2.** Participant demographics by role and years of experience (total number of participants = 91).

| | Number of participants (%) | | |
|---|---|---|---|
| Role | Under 5 | 5–10 | 10 or above |
| Surgeon | 4 (13.8%) | 4 (13.8%) | 21 (72.4%) |
| Anaesthesiologist | 2 (20%) | 4 (40%) | 3 (30%) |

attributed it to surgical equipment and monitors; and 36% suggested it was a combination of both. Nonetheless, only 11% classified the noise level as high.

Surgeons who perceived the OR as noisy said it negatively affected their performance (9%), concentration (27%) and communication (23%). Anaesthesiologists said noise had a neutral effect on their performance and concentration. Of residents, 30% said it negatively affected their concentration and 20% their communication, while for nurses noise negatively affected mostly their communication (53%) followed by performance (41%) and concentration (35%) (Table 3).

Noise levels retrieved from iPads placed in different ORs showed noise levels ranging between 59.52 and 85.60 dB(*A*). The highest noise levels were reported during orthopaedic surgeries with an average noise level of 73.67 dB(*A*), while cardiac surgeries reported the lowest with an average noise level of 68.98 dB(*A*).

### 3.2. Inferential analyses

To test for relationships between variables, $\chi^2$ and correlation tests were performed. $\chi^2$ tests were conducted between independent variables such as age, gender and role of participants and the dependent variable of being affected by music (yes/no). $\chi^2$ results were not significantly different between gender ($\chi^2(1, N = 62) = 0.060, p = 0.806$) and age ($\chi^2(3, N = 62) = 3.971, p = 0.265$). However, significance was found between participant's role and being affected by music ($\chi^2(3, N = 62) = 9.584, p = 0.022$). No correlation was found between the duration of the surgery and noise levels from the iPads ($r(62) = -0.22, p = 0.860$).

### 3.3. Perceptions of music in the OR

Twenty-five per cent of participants reported music playing in the OR on the day the interview was conducted. All surgeons ($n = 8$) within this subset reported that music had a positive effect on their performance, concentration and communication. As for anaesthesiologists, 67% reported a neutral effect on all three, while some residents reported positive effects on their performance (71.4%), concentration (57%) and communication (57%). Lastly, all nurses reported neutral effects on their performance and concentration (Table 3).

Various genres of music were played, including Oriental/Arabic (30.4%), non-Oriental/Western (52.2%), instrumental (8.7%) and playlists containing a range of songs and styles (8.7%). Participants reported that music was mostly played at a moderate volume (15%), 11% thought it was low and only 1% perceived it to be high.

### 3.4. Thematic categorization of narrative responses

To contextualize and expand on the quantitative data, we thematized the narrative responses and comments of participants to open-ended questions in the interview guide about the perceived effects of music on performance, concentration and communication (Table 4).

## 4. Discussion

ORs are high-acuity and high-stress theatres, which require utmost focus and precision [9]. There is no consensus yet on whether music affects OR staff positively or negatively [9], therefore exploring varying perspectives from all stakeholders is key to understanding the effects in the OR.

Some suggest that to understand speech at 90% accuracy, the source must be 10–15 dB(*A*) higher than the ambient noise or the source of noise [9]; readings retrieved from the iPads reveal noise levels ranging between 59.52 and 85.60 dB(*A*). Therefore, for our staff to be understood at 90% accuracy, they would have to speak between the ranges of 75–100 dB(*A*), which means they would have to yell to be heard accurately. Yet our findings suggest that most surgeons and residents did

**Table 3.** Effect of noise and music on performance, concentration and communication of different healthcare workers who reported the presence of noise and/or music (total number of participants = 91).

| | Number of participants (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Effect on performance | | Effect on concentration | | Effect on communication | | |
| Role | Noise | Music | Noise | Music | Noise | Music | Effect |
| Surgeon | 0 (0%) | 8 (100%) | 0 (0%) | 8 (100%) | 0 (0%) | 8 (100%) | Positive |
| | 20 (91%) | 0 (0%) | 16 (73%) | 0 (0%) | 17 (77%) | 0 (0%) | Neutral |
| | 2 (9%) | 0 (0%) | 6 (27%) | 0 (0%) | 5 (23%) | 0 (0%) | Negative |
| Anaesthesiologist | 0 (0%) | 1 (33%) | 0 (0%) | 1 (33%) | 0 (0%) | 1 (33%) | Positive |
| | 9 (100%) | 2 (67%) | 9 (100%) | 2 (67%) | 8 (89%) | 2 (67%) | Neutral |
| | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 1 (11%) | 0 (0%) | Negative |
| Resident | 0 (0%) | 5 (71.4%) | 0 (0%) | 4 (57%) | 0 (0%) | 4 (57%) | Positive |
| | 10 (100%) | 1 (14.3%) | 7 (70%) | 3 (43%) | 8 (80%) | 2 (29%) | Neutral |
| | 0 (0%) | 1 (14.3%) | 3 (30%) | 0 (0%) | 2 (20%) | 1 (14%) | Negative |
| Nurse | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | Positive |
| | 10 (59%) | 2 (100%) | 11 (65%) | 2 (100%) | 8 (47%) | 1 (50%) | Neutral |
| | 7 (41%) | 0 (0%) | 6 (35%) | 0 (0%) | 9 (53%) | 1 (50%) | Negative |

**Table 4.** Thematic categorization of narrative responses.

| Theme | Narrative response | Quote |
|---|---|---|
| Music as a distraction | Surgeons and residents: distracting during critical, time-sensitive and stressful cases, unexpected intraoperative complications and tasks that require their utmost focus; music exacerbates stress especially when they have to raise their voices to communicate with their team Nurses: music affects their concentration as they cannot hear the surgeon's orders and the risk of miscommunication becomes high Anaesthesiologists: loud music is most distracting during the critical stages of induction and emergence | Resident: 'in routine parts, it relaxes the environment but it is distracting when the case is complex and patient care and safety might be affected' Nurse: 'Music is relaxing if it is low and the surgical case is smooth but it can be distracting in case you are under pressure; you can't listen because it negatively affects performance/communication especially if it is loud' |
| Music as soothing and helpful | All participants suggested that, in the absence of complications, music acts as a de-stressor, is soothing and helpful, even affecting their performance and concentration positively For nurses, it is especially calming during long operations | Anaesthesiologist: 'During surgery, music makes people calm so they do not talk and it helps personnel concentrate, but it is distracting to me at the induction and emergence phases when it is loud' |

not perceive music as an additional source of noise, and rather they found it affected their performance, concentration and communication positively. This may be explained by the fact that, almost always, surgeons themselves choose to play music in the OR. This same reason may explain why anaesthesiologists and nurses perceive music as having a neutral or negative effect on them during the operation; especially during critical instances where communication is key.

It has been shown that the positive effect that music has on surgeons' performance outweighs music's negative effects [21]. Music at a low or medium volume was shown to increase accuracy and speed but when the volume becomes loud, music becomes distracting and affects communication [21,22]. For example, during a simulated wound closure during which the trainees were listening to music, there was an improvement in the efficiency of the skin repair as well as overall reduction of the operative time; at the same time, music interfered with communication, which is linked to an increase in operation time and frustration [21].

The surgeon/anaesthesiologist–resident–nurse dynamics reflect the high power distance index (PDI) in the Lebanese culture where 'people accept a hierarchal order in which everybody has a place and which needs no further justification' and where people expect to be told what to do [23]. We did not find a correlation between age of the participants and speaking up about music, indicating that hierarchy did not seem to be influenced by seniority, but rather by the nature of the job (doctor versus nurse, surgeon versus anaesthesiologist).

Therefore, surgeons and surgical residents have a generally positive attitude towards music playing in the OR. However, nurses and anaesthesiologists seemed negatively affected by the dynamics present in the OR as they do not get a say on whether music is played or not. This could explain why music was occasionally perceived as noise by these groups.

### *4.1. Limitations*

The results of the study show that the music listened to the most is Middle Eastern music, which is expected considering that Lebanon is a Middle Eastern country. Therefore, the results of this study cannot be directly extrapolated to other settings without taking culture into consideration. Participation in the study was voluntary and this introduced a potential for recruitment bias.

## 5. Conclusion

Surgeons generally choose the music played in ORs and are therefore positively inclined to its effects, while anaesthesiologists and nurses tend to mind the lack of choice and are more likely to consider music as 'noise'. Speaking up about music is likely hindered by the dynamics in the OR where nurses and anaesthesiologists bear with the presence of music as requested by the surgeon, even if, to them, it is a source of distraction.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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