The effects of environmental factors in waiting rooms on anxiety among patients undergoing coronary angiography: A randomized controlled trial

ABSTRACT

Background: According to Florence Nightingale's hypothesis, the environment can play a central role in the healing of the patient's body and mind. The nurse should, therefore, strive to provide a healing and stress-reducing environment for patients about to undergo invasive procedures.

Aims: This study aimed to investigate and compare the effects of environmental factors, including sound, daylight and colour, on the physiological indices of anxiety as experienced by patients in waiting rooms prior to coronary angiography.

Methods: In this randomized controlled trial, 200 patients undergoing coronary angiography in an urban area of Iran were assigned randomly to the following intervention groups: (i) nature sounds; (ii) nature sounds and daylight; (iii) nature sounds, daylight and colour enhancements, and (iv) control. Portable monitors were used to measure the patients' physiological indices upon admission and 30 and 60 minutes thereafter.

Results: Patients who experienced environmental affecting interventions had significantly lower physiological indices of anxiety than the control group ($p<0.001$). Some significance was demonstrated between the three interventions groups, with patients in the intervention group that experienced maximum environmental interventions demonstrating the most overall reduction in anxiety indices.

Conclusion: Environmental factors were shown to have a positive effect on the indices of anxiety experienced by patients waiting for the procedure of coronary angiography; this is therefore an area of study and practice worthy of further development.

SUMMARY STATEMENT

What is already known about this topic?

- Waiting for coronary angiography is a source of anxiety for patients.
- Anxiety can influence patients' physiological responses.

- People have an inherent tendency to respond positively to nature sounds, daylight and colour.

What this paper adds

- Environmental factors had positive effects on the physiological indices of anxiety among patients undergoing coronary angiography.
- Environmental factors can reduce the physiological indices of anxiety before coronary angiography.
- Nature sounds, daylight and colour can affect positively physiological indices of anxiety.

The implications of this paper

- Environmental factors should be considered, alongside other interventions, during the provision of nursing care to prevent adverse physical and psychological affects in patients.
- Environmental changes help nurses to relieve patients' anxiety when they are waiting for invasive procedures.
- Environmental factors can help create a relaxing waiting time and improve the physiological indices of anxiety among patients undergoing coronary angiography.

Keywords: anxiety; coronary angiography; environmental factors; nursing care

Clinical trial registration number: IRCT2016110317197N2

INTRODUCTION

A common diagnostic procedure undertaken in cardiology wards across the world is that of Coronary Angiography (CA) (King et al., 2008). Waiting for this invasive procedure can be a potential source of stress and anxiety for patients (Buzatto & Zanei, 2010). Anxiety causes haemodynamic stress responses that lead to increased myocardial oxygen consumption and the potential for harmful effects on cardiac functioning (Tahmasbi et al., 2012). Nurses have a responsibility to establish a healing and calm environment for patients before invasive procedures (Weeks & Nilsson, 2011). Nurses should recognise patients' anxieties and provide interventions to lessen these anxieties (Doğan & Şenturan, 2012). For instance, therapeutic sounds, daylight, pleasant views and room colours can lessen anxiety during clinical interventions (Altimier, 2004).

According to Florence Nightingale's hypothesis (1992), the environment can play a central role in the healing of the patient's body and mind. Alvarsson et al. (2010) studied whether recovery from physiological stress was faster after exposure to pleasant sounds of nature, as opposed to noisy environmental sounds. They suggest that nature sounds facilitated recovery from sympathetic activation after the experience of psychological stress. Saadatmand et al. (2013) examined the effect of a nature-based sound intervention on patients undergoing mechanical ventilator support. The intervention groups had significantly lower blood pressure and anxiety levels than the control group.

In addition to the probable positive benefits of nature sounds to moderate patients' anxiety, access to daylight in healthcare facilities may also relieve stress, pain and length of hospital stay (Choi et al., 2012; Sherif et al., 2013). Walch et al. (2005) examined the effect of sunlight on patients' psychosocial health, the amount of analgesic medications taken and the cost of such medication. Utilising the same hospital unit some patients were nursed in an area with bright sunlight with other patients nursed on the darker side of the unit. Patients who were exposed to increased intensity of sunlight experienced less perceived stress, used less analgesic medication and had, therefore, less pain medication costs. Mehrotra et al. (2015) report that exposure to bright morning light reduced agitation among older patients with dementia.

Besides sounds and light, colour can have many effects on human behaviour (Zraati, 2012). Colour can influence patients' recovery and promote a sense of well-being (Liu et al., 2014). Al-Ayash et al. (2015) suggest that the colour red makes individuals more active whereas the colour blue makes them feel calmer. Despite numerous studies about the influence of colour on individuals in the architectural literature, few studies were discovered on this subject in the healthcare literature. Mankeh (1996) investigated the effect of watching a coloured light for two minutes on the physiological reactions of 38 individuals in an informal study. The majority of the participants felt anxiety when viewing a red light and had a sense of relief when viewing blue or green lights. In contrast to these findings Yoto et al. (2007), in a study with eleven university students with normal colour vision, report that looking at red paper had a less arousing effect than looking at blue paper. Also, that colour difference had no significant effect on participants' blood pressure.

Previous studies on the impact of the environment on levels of patients' anxiety did so without seeking to assess the participants' physiological parameters. Sometimes, these parameters were evaluated indirectly and contradictory results were reported. This study aimed to investigate and compare the effects of environmental factors, including sound, daylight, and colour, in waiting rooms on the physiological indices of anxiety among patients undergoing CA.

METHOD

Study design

This was a randomized controlled trial study with four groups (three interventions and one control) conducted from November 2016 to February 2017. According to previous studies (Saadatmand et al., 2013), with a significance level (α) of 0.05, a statistical power ($1 - \beta$) of 0.80 and an anticipated attrition rate of 15 percent a suitable sample size was 50 patients to each group. As a result, a total of 200 patients undergoing CA were selected using a convenience sampling method. The patients were assigned randomly to an intervention group or to the control groups by the random selection of a group-assignment card from a box by a staff nurse who was not informed of the assignment process (Polit & Beck, 2010). The research process is detailed in Figure 1.

Setting and participants

The waiting rooms in a CA centre in an urban area in the east of Iran were the setting for this study. Patients waiting for the procedure of CA, from admission until their transfer to a catheterization laboratory, were the target population.

The inclusion criteria were patients who: 1) were between 18-65 years, 2) were undergoing CA for the first time i.e. without any previous experience of the procedure, 3) were fit and healthy with no health issues, apart from the cardiac related issue occasioning the procedure , 4) were not on any medication apart from acetyl salicylic acid (80 mg), 5) had no hearing and visual problems, 6) had consumed no sedative or anti-anxiety drugs in the previous 24 hours, with the exception of the single dose of Oxazepam that was prescribed for all patients, 7) reported no addictions or anxiety disorders, 8) were conscious and had stable haemodynamic conditions. If sudden changes were observed in the patient's physiological parameters of anxiety, or if they expressed their unwillingness to continue, they would be excluded from the study.

Measurement

Data collection lasted for three months. Demographic and medical information such as age, gender, medication taken in the 24 hours prior to the procedure, past medical history and psychological health status were collected using patients' medical files. The physiological indices of anxiety (systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR) and respiratory rate (RR)) were measured using portable monitors of the same brand and model (Novin S1800®, Iran) to ensure precise calibration and consistency.

Interventions

The researcher conducted the following interventions for each group:

I. Control group: Patients in this group entered a single-bed waiting room that had no window because it was located at the end of the waiting hall. Its lighting was provided by artificial light sources from the hall. In this area, walls and appliances such as the bed, bed table and patient's chair were white. The patients were advised that they would wait in this room for 60 minutes before being transferred to the CA laboratory. During this time they were asked to rest in bed. A nurse (as a co-researcher) came immediately after the patients entered this area, as well as 30 and 60 minutes later, to record physiological indices before the patient was sent to the CA laboratory.

II. Intervention group 1 (nature sounds): This waiting room was near the previous area and had the same physical conditions. Unlike the control group, a media player and disposable headphones were placed on the bed table. A similar explanation was provided to the patients by the researcher. They were also asked to select a sound according to their personal preferences from the list of nature sounds in the media player; these included the sound of birds, rain, sea waves and walking through the forest. Thereafter, they listened to their choice using the disposable headphones for 60 minutes. Also, a sign stating 'The patient is at rest. Please do not disturb' was attached to the waiting area door to prevent unnecessary visits to the area and disruption of the patients' peace.

III. Intervention group 2 (nature sounds and daylight): The characteristics of this waiting room were the same as the waiting area for intervention group 1 in terms of colour, the number of beds, availability of a media player and the ‘do not disturb’ sign. The difference was that this room had a window that opened onto the courtyard of the hospital. The lightening of this waiting room was therefore provided by daylight. The patients received similar instructions as the other groups. They were asked to draw back the curtains so as to allow daylight into the room.

IV. Intervention group 3 (nature sounds, daylight and colour): The participants in this group received the same instructions and experienced similar waiting room conditions as Intervention group 2. The difference for this group being that the curtains, bedspreads, bed table and patient’s chair were all blue.

Since morning light has been demonstrated as being more effective in elevating patients’ mood and reducing stress than the daylight at other times of the day (Ampt et al. 2008; Mehrotra et al. 2015), data were collected in the morning.

Ethical considerations

This study’s research protocol was approved by the research committee affiliated with the University in which the authors worked (decree code: IR.TUMS.FNM.REC.1395.917). The purpose of this research was explained to each patient and a written consent form was signed by each before commencement of the study. Patients were assured that the collected data would remain anonymous and confidential. They were made aware of their right to withdraw from the study at any time without being penalised. The research’s protocol was also registered at the Registry of Clinical Trial Centre.

Data analysis

Descriptive and inferential statistics were used for the data analysis via the SPSS software version 21 (SPSS, Chicago, IL, USA). The normal distribution of the demographic and baseline information (age, gender, RR, SBP, DBP and HR) were analyzed using the Kolmogorov-Smirnov test. Since deviations were observed, nonparametric tests (Kruskal-Wallis, Chi square) were used to assess the differences between the groups.

Due to the violations of sphericity in Mauchly's test of sphericity hypothesis, the Huynh-Feldt correction was applied. The repeated measures of analyses of variance (RANOVA) were used to assess the effect of the time trends, interventions and interactions between time and groups.

Finally, the intra-group homogeneity of variances for physiological indices was assessed using Levene's test of equality of error variances ($p > 0.05$). Pairwise comparisons were conducted to investigate any significant differences between the groups' mean values of the physiological indices. The statistical significance level was set at $p<0.05$.

RESULTS

Demographic and baseline information of the patients in the groups

Two hundred patients were assigned to either the control group or to one of the three intervention groups (n= 50 for each group). Ninety-six patients (48%) were male and 104 patients (52%) were female. The range of the patients' ages was 30-65 years, with the mean age of 51.85 years (SD = 9.06). No statistically significant differences were reported between the groups in terms of age ($p=0.24$) or gender ($p=0.26$) (Table 1). Also, no statistically significant differences in the baseline information related to the patients' RR ($p = 0.07$), SBP ($p = 0.86$), DBP ($p = 0.96$) and HR ($p = 0.56$) were reported.

Effects of time and interventions on the physiological indices of anxiety

RR

A statistically significant reduction ($p<0.001$) was identified in the patients' RR in the intervention groups compared to the control group. In addition, the mean RR was statistically significant between the groups ($p<0.001$) (Table 2, Figure 2).

SBP

The patients' SBP was significantly lower in the all intervention groups compared to the control group ($p<0.001$). However, no statistically significant difference was found between the groups in terms of the patients' mean SBP ($p = 0.278$) (Table 2, Figure 3).

DBP

In terms of the patients' DBP, a statistically significant reduction was also found between the intervention groups and the control group ($p<0.001$). Also, the patients' mean DBP was statistically significant between the groups ($p=0.020$) (Table 2, Figure 4).

HR

The patients in the intervention groups showed significantly lower HR than the control group ($p<0.001$). Also, the patients' mean HR was statistically significant between the groups ($p<0.001$) (Table 2, Figure 5).

The application of environmental factors in the waiting rooms of the intervention groups resulted in reductions in the patients' physiological indices of anxiety compared to the control group. Statistical differences were identified between the three intervention groups that indicated that patients in Intervention Group 3 (with maximum environmental interventions) experienced the most reduction in anxiety.

DISCUSSION

The findings from this study support the hypothesis that differences in the conditions of waiting rooms in terms of sound, daylight and colour affect positively the physiological indices of anxiety in patients undergoing CA, as compared to patients cared for in the usual waiting room environment.

It has been known for many years that environmental factors such as nature sounds, daylight and colour are intertwined with many aspects of human health such as circadian rhythms, pain and agitation (Ampt, et al., 2008; Ulrich, et al., 2008). There is, however, a paucity of studies that examine the effect of environmental factors on the physiological indices of anxiety. Results from this study support findings from previous research that have demonstrated that exposure to nature sounds decrease patients' physiological parameters of anxiety, such as SBP and DBP (Saadatmand et al., 2013). If, however, natural sounds were to be considered a specifically designed form of music, the results of this study differ to those of Taylor-Piliae (2002) who found no significant effect on patients' anxiety (HR and RR) following a musical intervention prior to cardiac catheterization. Differences in sample size, duration of time listening to music and cultural differences might help to explain this apparent disparity.

With regard to the benefits of daylight, the findings of this study were consistent with those of earlier studies (Mehrotra et al., 2015; Walch et al., 2005). The stress-reducing positive physiological benefits of daylight were also identified in a study by Zadeh et al. (2014). Furthermore, our findings add support to the calming effect of the colour blue on patients as identified by Zraati (2012).

No literature was discovered that examined the effects of combined environmental factors, or compared such interventions, on the physiologic indices of anxiety. The intervention of environmental factors in the waiting room evidenced a significant impact on the reduction of anxiety. This is the first study to assess the impact of differing combinations of environmental factors on the physiologic indices of anxiety in the form of a randomized controlled trial. The possibility of choosing a nature sounds intervention was a novel aspect of this study.

Limitations and suggestions

Although this study was innovative, limitations should be noted. This study was restricted to patients with an age range of 18-65 years, and conducted in pre-existing waiting rooms. For the patients assigned to intervention group 3, no opportunity was provided to select a preferred colour from other soothing colours, such as purple or green (Applebaum, et al., 2010). This may have limited the applicability of results in relation to the variety of colours that can affect patients' anxiety. Also, the type of invasive procedure may affect the results, and result in higher levels of anxiety in patients than might be found when waiting for less stressful procedures. Therefore, the focus of this study on patients undergoing CA limits the generalisability of the findings. Also, the use of environmental factors alone, i.e. with no other interventions, might have reduced the potential to reduce further the physiological indices of anxiety. More studies are recommended with broader age ranges and groups undergoing other invasive procedures and to plan studies that include patient choice in colour intervention selection.

CONCLUSION

This study was the first randomized controlled trial to assess the effect of a combination of environmental factors on patients' anxiety. It was found that environmental factors had a positive effect on patients undergoing CA, with reductions in the physiological indices of anxiety evidenced. Given the positive effect of nature sounds, daylight and colours on patients, these factors should be considered when nurses are involved in planning supportive nursing interventions to relieve patients' anxiety whilst waiting for invasive procedures. In collaboration with the organisation's administration and managers, nurses can assist in the creation of soothing and therapeutic environments to decrease the anxiety of patients waiting for a CA procedure. These environmental changes can reduce stress reactions and thus contribute to a more positive overall health status for patients.

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Table 1. The demographical characteristics of the patients in the groups

Characteristics	**Total (n =200)**	**Control group (n =50)**	**Introversion group 1 (n =50)**	**Introversion group 2 (n = 50)**	**Introversion group 3 (n =50)**	**Statistical test & p-value**
Age						Chi square=4.2
Mean	51.85	51.64	53.66	50.08	52.00	df= 3
SD	9.06	9.44	8.71	9.07	8.91	p= 0.24
Gender, n (%)						
Male	96(48%)	23(46.0%)	30(60.0%)	22(44.0%)	21(42.0%)	Chi square= 3.8
Female	104(52%)	27(54.0%)	20(40.0%)	28(56.0%)	29(58.0%)	df= 3
						P= 0.26

Table 2. The comparison of the mean physiological indices of anxiety

Variables /Time	Baseline time Mean ± SD	30 min time's Mean ± SD	60 min time's Mean ± SD	Between group p-value	Within group p-value
RR					
Control group	19.48±1.84	21.30±1.58	21.50±1.64	<0.001	<0.001
Intervention 1	19.36±1.52	17.92±1.47	18.02±1.70		
Intervention 2	18.74±1.64	17.62±1.34	16.98±1.33		
Intervention 3	18.84±1.52	17.42±1.23	16.64±1.21		
SBP					
Control group	132.58±18.41	131.60±18.90	132.00±18.47	0.278	<0.001
Intervention 1	129.58±16.82	127.66±16.13	125.74±15.62		
Intervention 2	131.18±18.79	127.44±18.03	124.96±17.59		
Intervention 3	130.20±19.95	124.30±17.15	121.12±16.85		
DBP					
Control group	81.26±9.19	83.00±9.60	83.90±9.27	0.020	<0.001
Intervention 1	81.28±9.06	79.14±8.55	78.30±8.52		
Intervention 2	80.00±8.55	77.70±7.86	76.64±7.56		
Intervention 3	79.74±8.69	77.68±7.77	76.84±7.17		
HR					
Control group	80.88±7.55	82.80±6.78	84.62±6.29	0.001	<0.001
Intervention 1	82.92±7.14	80.44±6.72	78.64±6.15		
Intervention 2	81.22±7.71	78.88±7.61	77.16±7.76		
Intervention 3	81.86±7.58	76.94±6.21	73.74±5.45		

*Between group comparison ** within group comparison

Respiratory rate (RR), Systolic blood pressure (BP), Diastolic blood pressure (DBP), and Heart rate (HR)

Figure legend

Figure 2. The means of respiratory rate (RR) in the intervention groups show a reduction trend with a downward slope within the first 30 minutes of the interventions. The mean of RR of the control group shows an upward slope during the same time, and also within 30 minutes thereafter.

Figure 3. The means of systolic blood pressure (SBP) in the intervention groups show a reduction trend with a downward slope within the first 30 minutes of the interventions. This reduction trend for the patients' SBP is obvious over the subsequent 30 minutes. The mean of SBP of the control group, except in the first 30 minutes, shows an upward slope.

Figure 4. The means of diastolic blood pressure (DBP) in the intervention groups show a reduction trend with a downward slope within the 60 minutes of the interventions. The mean of DBP of the control group show an upward slope during the same time.

Figure 5. The means of heart rate (HR) in the intervention groups show a reduction trend with a downward slope within the all 60 minutes of the intervention. The mean of HR of the control group shows an upward slope during the same time.