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# The HEALTH SCIENCES JOURNAL

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# Association between family dynamics and the length of screen time of preschool children in Quezon City: A cross-sectional study

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## Abstract

***Introduction*** Excessive screen time has been found to be detrimental to a child's development. Despite its prevalence, there is a dearth of studies relating family dynamics and screen time. This study aimed to determine the association between family dynamics and the length of screen time among preschool children.

***Methods*** Participants were selected through convenience sampling and interviewed using the Family APGAR questionnaire. Families were classified as functional or dysfunctional. The adult respondents estimated the total screen time and this was classified as low-level or excessive. The association between screen time and APGAR classification was determined using prevalence rate ratio.

***Results*** Majority of 115 families had an APGAR classification of highly functional, with the children having an average screen time of five hours. Children from dysfunctional families were 1.23 times more likely to have an excessive amount of screen time than those with highly functional families and the difference was significant (p = 0.041).

***Conclusion*** Majority of the families in this study were highly functional and the average screen time of the children included in the study was five hours. Children from dysfunctional families were 1.23 times more likely to have an excessive amount of screen time than those with highly functional families.

***Key words***: Child development, family dynamics, screen time, preschool child

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In today's fast paced life, screen time babysitting is viewed as an acceptable distraction for children because limiting children's screen time would mean limiting parents' free time to do their work. Without screen media, parents have to serve as entertainers to keep their children safely occupied.[1] Several studies have enumerated the detrimental effects of excessive screen exposure on a child's early life and have recommended two hours or less of recreational screen time per day for children over two years of age.[2,3]

Despite these guidelines, screen time among preschool aged children continues to rise and its popularity has paved the way for these devices to become an integral part of the family.[4]

Excessive screen time at the preschool age is detrimental to a child's cognitive, psychosocial, and physical health. Heavy screen exposure of more than two hours per day resulted in significant language delays and lower cognitive abilities such as those related to short-term memory, early reading, and math skills.[5-7] Children with heavy screen exposure also presented with self-regulation difficulties due to parents' use of smartphones to pacify them. Moreover, early TV exposure at age two resulted to increased social isolation, pro-active aggression, and antisocial behavior during middle childhood.[5-7] Early screen use and the risk for being overweight have been suggested to persist into later life as children became routine heavy viewers, increasing the risk of being sedentary and overweight. Prolonged use can also result in classic addiction behavior such as increased tolerance, withdrawal symptoms, and social isolation.[8]

There is a dearth of local literature tackling screen time in preschool children and family dynamics. Hence, the objective of this study is to bridge the two and determine the association of the length of screen media usage with family dynamics among pre-school aged children.

## Methods

This is a cross-sectional study conducted on families with preschool children 3 to 5 years old from Quezon City. Participants were selected based on convenience sampling of at least two members of a family with a preschool aged child who were willing to answer a demographics questionnaire, the five-item Family APGAR, and a questionnaire to quantify the preschool child's average daily screen time.[9] The child's screen time was classified as low-level ($\leq$ 2 hours) or excessive ($>$ 2 hours) and each family was classified as highly functional (8-10), moderately dysfunctional (4-7), or severely dysfunctional (0-3) based on their Family APGAR scores.[9]

Families with children 3 to 5 years old living in Quezon City were recruited to the study. Participants were identified through convenience sampling; researchers visited sites frequented by families such as malls, groceries, and hospitals. Children with less than two adult ($\geq$ 18 years old) family members present were excluded from the study. Respondents who did not answer the questionnaires completely were excluded. A sample size of 115 was computed based on the following parameters: $Z_a = 1.96$, $Z_b = 0.84$, $P_1 = 0.6$, $P_2 = 0.4$ and $P_{ave} = 0.5$.

Three sets of self-administered questionnaires were handed out by the researchers to parents or family members who agreed to participate in the study. The self-administered questionnaires were comprised of 1) personal information and demographics, 2) Family APGAR, and 3) screen time use. The personal information and demographics questionnaire included the ages of both the child and the respondents, sex, and family income. At least two family members of legal age ($\geq$ 18 years old) were required to individually answer the Family APGAR questionnaire.[9] Each questionnaire corresponded to a designated control number or code in which each family member-child tandem was assigned to, in order to assure anonymity of the data. Screen media pertained to any of the following devices: television, tablet, smartphone, laptop, and desktop computer. Screen time was the total accumulated time spent using screen media in one day as estimated by the adult respondent.

After gathering data from the respondents, the researchers encoded and processed the information from the questionnaires. Family income was classified into socioeconomic classes based on the income classification from the 2012 Family Income and Expenditure Survey (FIES).[10]

The researchers classified screen media usage time as low-level or excessive. The researchers also classified the families based on their Family APGAR scores as functional, or dysfunctional, encompassing both moderately and severely dysfunctional.[9] The association between family dynamics and screen media was tested using prevalence rate ratio and statistical significance was determined using the chi square test. Statistical data was analyzed using SPSS PSPPIRE, an open domain statistical analysis software (GNU) and OpenEpi (Open Source Epidemiologic Statistics for Public Health).

The study was approved by the Ethics Research Committee of the UERMMMCI. During the data gathering process, the researchers explained the study's objectives, significance, benefits, and risks to the participants. Informed consent was obtained, and confidentiality was strictly observed with regard to the participants' identities, demographics, and questionnaire

scores. Anonymity and confidentiality were ensured by assigning codes for each parent/adult-child tandem. All acquired data for the research were handled only by the researchers of the study to ensure the privacy of all participants.

## Results

The study participants consisted of 115 families with 230 adult respondents. Around two-thirds of the adults were female; majority of the respondents belonged to the 20 to 45-year age group and 30% belonged to the middle class, as seen in Table 1. There were more girls among the children, 40% were three years old and the mean age was 3.9 years, as shown in Table 1. There were significant differences among the adult respondents in terms of sex, age of guardians, and socioeconomic status. There were no significant differences in the sex and age of the children.

**Table 1.** Summary of socio-demographic characteristics of the sample population.

| | n (%) | pvalue* |
|---|---|---|
| Characteristics of adult respondents | | |
| Sex (n = 230) | | 0.000 |
| Male | 86 (37.39) | |
| Female | 144 (62.61) | |
| Age (n = 230) | | 0.000 |
| 18-24 | 32 (13.91) | |
| 25-35 | 80 (34.78) | |
| 36-45 | 81 (35.22) | |
| 46-55 | 21 (9.13) | |
| 55 + | 16 (6.96) | |
| Monthly family income** (n = 115) | | 0.000 |
| Poor | 22 (19.13) | |
| Low income | 22 (19.13) | |
| Lower middle | 23 (20.00) | |
| Middle | 34 (29.57) | |
| Upper middle | 4 (3.48) | |
| Upper | 0 (0.00) | |
| Rich | 10 (8.70) | |
| Characteristics of preschool children (n = 115) | | |
| Age | | 0.388 |
| 3 years old | 44 (38.26) | |
| 4 years old | 39 (33.91) | |
| 5 years old | 32 (27.83) | |
| Sex | | 0.641 |
| Male | 55 (47.83) | |
| Female | 60 (52.17) | |

* p-values computed via chi-square test
** Based on 2012 Family Income and Expenditure Survey[10]

As shown in Table 2, majority of the families were highly functional (66.96%) and the average screen time use was 5 hours per day. Children from dysfunctional families were 1.23 times more likely to have excessive screen time than those from functional families, as seen in Table 3, and the difference was significant ($p = 0.041$)

**Table 2.** Percentage of screen time classification according to family function (n = 115).

| | > 2 (%) | ≤ 2 (%) | Total (%) |
|---|---|---|---|
| Highly functional | 56 (48.70) | 21 (18.26) | 77 (66.96) |
| Moderately dysfunctional | 4 (3.48) | 32 (27.83) | 36 (31.30) |
| Severely dysfunctional | 2 (1.74) | 0 | 2 (1.74) |

## Discussion

This study examined the association of family dynamics and screen time among preschool children in a sample of Filipino families living in Quezon City. Two-thirds of the families interviewed in this study were highly functional, showing that a large proportion of families can work as a unit and can adjust to different types of situations. The average screen time of preschool children included in the study was five hours, classified as excessive based on guidelines. The results indicate that dysfunctional families were more likely to have preschool children with excessive screen time.

The role of the parents in a family is vital in the development of young children's behaviors, including screen time.[11] A parent's perception of screen time affects the regulation of his/her child's screen time, leading to difficulties in accepting and implementing guidelines.[1] Parents may also be unaware of the harmful effects of screen time or are torn between its advantages and disadvantages, i.e., whether technology prepares children for the future or is detrimental to their development.[12]

Filipino culture places priority on the family, and screen media use has found its way into becoming a requirement for family bonding.[13] Activities such as watching series and movies on the television with the family, sharing videos online, and using social media as a primary tool in communication have become the norm. The lack of alternatives to these activities then increases the need for screen media use.[14]

The most prevalent explanation for increased screen time use in children today is believed to be the lack of time and resources to find better alternatives to entertain young children as parents go about their daily chores.[12] It is typical in a Filipino household to have both parents working while the child is left in the care of older siblings, grandparents, or household helpers. Limiting children's screen time is a concern for both parents and their guardians because this would mean limiting free time for their own work. Without screen media, they would have to serve as entertainers to keep the children safely occupied.[1]

Ultimately, the task of controlling and setting limits for screen time falls on the parents, making family dynamics a key factor in the implementation of screen time regulations. When parents are faced with conflict and resistance from their children upon attempting to control screen time use, many parents often ease restrictions. In dysfunctional families, children may view parent-imposed time limits as unfair and unreasonable, leading to family conflict.[1] In many families, parents serve as role models for their children. However, studies show that parents themselves refuse to change their own screen viewing behaviors.[11] Parents may also use screen media to regulate behaviour giving additional screen time to reward good behavior and restrict it as punishment for misbehavior.[12] These parenting strategies only further solidify the role of screen media in family dynamics.

Technology has become all too convenient and affordable. Results of our study show that excessive screen time use can be observed in all socioeconomic classes, but even more so in dysfunctional families. While parents may find it difficult to name non-electronic alternatives that are safe and affordable, the restriction of screen time actually provides children an opportunity to develop independent and unstructured play skills.[12] Interventions should focus not only on limiting screen time use for children, but also focus on parents' knowledge and attitude towards screen time use.

This study examined the association of family dynamics and screen time in pre-school children among a sample of Filipino families with preschool children living in Quezon City. Majority of the families in this study were highly functional and the average screen time of the children included in the study was five hours. Children from dysfunctional families were 1.23 times more likely to have an excessive amount of screen time than those from highly functional families.

One of the limitations of the study was that screen time use per day was subjective and was dependent on the time of use observed by the adult respondent; hence, non-supervised time was not accounted for. Another limitation was that screen media use was measured only for the children, but not for the parents and other family members. Finally, participants were recruited via convenience sampling, which may have led to selection bias.

The researchers recommend that for future studies both active and background screen media use such as television shows playing in the background or playing videos while doing something else be accounted for. Another recommendation is to quantify screen time prospectively by recording the time used per gadget. Qualitative studies may more insight into the relationship between family dynamics and screen time.

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# The accuracy of the Innovo Deluxe Fingertip Pulse Oximeter perfusion index in predicting hypotension during balanced general anesthesia induction – a prospective observational study*

Brian Rainier T. Herradura, MD; Beverly Anne P. Portugal, MD and Olivia C. Flores, MD, MEM

## Abstract

***Introduction*** Balanced general anesthesia technique is a popular choice for induction because it can minimize potential side effects from individual drugs when otherwise used alone. However, hypotension is still a common occurrence during induction. Perfusion Index (PI) has been used as a measure of systemic vascular resistance and has shown to predict hypotension after regional anesthesia and propofol induction. This study aimed to determine whether baseline PI can predict hypotension following balanced general anesthesia induction and determine a cut-off value where hypotension is expected to occur.

***Methods*** Thirty-five ASA I/II adults for elective surgery under general anesthesia were enrolled. Heart rate, blood pressure and PI were measured every minute from baseline to 5 minutes following induction and 10 minutes after endotracheal intubation. Hypotension was defined as fall in systolic BP (SBP) by >30% of baseline and/or mean arterial pressure (MAP) to <60 mmHg. Severe hypotension (MAP of <55 mm Hg) was treated.

***Results*** No hypotension was observed in the first 5 minutes. Within 10 minutes, hypotension occurred in 8.6% by SBP criterion and 2.6% by MAP criterion. Within 15 minutes, hypotension was seen in 5.7% by SBP and MAP criterion, respectively. PI showed very low ($r < 0.2$) to low ($r = 0.2$ to 0.39), negative to positive and insignificant correlation ($p > 0.05$) with hypotension whether using SBP or MAP criterion and whether observed at 10 or 15 minutes of anesthesia induction. The Area under the ROC curve is 0.397, 95% CI [0 .126, 0.667], $p = 0.431$.

***Conclusion*** This study lends inconclusive evidence on the usefulness of Innovo Deluxe Fingertip Pulse Oximeter with Plethysmograph and Perfusion Index to predict intraoperative hypotension following balanced general anesthesia induction for this sample of patients. However, there was a positive, moderate ($r=0.538$, 0.501 and 0.469) and significant ($p<0.05$) correlation between perfusion index and SBP, Diastolic BP and MAP, respectively.

***Key words***: Perfusion index, blood pressure, arterial blood pressure, general anesthesia, hypotension, pulse oximetry

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Many surgical patients cannot tolerate perioperative hypotension because of co-morbid conditions. Hypotension during balanced anesthesia induction is frequently encountered. A tool that can predict the occurrence of hypotension during induction of general anesthesia will be beneficial in identifying this subset of patients. Measures can then be instituted to avoid hypotension during induction of anesthesia.

The pulse oximeter perfusion index (PI) has been used as an indicator of systemic vascular resistance (SVR). It is measured as a ratio of the pulsatile blood flow to the non-pulsatile or static blood in peripheral tissue. Studies using PI in measuring SVR and predicting hypotension in both regional and general anesthesia are few. In general, perfusion index decreases because of local vasoconstriction and increases with vasodilation in the monitoring site.[1] Therefore, PI can be used as a continuous, indirect, non-invasive measure of peripheral perfusion. Studies have shown that PI is useful in monitoring effectiveness of regional anesthesia, depth of general anesthesia, successful epidural placement and hemodynamic status of critically-ill patients.[2-9]

A study by Mehandale and Rajasekhar concluded that PI could predict hypotension following propofol induction.[10] All previous studies used expensive pulse oximeters to measure PI. However, newer portable and affordable pulse oximeters already have this feature built in. No study correlating the measurements of the newer affordable pulse oximeters with hypotension in the perioperative setting have been encountered. This study is geared toward supplementing studies done is the past to strengthen the use of perfusion index as a useful intraoperative and perioperative monitoring equipment especially in addressing hypotension during anesthesia induction using an inexpensive pulse oximeter with built-in ability to measure PI. The authors hypothesize that baseline pulse oximeter PI taken from portable pulse oximeters can predict hypotension following balanced general anesthesia induction and a cut-off value can be determined beyond which the incidence of hypotension is more frequent.

## Methods

A prospective observational study was performed in a tertiary care hospital after approval from the institutional ethics committee (RIHS ERC Code: 0632/E/H/18/143). Adults aged between 18 and 65 years belonging to the American Society of Anesthesiologists' Physical Status 1 and 2 for elective surgery under general anesthesia who agreed and gave their written informed consent were included. Patients who were pregnant, hypertensive, taking vasoactive medications, assessed to have a difficult airway, or had body mass index (BMI) > 35 kg/m$^2$ were excluded from the study. No premedications were given to the patients. Upon reception in the operating room, electrocardiograph, non-invasive blood pressure (BP), pulse oximeter (Innovo Deluxe Fingertip Pulse Oximeter with Plethysmograph and Perfusion Index, Innovo Medical, Stafford, TX) were connected, and baseline values of heart rate (HR), PI, systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) were recorded. Pre-oxygenation with 100% $FiO_2$ was done. Intravenous midazolam 1-2 mg and fentanyl 1 ug/kg were administered followed by titrated doses of propofol until loss of response to verbal communication was achieved. Sevoflurane was then started at 1 MAC and a neuromuscular blocker of choice (atracurium 0.5 mg/kg or cisatracurium 0.15 mg/kg or rocuronium 0.6 mg/kg) was administered. The parameters were recorded every minute for 15 minutes. The trachea was intubated by a resident or consultant anesthesiologist 5 minutes after giving the neuromuscular blocker. Maintenance of anesthesia was maintained with sevoflurane. Hypotension was defined as a drop in SBP to < 30% of baseline or absolute MAP < 60 mm Hg. MAP < 55 mm Hg (severe hypotension) was treated immediately by rapid intravenous fluid administration (10 mL/kg) and ephedrine 5 mg IV boluses. Bradycardia was defined as HR < 50 bpm or decrease by more than 30% below the baseline value, whichever was lower, and was treated with atropine 0.5 mg IV boluses. The incidence of hypotension was computed at 5-minute intervals as to differentiate between the effects of anesthesia induction, endotracheal intubation and maintenance of anesthesia. A cut-off value of baseline PI below which hypotension post-induction could be predicted was the primary outcome, while positive and negative predictive values of the relationship between PI and other parameters (HR, SBP, DBP, MAP) were secondary outcomes.

The sample size was calculated to observe effect size of at least 0.503 based on a study by Mehandale for correlation of PI and change in the SBP after propofol induction.[10] For an alpha error of 5% and 80% power, the sample size required was found to be

29. Factoring in an attrition rate of 20%, the sample size was 35 participants. Sample size was computed using UCSF Clinical and Translational Science Institute online sample size calculator. Data were collected and computed using Microsoft Excel Home and Student 2016 (Microsoft Corporation, Redmond, Washington, 2016) and analyzed using SPSS version 21. Continuous variables were expressed as mean ± standard deviation (SD). Point biserial correlation was used to determine the correlation between baseline PI and incidence of hypotension using SBP and MAP criteria. Spearman rank order correlation was utilized to determine the correlation between PI and the other hemodynamic variables (HR, SBP, DBP, MAP). Correlation was classified as very weak ($r < 0.20$), weak ($r = 0.20$ to $0.39$), moderate ($r = 0.40$ to $0.59$), strong ($r = 0.60$ to $0.79$), or very strong ($r > 0.80$). A p-value $< 0.05$ was used as cut-off value for significance. A receiver operating characteristic (ROC) curve was constructed to determine the utility of baseline perfusion index to predict hypotension during general anesthesia induction.

## Results

Thirty-five patients with a mean age of 36 years, mean BMI in the ideal body weight range were included in the study; there were more women and more patients were classified as ASA 1, as shown in Table 1. As seen in Table 2, there was a decrease in the average measurements of the HR, SBP, DBP and MAP on the 5th and 10th minutes. The HR was noted to return to baseline levels while the blood pressure parameters increased slightly on the 15th minute. The PI was noted to increase from baseline to the 15th minute.

There was a negative weak correlation of PI with heart rate at all time points. There was a positive moderate to strong correlation of PI with SBP, DBP and MAP at all time points and all were significant, as shown in Table 3. The correlation coefficient was observed to be highest (r = 0.68, 0.62 and 0.62)

**Table 1.** Baseline characteristics of 35 participants.

| Parameter | |
|---|---|
| Age (yr) (mean ± SD) | 36.2 ± 12.80 |
| BMI (kg/m$^2$) (mean ± SD) | 24.0 ± 3.46 |
| Sex – n (%) | |
| Male | 15 (43) |
| Female | 20 (57) |
| ASA classification – n (%) | |
| ASA 1 | 30 (86) |
| ASA 2 | 5 (16) |

ASA – American Society of Anesthesiologists; SD – Standard deviation

**Table 2.** Hemodynamic measurements at baseline, 5, 10, and 15-minute intervals.

| Parameter (Mean ± SD) | Baseline | 5 min | 10 min | 15 min |
|---|---|---|---|---|
| Heart rate | 80.5 ± 15.8 | 76.4 ±14.0 | 74.8 ± 14.5 | 81.7 ± 14.3 |
| Systolic blood pressure | 131.6 ± 18.9 | 120.4 ± 18.0 | 110.1 ± 18.1 | 122.3 ± 21.0 |
| Diastolic blood pressure | 80.9 ± 12.8 | 72.4 ± 12.0 | 55.4 ± 11.2 | 74.4 ± 15.9 |
| Mean arterial pressure | 98.3 ± 13.7 | 88.3 ± 13.9 | 81.9 ± 16.0 | 93.1 ± 17.8 |
| Perfusion index | 4.9 ± 3.7 | 5.4 ± 4.5 | 5.4 ± 5.2 | 7.8 ± 4.5 |

**Table 3.** Correlation between perfusion index and hemodynamic variables at 5, 10, 15 minutes and overall.

| Time | HR* | SBP* | DBP* | MAP* |
|---|---|---|---|---|
| 5 min | -0.14 (0.405) | 0.48 (0.004) | 0.47 (0.005) | 0.41 (0.014) |
| 10 min | -0.01 (0.963) | 0.68 (0.000) | 0.62 (0.000) | 0.62 (0.000) |
| 15 min | -0.02 (0.922) | 0.56 (0.000) | 0.48 (0.004) | 0.54 (0.001) |
| Overall | -0.18 (0.309) | 0.54 (0.001) | 0.50 (0.002) | 0.47 (0.005) |

*Spearman rank order correlation: r (p-value)
HR – heart rate; SBP – systolic blood pressure; DBP – diastolic blood pressure; MAP – mean arterial pressure

between PI and SBP, DBP and MAP, respectively, at 10 minutes post-induction. Overall, there was a positive, moderate (r = 0.54, 0.50 and 0.47) and significant (p = 0.001, 0.002, 0.005) correlation between PI and SBP, DBP and MAP, respectively (Table 3).

Hypotension was not observed within the first 5 minutes post-induction. By the 10th minute, hypotension occurred in four patients (three by SBP criterion and one by MAP criterion). By the 15th minute, hypotension was seen in two patients, by SBP and MAP criteria, respectively. Perfusion index showed very weak to weak, negative to positive and insignificant correlation (p = 0.124 to 0.453) with hypotension whether using SBP or MAP criterion and whether observed at 10 or 15 minutes of anesthesia induction as seen in Table 4.

The area under the ROC curve (AUC) was 0.397 (95% CI (0 .126, 0.667, p = 0.431). Having an area close to 0.5 and a curve that follows an almost diagonal path from the lower left-hand corner to the upper right-hand corner, indicates inconclusive evidence on the usefulness of perfusion index to predict intraoperative hypotension for this sample of patients (Figure 1).

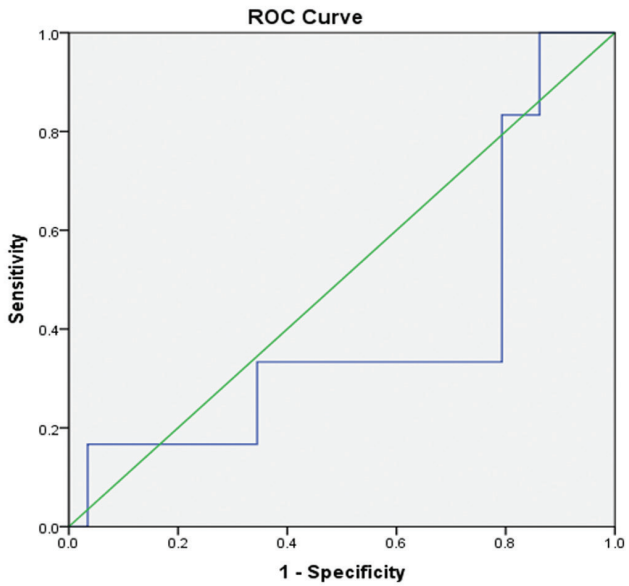


**Figure 1.** Receiver operating characteristic (ROC) curve of perfusion index predicting hypotension

## Discussion

The study by Mehandale and Rajasekhar concluded that baseline PI could predict hypotension after propofol induction and that a baseline PI < 1.05 was associated with a higher incidence of hypotension.[10] This study was designed to try to replicate their results using a different and more affordable device to measure PI. The investigators did not intend to affirm nor invalidate their work. Cardiac monitors or dedicated high-end pulse oximeters with the ability to measure PI are expensive to acquire. Given that the types of surgical procedures done in large, state of the art hospitals are similar to those done in smaller yet sufficiently equipped medical facilities, the applicability of Mehandale and Rajasekhar's study could have been expanded further if the results held true using an affordable finger clipped pulse oximeter with the ability to measure PI.

The decision to conduct the study on ASA 1 and 2 patients as subjects was reached in order to eliminate confounding physiologic states that could possibly be present in the critically-ill, pregnant, pediatric, use of vasoactive medications and extreme elderly. The applicability of the study to these subsets of patients can be attained if this method of measuring hemodynamics is already well-understood. The decision to induce with titrated doses of propofol until loss of response to verbal stimulus was reached in order to make a uniform objective end point and remove possible confounders when giving fixed doses.

**Table 4.** Correlation between baseline perfusion index and hypotension.

| Perfusion Index | Hypotension | | | |
|---|---|---|---|---|
| | Using SBP criteria | | Using MAP criteria | |
| | 10 minutes | 15 minutes | 10 minutes | 15 minutes |
| Correlation coefficient (r) | 0.265 | -0.197 | -0.131 | 0.229 |
| p-value* | 0.124 | 0.256 | 0.453 | 0.186 |

*Point bi-serial correlation

This study lends inconclusive evidence on the usefulness of the Innovo Deluxe Fingertip Pulse Oximeter with Plethysmograph and Perfusion Index to predict intraoperative hypotension following balanced general anesthesia induction for this sample of patients. Since PI is a measure of perfusion and the strength of pulsatile activity in the measured area, it could generally be concluded that vasodilation will increase PI and vasoconstriction will do the opposite. Due to the vasodilatory effects of general anesthesia, there was the expected downward trend of hemodynamic variables in the first 5-7 minutes. This was accompanied by slowly increasing PI which could be attributed to the vasodilation brought about by general anesthetics. The return to baseline or near baseline of hemodynamic values at the 15th minute and accompanied by the gradual increasing trend of PI can be explained by the down titration of inhalational anesthetic and decreasing effect of propofol while maintaining their vasodilatory effects. The predicted sympathetic surge during endotracheal intubation which could result in increase in systemic vascular resistance and a subsequent decrease in PI was not observed in this study. Tachycardia and transient elevation of blood pressure were seen during endotracheal intubation but the acute changes in PI were not seen. This may be explained by the possible inability of the Innovo Pulse Oximeter to detect abrupt changes in PI. The decrease in PI with increasing SVR was already observed in a study where a decrease in PI by 10% from baseline was used as a criterion for a positive intravascular epidural test dose (lidocaine + epinephrine) injection.[1] Surgical cutting time did not occur within 15 minutes from start of induction in this population. Therefore, it can be safely mentioned that the return to baseline hemodynamic values on the 15th minute was not because of surgical stimulus.

No hypotension was observed in the first 5 minutes. Within 10 minutes, hypotension occurred in 8.6% by SBP criterion and 2.6% by MAP criterion. Within 15 minutes, hypotension was seen in 5.7% by SBP and MAP criterion, respectively. There was no severe hypotensive episode that necessitated giving of ephedrine. In the current results, there seems to be very weak to weak negative to positive and insignificant correlation ($p > 0.05$) between PI and incidence of hypotension whether using SBP or MAP criteria. Therefore, the authors cannot recommend using PI to predict hypotension.

Since circulatory volume affects a patient's hemodynamics, it will likewise affect the PI readings. Authors have suggested a PI median value of 1.4 as normal for healthy individuals.[11] Patients who are relatively hypovolemic with reflex vasoconstriction and low PI could experience hypotension with general anesthesia induction. These patients could benefit from volume loading prior to induction.

Overall, there was a positive, moderate and significant association between PI and SBP, DBP and MAP. The current results were different from Mehandale and Rajasekhar's findings which showed a weak negative correlation of PI with SBP, DBP, MAP and HR.[10] In their study, SBP was the only independent predictive variable with correlation coefficient of $r = -0.503$ ($p < 0.001$). Their scatter plot of baseline PI showed a bell-shaped curve with very high and very low SBP values being associated with low PI. They explained that a low PI with a low SBP is attributable to loss of pulsatility and is seen with hypovolemia and use of vasopressors.[12] However, high SBP with low PI may be due to concomitant increases in the non-pulsatile component (circulatory volume or SVR). The current study showed a positive correlation of PI not only with SBP but also with DBP and MAP. Starting with induction, there was a slight decrease of hemodynamic parameters and a concomitant gradual increase in PI. There was a steady rise in PI even when hemodynamic values had returned to baseline or near baseline. All patients were started with intravenous fluids running at maintenance rates at least 8 hours prior to induction of general anesthesia. The authors assume that these patients were well hydrated and had adequate circulatory volume right before the start of induction. The gradual progressive increase in PI could be explained by consistent vasodilatory effect of inhalational anesthetics but without the reflex vasoconstriction that is seen in volume-depleted patients. HR showed a poor, negative and not significant correlation with PI.

The usefulness of PI to predict post induction hypotension has been inconclusive in this study. The area under the ROC curve (AUC) (0.397, 95% CI [0 .126, 0.667], $p = 0.431$) failed to establish a cut-off value beyond which hypotension occurs more often.

This study is limited by the lack of direct evidence for the explanations proposed which are only based on hypothesis. Current results are inconsistent with similar studies. This could not be attributed to the study design and data collection as the researchers

implemented these in such a way that the authors could closely resemble their methods. The difference of this study from previous ones was the use of a low-cost finger clipped pulse oximeter versus their use of more sophisticated, standard, operating room monitors manufactured by Masimo or Philips. As of this writing, there is no available literature comparing PI readings of these pulse oximeters.

The data show that PI can be used as a measure of hemodynamic status. The data from a simple pulse oximeter can be very useful in critical ways if clinicians are trained to interpret it. An inexpensive clip-on pulse oximeter that can measure PI that is easy to use and is more readily available can give a clinician another tool for measuring the hemodynamic status of patients. This study lends inconclusive evidence on the usefulness of Innovo Deluxe Fingertip Pulse Oximeter with Plethysmograph and Perfusion Index to predict intraoperative hypotension following balanced general anesthesia induction for this sample of patients. However, there was a positive, moderate ($r = 0.54$, 0.50 and 0.47) and significant ($p < 0.05$) correlation between perfusion index and SBP, DBP and MAP, respectively.

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# A comparative dose-response study on the efficacy and safety of intrathecal morphine effectiveness in post-cesarean patients under spinal anesthesia at a tertiary hospital

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## Abstract

***Introduction*** Intrathecal morphine, commonly administered at doses of 100 to 200 mcg, is a popular choice for post-cesarean analgesia; however, a trade-off between opioid analgesia and side effects exists. This study was conducted to determine the lowest dose of intrathecal morphine that will provide adequate analgesia with the least side effects among post-cesarean patients.

***Methods*** Sixty term parturients for cesarean delivery under spinal anesthesia were randomized into three treatment groups to receive 50, 100 or 150 mcg of intrathecal morphine with a standard multimodal pain regimen and intravenous tramadol as needed. Pain scores, demand for rescue analgesic, and incidence of adverse effects (nausea, vomiting, and pruritus) during the first 24 hours' post-spinal anesthesia were recorded and compared between groups.

***Results*** Pain scores and demand for rescue doses of tramadol were higher for the 50-mcg group as compared to the other groups. There was no significant difference in pain scores between the 100 and 150-mcg groups. No rescue dose of tramadol was necessary in the 100 and 150-mcg groups. No significant difference was seen in the incidence and severity of nausea and vomiting across treatment groups. The incidence and severity of pruritus were significantly higher in the 150-mcg group. No significant difference was noted in the incidence and severity of pruritus between the 50 and 100-mcg groups.

***Conclusion*** A dose of 100 mcg of intrathecal morphine, in combination with a multimodal regimen, provides adequate analgesia with the least side effects.

***Key words***: Spinal anesthesia, intrathecal morphine, opioid analgesics, post-cesarean analgesia, cesarean section anesthesia, multi-modal pain management

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The effectiveness of intrathecal (IT) morphine for post-cesarean delivery analgesia is well established. Advantages of IT morphine include excellent postoperative analgesia for 14-36 hours with a decrease in total dose of opioid required, a low level of sedation, minimal accumulation of the drug in breast milk, facilitation of early ambulation, and early return of bowel function.[1-8] Though it is commonly administered at a dose of 100 to 200 mcg,

the optimal dose for pain control with the least side effects has yet to be established. Studies have shown that lower doses result in more patient discomfort and pain, however the incidence of side effects increases with higher doses.[9-17]

This study may serve as a reference for anesthesiologists regarding the use of low-dose intrathecal morphine to decrease unnecessary exposure to opioids and lessen side effects without decreasing the quality of post-operative analgesia, thus promoting patient satisfaction and comfort. In UERMMMC, the usual dose of IT morphine administered for post-cesarean pain control is 150 to 200 mcg. However, this is usually accompanied by pruritus commonly in the nasal and maxillofacial areas, with some patients having non-tolerable generalized pruritus. Hence, the purpose of this study was to determine the lowest dose of intrathecal morphine that would provide adequate analgesia with the least side effects among patients for cesarean section. Specifically, this study aimed to compare the pain scores at rest and upon movement of study groups (50 mcg, 100 mcg, 150 mcg) at 6, 12 and 24 hours post-spinal anesthesia, the incidence of IV opioid rescue dose demand in the first 24 hours across the study groups, and the incidence of side effects (i.e., nausea and vomiting, pruritus) across individual IT morphine doses.

## Methods

This was a randomized trial comparing three doses of intrathecal morphine among women undergoing cesarean section. Participants were randomized to receive either 50, 100 or 150 mcg morphine during spinal anesthesia. Pain scores, the need for rescue doses of IV opioids and the incidence of side effects were determined and compared across the three study groups.

Sixty pregnant women aged 18 to 40 years at 37 weeks of gestation presenting for cesarean delivery under spinal anesthesia, who gave their written informed consent, were enrolled in this study. Those with any of the following characteristics or conditions were excluded: height of less than 147 cm, body mass index (BMI) greater than 45 kg/m$^2$, ASA Physical Status 3 or higher, allergy or contraindication to morphine, receiving analgesics or with an acute or chronic pain syndrome, history of neuropsychiatric disorder, and third trimester pruritus.

Each participant was randomized based on a computer-generated table of random numbers, with her dose assignment placed in a sealed numbered opaque envelope that was opened immediately before preparation of the spinal anesthetic dose. Patients were randomly assigned to one of three treatment groups to receive 50, 100 or 150 mcg of IT morphine with hyperbaric bupivacaine 0.5% 15 mg in a total volume of 3.2 mL with saline if necessary. The morphine and saline doses were drawn into a 1 mL syringe for accuracy and added to the spinal injection syringe containing 0.5% hyperbaric bupivacaine 15 mg/3 mL. Assigned doses were prepared by the assisting anesthesiologist. The patient, clinical care team, and the investigators performing all study-related assessments were blinded to the treatment group. The anesthesiologist who prepared the dose of morphine had no further involvement in the care or assessment of the patient.

All patients received crystalloid solution before anesthesia administration. Spinal anesthesia with the designated dose of morphine was administered with the patient in a lateral decubitus or sitting position depending on operator's preference, at an interspace judged to be L2-L3, L3–4 or L4–5 using a 25-gauge Quinckie spinal needle. Upon return of clear cerebrospinal fluid, bupivacaine 15 mg was injected with a morphine dose according to the patient's randomization. After injection, the patient was put in a supine position with left tilt. Surgery was started following temperature and/or pin-prick testing to the T4 level. Blood pressure was monitored every 2-3 minutes until delivery of the baby, after which blood pressure was monitored every 5 minutes at the provider's discretion. After delivery of the baby, oxytocin, using a standard concentration of 20 U in 1000 mL, and paracetamol 1g IV were infused. During closure of the subcutaneous layer, the patient received an intravenous dose of ketorolac 30 mg, or parecoxib 40 mg IV if the skin test to ketorolac was positive.

After surgery, all patients were provided with a standard set of pain medications of ketorolac 30 mg IV every 6 hours after a negative skin test and paracetamol 600 mg IV every 6 hours for the first 24 hours. Patients were also given a standing order of tramadol 50 mg IV every 6 hours as needed for breakthrough pain defined as a visual analog scale (VAS) score $\geq$ 6/10 or upon the patient's request. The pain score at the time of administration of tramadol was carried over to the next scheduled pain score assessment. The

incidence of IV tramadol demands was recorded for the first 24 hours' post-spinal anesthesia. Pain scores were recorded on an unmarked 100-mm line (at rest and with movement). Nausea and pruritus were each graded using a 4-point scale, where 0 = none, 1 = mild (requiring no treatment), 2 = moderate (responsive to treatment), and 3 = severe (unresponsive to treatment). Post-operative vomiting was assessed using a different 4-point scale as follows: 0 = none, 1 = 1 to 2 episodes, 2 = 3 to 4 episodes, and 3 = more than 4 episodes. Scores were collected by study personnel at the designated times (± 1 h).

Diphenhydramine 50 mg as first-line therapy for pruritus, nalbuphine 5 mg for refractory pruritus, and naloxone 0.4 mg for respiratory depression were available for treatment of side effects. First line treatment for nausea and vomiting was metoclopramide 10 mg IV; ondansetron 4 mg IV and dexamethasone 5 mg IV, respectively, were the 2nd and 3rd line treatments for unrelieved nausea/vomiting. Nurses administered the treatment based on the patient's reporting of symptoms and the nurses' clinical judgment within the order-set confines.

Data were analyzed using Stata version 13. Categorical data were expressed as counts and proportions and continuous data as mean and standard deviation or median and range, when appropriate. Baseline characteristics (age, BMI) were compared between treatment groups using one-way ANOVA. To determine significant differences in pain scores on the 6th, 12th and 24th hour post-spinal anesthesia between treatment groups, Kruskal Wallis one-way ANOVA with paired comparisons was used. To compare the need for rescue analgesics and the incidence and severity of side effects (e.g., nausea, vomiting and pruritus) between treatment groups, chi square test or Fishers exact test (for small samples) was done. A p-value < 0.05 was used as cut-off for significance.

## Results

The mean age of the women was 29 years, the mean weight was 67 kg and the mean BMI was 27.8 kg/m$^2$. As seen in Table 1, there were no significant differences among treatment groups with respect to age, weight, height and BMI.

At rest and on movement, the mean and maximum pain scores were higher for the group receiving 50 mcg morphine. The pain scores decreased over time and were correspondingly lower in the higher morphine dose groups. Significant differences were noted in pain scores at rest between treatment groups on the 6th (p = 0.011) and on the 12th hour (p = 0.011) post-spinal anesthesia. By the 24th hour, pain perception was similar across treatment groups (p = 0.092) as shown in Table 2. Paired comparisons showed significant differences were between the 50 and 100 mcg groups (p = 0.020 on the 6th hour; p = 0.016 on the 12th hour) and between the 50 and 150 mcg groups (p = 0.005 on the 6th hour; p = 0.006 on the 12th hour). No significant differences were found between the 100 and 150-mcg groups at both time intervals (p = 0.624 and p = 0.728, respectively) as seen in Table 3.

On movement, pain scores differed significantly between treatment groups on the 6th (p = 0.002) and on the 12th hour (p = 0.030) but not on the 24th hour (p = 0.101) as seen in Table 2. These differences were noted between the 50 and 100-mcg groups (p = 0.005 on the 6th hour; p = 0.027 on the 12th hour) and between the 50 and 150-mcg groups (p = 0.004 on the 6th hour; p = 0.018 on the 12th hour).

**Table 1.** Baseline comparison among treatment groups.

| Characteristics | Morphine dose groups* | | | p-value** |
|---|---|---|---|---|
| | 50 mcg<br>n = 20 | 100 mcg<br>n = 20 | 150 mcg<br>n = 20 | |
| Age (yr) | 30.2 ± 5.1 | 28.8 ± 6.1 | 28.9 ± 6.5 | 0.724 |
| Weight (kg) | 69.7 ± 6.7 | 66.7 ± 9.1 | 65.9 ± 7.5 | 0.290 |
| Height (m) | 1.6 ± 0.05 | 1.6 ± 0.06 | 1.6 ± 0.07 | 0.845 |
| BMI (kg/m$^2$) | 28.6 ± 2.2 | 27.4 ± 3.5 | 27.4 ± 2.2 | 0.257 |

* Data expressed as mean ± SD
** One-way ANOVA

**Table 2.** Comparison of post-operative pain scores at rest and on movement among treatment groups.

| Time in hours post-spinal anesthesia | Morphine dose groups* | | | p-value** |
|---|---|---|---|---|
| | 50 mcg | 100 mcg | 150 mcg | |
| At rest | | | | |
| 6th hour | 2.0 (0, 8) | 0 (0, 4) | 0 (0, 4) | 0.011 |
| 12th hour | 0.5 (0, 8) | 0 (0, 2) | 0 (0, 2) | 0.011 |
| 24th hour | 0 (0, 8) | 0 (0, 3) | 0 (0, 5) | 0.092 |
| On movement | | | | |
| 6th hour | 4.0 (0, 8) | 1 (0, 8) | 1.5 (0, 4) | 0.002 |
| 12th hour | 3.0 (0, 8) | 0 (0, 4) | 0 (0, 4) | 0.030 |
| 24th hour | 2.5 (0, 8) | 0 (0, 4) | 0.5 (0, 5) | 0.101 |

* Data expressed as median (range)
** Kruskal-Wallis one-way ANOVA

**Table 3.** Pairwise comparison for significant differences between groups.

| At rest | 6th hour | 12th hour |
|---|---|---|
| Between 50 and 100 mcg | 0.020 | 0.016 |
| Between 50 and 150 mcg | 0.005 | 0.006 |
| Between 100 and 150 mcg | 0.624 | 0.728 |
| On movement | | |
| Between 50 and 100 mcg | 0.005 | 0.027 |
| Between 50 and 150 mcg | 0.004 | 0.018 |
| Between 100 and 150 mcg | 0.798 | 0.868 |

Data in p-values

No significant differences were found between the 100 and 150-mcg groups in both time intervals ($p = 0.798$ and $p = 0.868$, respectively) as shown in Table 3. Six out of 20 patients in the 50-mcg group required rescue doses of tramadol, and none in the 100 and 150-mcg groups. As seen in Table 4, the difference was significant ($p = 0.009$).

The incidence and severity of nausea was 20-25% and did not differ significantly across treatment groups. The incidence of vomiting was highest at 20% in the 150-mcg group but the difference with the lower doses was not significant. The incidence and severity of pruritus was significantly higher in the 150-mcg group (vs 50 mcg, $p < 0.001$; vs 100 mcg, $p = 0.025$). The difference between the 50 and 100 mcg groups was not significant ($p = 0.077$) as seen in Table 5.

## Discussion

It has been reported that more than 90% of obstetric anesthesiologists administer subarachnoid or epidural opioids to women undergoing cesarean deliveries under spinal, epidural or combined spinal-epidural anesthesia. Among the neuraxial opioids used, morphine has been described as having little intraoperative effect but is the opioid of choice for postoperative pain management.[10-11]

Intrathecal morphine appears to act principally on mu opioid peptide (MOP) receptors in the substantia gelatinosa of the dorsal horn by suppressing the release of excitatory neuropeptides from C fibers.[18] Due to morphine's high ionization and hydrophilic properties, morphine does not penetrate lipid-rich tissues as rapidly as fentanyl. It remains within the CSF for a prolonged period, spreading rostrally and reaching the trigeminal nerve distribution as early as three hours after intrathecal injection in healthy volunteers. It requires 45 to 60 minutes to achieve a peak effect, and the duration of analgesia is 14 to 36 hours depending on the dose.[2]

Intrathecal morphine is commonly used at doses of 100 to 200 mcg with excellent analgesic results;

**Table 4.** Differences in requirement for rescue doses of tramadol.

| Requirement for rescue doses of tramadol | Morphine dose groups* | | | Comparison | p-value** |
|---|---|---|---|---|---|
| | 50 mcg | 100 mcg | 150 mcg | | |
| With | 6 (30.0) | 0 | 0 | 50 vs 100 | 0.009 |
| Without | 14 (70.0) | 20 (100.0) | 20 (100.0) | 50 vs 150 | 0.009 |
| | | | | 100 vs 150 | > 0.999 |

* Data expressed as frequency (%)
** Fishers exact test

**Table 5.** Comparison of side effects between treatment groups.

| Side effects | Morphine dose groups* | | | Comparison | p-value** |
|---|---|---|---|---|---|
| | 50 mcg | 100 mcg | 150 mcg | | |
| Nausea | | | | 50 vs 100 | > 0.999‡ |
| None | 15 (75.0) | 16 (80.0) | 16 (80.0) | 50 vs 150 | > 0.999‡ |
| Mild to moderate | 5 (25.0) | 4 (20.0) | 4 (25.0) | 100 vs 150 | > 0.999‡ |
| Vomiting | | | | 50 vs 100 | 0.605‡ |
| None | 19 (95.0) | 17 (85.0) | 16 (80.0) | 50 vs 150 | 0.342‡ |
| ≥ 1 episode | 1 (5.0) | 3 (15.0) | 4 (20.0) | 100 vs 150 | > 0.999‡ |
| Pruritus | | | | 50 vs 100 | 0.077§ |
| None | 17 (85.0) | 12 (60.0) | 5 (25.0) | 50 vs 150 | < 0.001§ |
| Mild to moderate | 3 (15.0) | 8 (40.0) | 15 (75.0) | 100 vs 150 | 0.025§ |

* Data expressed as frequency (%)
‡ Fishers exact test
§ Chi square test

however, many studies have different results on the adequacy of analgesia for post-cesarean patients. One study determined that the ED90 of IT morphine for post-cesarean analgesia is 150 mcg. The study also states that a 150-mcg dose is most effective when used in conjunction with a multimodal analgesic regimen.[14] Another study suggests that 50 mcg IT morphine produces analgesia similar to that produced by either 100 or 150 mcg.[12] On the other hand, Palmer studied patients receiving intrathecal doses from 25 to 500 mcg and found a ceiling effect with doses greater than 75 mcg, as measured by patient-controlled intravenous morphine use.[10] This study concluded that there is little justification for using more than 100 mcg IT morphine for post-cesarean analgesia.

Consistent with the findings of Palmer, the current study showed that a 100-mcg intrathecal morphine dose, with a multimodal analgesia regimen, provides sufficient post-cesarean analgesia for the first 24 hours. In the current study, pain scores at rest and upon movement were significantly higher in the 50-mcg group as compared to the other groups, while no significant differences were found on pain scores between the 100 and 150 mcg morphine dose groups in both time intervals. No rescue pain doses were needed for the 100- and 150-mcg dose groups while 30% of the 50-mcg dose group required rescue doses of tramadol.

Differences in pain scores among other studies may be secondary to cultural differences in pain perception and attitudes towards pain. One journal describing Filipino attitudes toward pain medications described Filipinos as stoic when it comes to pain. Some also have higher pain thresholds, while others fear becoming addicted to narcotics. This article also stressed that cultural generalizations will not fit every patient, but awareness of broad patterns may give practitioners a starting point from which to provide appropriate care.[19]

Neuraxial opioids have well-known side effects of which most are more annoying than life-threatening. Pruritus, nausea, and vomiting are the most common side effects of these agents that may cause a decrease in maternal satisfaction. Parturients are generally at risk for emetic symptoms due to the level of progesterone that causes smooth muscle relaxation, increase in gastrin secretion, decrease in gastrointestinal motility, and lower esophageal sphincter tones.[4] Side effects such as urinary retention and respiratory depression were not observed in this study since cesarean delivery patients typically have urinary catheters in place for the first 24 hours and respiratory depression is exceedingly rare at doses of 100 to 200 mcg.

Studies with dose response and side effects of intrathecal morphine differ in conclusion. In a qualitative and quantitative systematic review of randomized controlled trials on intraoperative and postoperative analgesic efficacy and adverse effects of intrathecal opioids in patients undergoing cesarean section with spinal anesthesia, univariate logistic regression analysis showed that the relative risk of postoperative pruritus, nausea, and vomiting increased with higher doses of morphine.[11] On the other hand, some studies showed no significant differences in the incidence of nausea and vomiting across treatment groups given different doses and between treatment and control groups. These studies suggested that initial therapy for nausea or vomiting after cesarean delivery after intrathecal morphine of post-cesarean patients should perhaps be an antiemetic rather than an opioid antagonist.[10,12]

In the present study, the incidence and severity of nausea and vomiting were low to absent across treatment groups and did not differ significantly between groups. While studies showed an increased incidence and severity of pruritus with higher doses of morphine, only the 150 mcg group showed a significant difference when compared with the 50 and 100-mcg groups.[1,2,9,10] There was no difference in the incidence and severity of pruritus between the 50 and 100-mcg groups.

In summary, the dose-response relationship of intrathecal morphine for post-cesarean analgesia and side effects was investigated. The analgesic efficacy of 100 mcg intrathecal morphine is comparable to a dose of 150 mcg and superior to a dose of 50 mcg. The incidence and severity of nausea and vomiting were comparable across treatment groups. While the incidence and severity of pruritus between 50 mcg and 100-mcg group were comparable, the 150-mcg group had a higher incidence and greater severity. This study also highlights the importance of multimodal analgesia with the appropriate dose of intrathecal morphine as an ideal post-cesarean analgesic regimen that would provide consistent and high-quality pain relief with a low incidence of side effects and complications.[3,4,20] This regimen should not interfere with the maternal care of the newborn or with breastfeeding, and there should be minimal drug transfer to the breast milk and consequently minimal adverse effects on the newborn.[5-8] A dose of 100 mcg of intrathecal morphine, in combination with a multimodal regimen, provides adequate analgesia with the least side effects.

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# A descriptive cross-sectional study on the prevalence of noise-induced hearing loss among traffic enforcers in selected major roads in Quezon City

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## Abstract

***Introduction*** Noise-induced hearing loss (NIHL) attributed to occupational noise exposure is one of the most common causes of permanent hearing impairment. In the Philippines, road traffic remains the biggest source of noise. The authors aimed to determine the prevalence of NIHL among traffic enforcers in Quezon City and quantify their occupational noise exposure levels.

***Methods*** Traffic enforcers were recruited via convenience sampling and screened using a questionnaire and otoscopic examination. Participants underwent pure tone audiometry and those found to have hearing loss were classified as "indicative" or "suspected" NIHL. Audiometric measurements of noise levels in areas where the traffic enforcers were assigned were taken using a calibrated smartphone application.

***Results*** "Indicative of NIHL" was highest in the 41 to 50-year age group and "suspected NIHL" was highest in the 31 to 40-year age group. "Indicative of NIHL" was highest among those working for 1 to 5 and 11 to 15 years in the right ear (25%) and 11 to 15 years in the left ear (30%). "Suspected NIHL" was highest among those working for 6 to 10 years. The average noise levels from the different areas measured at different times ranged from 79.0 to 82.5 dB.

***Conclusion*** "Indicative of NIHL" is more prevalent in the older age group while "suspected NIHL" is more prevalent in the middle age group. The prevalence of "indicative of NIHL" is highest among those in service for 1 to 5 and 11 to 15 years while "suspected NIHL" is highest among those in the service for 6 to 10 years. The average noise level measurements were within the safe values suggested by WHO.

***Key words***: Occupational noise, noise induced hearing loss, pure tone audiometry

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Noise is defined as any undesired sound affecting people negatively by interfering with daily activities and health.[1] Hearing loss, a more common effect of exposure to excessive noise, is often overlooked since it can occur not only because of a single exposure to an intense sound but also through gradual and prolonged exposure to noise.[2] Noise-induced hearing loss (NIHL) is one of the most common causes of permanent hearing impairment and it has two stages.[3] The first stage - temporary threshold shift (TTS) is a temporary hearing loss wherein hearing ability returns to baseline levels after a period of rest.

When regular exposure to noise happens, however, a destructive change in the hair cells of the cochlea occurs. This next stage of NIHL is called permanent threshold shift (PTS).[4]

A significant number of cases of NIHL is attributed to occupational noise exposure.[5] According to the WHO, exposure to sounds greater than 85 decibels (dB) for eight hours or 100 dB for 15 minutes is considered unsafe.[6] Recent research quantified the noise exposure of traffic enforcers in Metro Manila to levels ranging from 75.0 to 99.3 dB.[7] Traffic enforcers have an increased risk of developing noise-induced hearing loss due to the continuous increase in magnitude and severity of road noise.[8] Moreover, road traffic remains to be the biggest source of noise pollution.[9] Hence, the present study aimed to investigate the effects of this occupational health hazard on traffic enforcers.

The results of this study may serve as a basis to implement policies on regular hearing screening for traffic enforcers. Knowing the prevalence of NIHL provides evidence which may help involved authorities recognize seriousness of the matter. It is also one of the few studies on the prevalence of NIHL among Metropolitan Manila Development Authority (MMDA) traffic enforcers in Quezon City; hence, it may serve as a basis for further research in the Philippines focusing on other factors that may contribute to NIHL, and effects of exposure to excessive sounds on health. Thus, the study aimed to determine the prevalence of noise-induced hearing loss among MMDA traffic enforcers working in selected roads in Quezon City using pure tone audiometry (PTA). Specifically, it aimed to: 1) determine the prevalence of NIHL among MMDA traffic enforcers according to length of service, 2) determine the prevalence of NIHL among MMDA traffic enforcers in different age groups, 3) measure the noise exposure levels to which the MMDA traffic enforcers are exposed to at different times of the day.

## Methods

This is a descriptive cross-sectional study that determined the prevalence of noise-induced hearing loss using PTA among MMDA traffic enforcers in selected major roads in Quezon City. The study also involved measuring the noise levels at the major roads and at different shifts.

Included as participants were MMDA traffic enforcers who were 1) 21 to 50 years old, 2) assigned along Aurora Boulevard, EDSA or Quezon Avenue, and 3) exclusively working for the MMDA as a traffic enforcer. A map of the assigned duty stations along the three major roads is provided in Figure 1. Excluded from the study were traffic enforcers who 1) had been previously diagnosed with any hearing impairment based on interview or questionnaire, and/or 2) have a ruptured tympanic membrane. Since the number of MMDA traffic enforcers assigned in these areas was limited, all who were eligible to participate in the study were recruited. All individuals who were eligible and who signed the informed consent were considered as study participants.

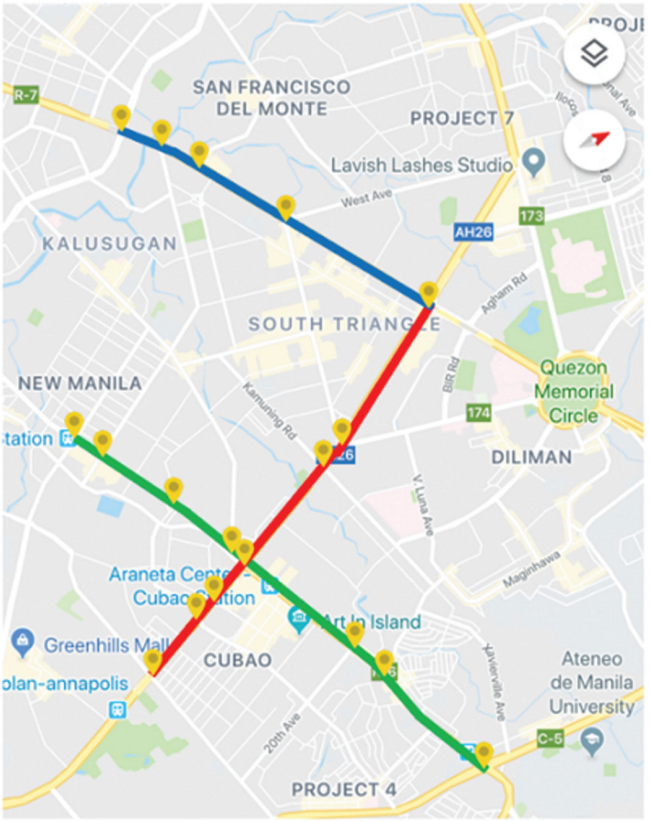


**Figure 1.** Map of assigned duty areas (yellow pins) of MMDA traffic enforcers along EDSA (red), Quezon Avenue (blue), and Aurora Boulevard (green).

In the computation of the sample size, a prevalence of 12.5% was used as the estimate from a similar study among traffic police in Dhaka, a 95% confidence coefficient and 5% margin of error.[10] This yielded a sample size of 168 MMDA traffic enforcers. However,

the number of enforcers assigned along the three major roads selected in Quezon City was 80. Thus, the sample size was recomputed and corrected for a finite population. The final sample size is 54 and convenience sampling was used.

After obtaining permission to conduct a study from the MMDA administration, traffic enforcers in Quezon City who were available at the MMDA Headquarters were approached by the researchers and invited to participate in the study. A recruitment protocol was followed by the researchers to ensure that important and relevant details about the study were explained to all prospective participants. A questionnaire was used for the initial screening of the subjects to determine if they were eligible. A written consent was obtained from those who were eligible and who agreed to participate. Otoscopic examination was performed on the traffic enforcers to determine the integrity of the tympanic membrane. Prior to data collection proper, the researchers underwent training on otoscopic examination under an ear, nose, throat (ENT) specialist to standardize the manner of performing the otoscopic examination.

Traffic enforcers who agreed to be part of the study and fulfilled the criteria were brought to the American Hearing Center Corporation (AMEARCO) along Aurora Boulevard, Quezon City and underwent a pure tone audiometric test to determine hearing thresholds and screen for hearing loss. Weber test and Rinne test were also done using a 512-Hz tuning fork; the results were noted and interpreted to determine the presence of conductive or sensorineural hearing loss. Hearing thresholds for each ear were measured at 250, 500, 1000, 2000, 4000, and 8000 Hz. Audiogram results were automatically computed and interpreted based on the following scale of hearing impairment: 0-25 dB (normal hearing level), 26-40 dB (mild hearing loss), 41-60 dB (moderate hearing loss), 61-70 dB (moderately severe hearing loss), 71-80 dB (severe hearing loss), and 81-90+ dB (profound hearing loss). Hearing loss was further classified into "indicative for NIHL" and "suspected NIHL". "Indicative for NIHL" was defined as any drop in hearing threshold from 2000 to 4000 Hz regardless of whether there was hearing loss noted at 500, 1000, and 2000 Hz. "Suspected NIHL" was defined as any level of hearing loss that did not present with a drop in hearing threshold from 2000 to 4000 Hz.

Audiometric measurements of the level of noise exposure along intersections where the MMDA traffic enforcers were assigned were done using a smartphone application called dB meter. A high-precision sound level meter (Norsonic Sound Analyser Nor140, Norsonic AS, Norway) was used to calibrate dB meter. Calibration was done in a silent room beside a main road for one minute each for 10 trials. The average of the 10 trials resulted in a 0.5 dB difference between the mobile application dB meter and the Nor140. Subtraction of 0.5 dB for each measurement was done to maintain the appropriate calibration.

Noise level measurements were taken at the following intersections along EDSA: Timog Avenue, Kamuning Road, Aurora Boulevard. Noise levels were measured along Aurora Boulevard at J. Ruiz, Gilmore Avenue, Araneta Cubao, Anonas Road, and Katipunan Avenue. Along Quezon Avenue, noise levels were measured at EDSA, Timog Avenue, Fisher Mall, G. Araneta Avenue, Banawe, and Welcome Rotonda. Measurements were taken at three different shifting periods - in the morning (5:00-7:00 AM), noon (11:00 AM-1:00 PM), and afternoon/night (5:00-7:00 PM) on three weekdays and two weekend days. Readings of ambient noise levels were taken for at least one minute for each area. Measurements for all the five days were averaged per area per shift. These averaged values were further averaged per major road.

Data were encoded in Google Sheets. Mean of data for noise levels taken for five days was calculated per area per shift. These mean values were further averaged per major road. Data for audiometry results were summarized as counts and proportions. Prevalence was computed using the number of MMDA traffic enforcers with "indicative" or "suspected NIHL" on PTA divided by the total number of MMDA traffic enforcers at risk for "indicative" and "suspected NIHL". The distribution of NIHL was described according to age and length of service.

## Results

Among the 54 MMDA traffic enforcers tested, 16 (29.6%) were "indicative for NIHL" of the right ear and 20 (27.0%) were "indicative for NIHL" of the left ear. There were 21 (38.9%) participants with "suspected NIHL" in the right ear and 19 (35.2%) in the left ear. Participants who were not suspected to have any NIHL in the right and left ear had prevalence proportions of 31.5% and 27.8%, respectively. The prevalence of NIHL for both ears, is shown in Table 1. The prevalence was highest at 48.2% for" suspected

NIHL" and lowest at 20.3% for "not suspected NIHL". The prevalence of NIHL in the right ear according to age and duration of service is shown in Table 2. With "indicative of NIHL", the prevalence was highest in the 41-50-year age group (75%) and among those who have been in service for 1 to 5 and 11 to 15 years (25.0%). With "suspected NIHL", the prevalence was highest in the 31-40-year age group (61.9%) and those who have been in service for 6 to 10 years (33.3%).

The prevalence of NIHL in the left ear according to age and length of service is shown in Table 3. With "indicative of NIHL", the prevalence was highest in the 41-50-year age group (60%) and those who have been in service for 11 to 15 years (30%). With "suspected NIHL", the prevalence was highest in the 31-40-year age group (57.9%) and those who have been in service for 6 to 10 years (47.3%).

Noise levels ranged from 70 dB to 93 dB. The lowest mean measurement was 79.0 ± 1.0 dB recorded during noon shift along EDSA. The highest mean measurement was 82.5 ± 1.87 dB recorded during morning shift also along EDSA. Quezon Avenue had the highest average noise level at 81.5 ± 3.07 dB and Aurora Boulevard had the lowest average noise level at 80.5 ± 2.97 dB. (Table 4)

## Discussion

The prevalence of "indicative for NIHL" is 29.6% for the right ear and 27% for the left ear while "suspected NIHL" had a prevalence of 38.9% for the right ear and 35.2% for left ear. These values are higher than the results of Gupta (22%) and Sharif (24%).[10,11] Win reported a higher prevalence of NIHL (34.2%) among officers in Brunei. Although this is higher than the computed prevalence of "indicative for NIHL" in the present study, it is still less than the prevalence of suspected NIHL among the study participants.[12] All of these support statistical data showing NIHL as a common worldwide problem with at least 10 million adults under age 70 having NIHL in one or both ears.

There were more respondents with "suspected" than "indicative of NIHL". This may be because "suspected NIHL" accounts for hearing loss for all

**Table 1.** Prevalence of NIHL detected by PTA in right and left ears among 54 traffic enforcers.

| NIHL n (%) | Right ear | Left ear | Both ears |
|---|---|---|---|
| Indicative | 16 (29.6) | 20 (27.0) | 17 (31.5) |
| Suspected | 21 (38.9) | 19 (35.2) | 26 (48.2) |
| Not suspected | 17 (31.5) | 15 (27.8) | 11 (20.3) |

**Table 2.** Prevalence of noise-induced hearing loss in right ear according to respondents' age and length of service.

| Characteristic n (%) | Indicative of NIHL | With suspected NIHL | Without suspected NIHL |
|---|---|---|---|
| Age group (yr) | | | |
| 21 - 30 | 0 | 1 (4.8) | 5 (29.4) |
| 31 - 40 | 4 (25.0) | 13 (61.9) | 8 (47.1) |
| 41 - 50 | 12 (75.0) | 7 (33.3) | 4 (23.5) |
| Total | 16 (100) | 21 (100) | 17 (100) |
| Years in service | | | |
| <1 | 0 | 1 (4.8) | 2 (11.7) |
| 1-5 | 4 (25.0) | 5 (23.8) | 7 (41.2) |
| 6-10 | 3 (18.8) | 7 (33.3) | 5 (29.4) |
| 11-15 | 4 (25.0) | 5 (23.8) | 2 (11.8) |
| 16-20 | 3 (18.8) | 2 (9.5) | 1 (5.9) |
| >20 | 2 (12.5) | 1 (4.8) | 0 |
| Total | 16 (100) | 21 (100) | 17 (100) |

**Table 3.** Prevalence of noise-induced hearing loss in left ear according to respondents' age and length of service.

| Characteristic n (%) | Indicative of NIHL | With suspected NIHL | Without suspected NIHL |
|---|---|---|---|
| Age groups (yr) | | | |
| 21 - 30 | 1 (5.0) | 1 (5.3) | 4 (26.7) |
| 31 - 40 | 7 (35.0) | 11 (57.9) | 7 (46.6) |
| 41 - 50 | 12 (60.0) | 7 (36.8) | 4 (26.7) |
| Total | 20 (100) | 19 (100) | 15 (100) |
| Years in service (yr) | | | |
| <1 | 0 | 1 (5.3) | 2 (13.3) |
| 1-5 | 5 (25.0) | 3 (15.8) | 8 (53.4) |
| 6-10 | 3 (15.0) | 9 (47.3) | 3 (20.0) |
| 11-15 | 6 (30.0) | 3 (15.8) | 2 (13.3) |
| 16-20 | 5 (25.0) | 1 (5.3) | 0 |
| >20 | 1 (5.0) | 2 (10.5) | 0 |
| Total | 20 (100) | 19 (100) | 15 (100) |

**Table 4.** Average daily noise levels for EDSA, Aurora Boulevard, Quezon Avenue.

| Mean ± SD Minimum, maximum value (dB) | EDSA | Aurora Blvd | Quezon Ave |
|---|---|---|---|
| Morning | 82.5 ± 1.87 (78, 92) | 81.1 ± 2.54 (70, 90) | 82.0 ± 1.00 (81, 83) |
| Noon | 79.0 ± 1.00 (78, 81) | 80.7 ± 1.78 (75, 85) | 81.75 ± 2.75 (79, 87) |
| Afternoon-evening | 81.8 ± 0.75 (75, 81) | 79.7 ± 4.60 (77, 79) | 80.9 ± 5.46 (75, 93) |
| Average of 3 periods | 81.08 ± 1.21 | 80.49 ± 2.97 | 81.54 ± 3.07 |

frequencies, excluding only results that show a drop in 4000 Hz. McBride concluded that although the notch at 4000 Hz is a well-established clinical sign, it is important to elicit a detailed and accurate history of exposure to noise in order to make a diagnosis of NIHL.[13] They also stated that a notch at 6000 Hz may not be a good marker for high intensity exposure to noise. Conversely, this exclusion is a requirement to be positive for "indicative for NIHL", thus limiting the count.

The factors considered in the study were age and length of exposure to noise. In general, for both ears, those "indicative for NIHL" fell within the 41-50-year age group and have been traffic enforcers for 11-15 years. Similarly, for both ears, those with "suspected NIHL" fell within the 31-40-year age group and have worked for 6-10 years. This bilaterality is expected in NIHL, since most noise exposures affect both ears.[14]

Current data show that there is a consistent increase in the prevalence of "indicative for NIHL" with increasing age. "Suspected NIHL" for participants aged 31 to 40 years is also higher (right ear 61.9%, left ear 57.9%) when compared to participants 21-30 years old (right ear 4.8%, left ear 5.3%). However, the highest prevalence of participants without "suspected NIHL" was also recorded at 31 to 40 years. Moreover, the prevalence of "suspected NIHL" for both ears was lower for traffic enforcers 41 to 50 years old. Toppila found that age was not a primary reason for hearing impairment and that age alone seemed to affect

NIHL to a lesser extent than reported in previous studies.[15] Thus, the finding that the highest prevalence of participants with and without "suspected NIHL" belong to the same age group (31-40 years), and the drop in prevalence of "suspected NIHL" for ages 41 to 50 years may suggest that age is a weak confounding factor for those below 50 years old, when age-related hearing loss or presbycusis is not apparent and not routinely considered.

Based on duration of exposure, the prevalence of subjects with both "indicative" and "suspected NIHL" generally follow the same trends. The higher prevalence among those in service for more than 10 years compared to those who worked for less than 10 years among participants "indicative for NIHL", and the higher prevalence among those who worked for more than five years is consistent with the results of a study among jeepney drivers.[16] These suggest a positive relationship between duration of exposure and prevalence of NIHL. Another study with similar findings reported that 41.1% of traffic policemen with 3 to 5 years' service showed hearing loss compared with 25% among those with 2 to 3 years' service.[17]

The pattern of reaching the highest prevalence at 11 to 15 years ("indicative for NIHL") and 6-10 years ("suspected NIHL") of service and the subsequent declining prevalence thereafter was found to be typical of NIHL according to Mirza.[18] According to them, the rate of hearing loss due to chronic noise exposure increases most rapidly during the first 10 to 15 years of exposure, then decelerates as the hearing threshold increases. This contrasts with age-related loss, which accelerates over time.[18]

This increased prevalence in NIHL for exposures longer than 5-10 years poses risks in the overall health of the MMDA traffic enforcers and other individuals with a similar occupational hazard. A study in India assessed the hearing status of traffic policemen by evaluating their auditory pathway through Brainstem Evoked Response Audiometry (BERA), mid-latency response and slow vertex response. Findings showed that there were increased latencies in waves compared to controls, meaning that chronic exposure of traffic policemen to traffic noise resulted in delayed conduction in the peripheral part of the auditory pathway, more specifically from the auditory nerve to the superior olivary nucleus. No impairment was observed at the level of subcortical, cortical or the association areas.[19] Another study noted that individuals with NIHL may develop hearing loss, concomitant tinnitus, and/or impaired speech discrimination, hypertension, depression, dementia, social isolation, increased risk of accidents, and retrocochlear lesions. Thus, employees with hearing loss should be evaluated to protect them from further damage due to noise as it can impact the worker's communication and safety.

Based on the standards recommended by the WHO, exposure to sounds greater than 85 dB for eight hours or 100 dB for 15 minutes is considered unsafe.[6] The noise exposure levels to which the MMDA traffic enforcers were exposed were measured in the morning, noon, and afternoon and were within 70 to 93 dB. The average values of collected decibel meter readings per shift and per area did not exceed 85 dB but were above 80 dB. Nevertheless, there are individual measurements recorded that went beyond the safe level, with highest at 93 dB, proposing that the risk for NIHL cannot be excluded. Unusually susceptible individuals exposed to noise levels of 80 to 85 dB may develop hearing loss as evidence suggests. Long term exposure above 80 dB increases the risk of developing NIHL.[14]

The 2017 data from MMDA showed that an average of 2.7 million vehicles pass through Metro Manila's roads daily. EDSA was the most congested, with an average daily load of 367,728 vehicles equivalent to 13.62% of vehicles in Metro Manila roads daily. Quezon Avenue was fourth, with 195,335 vehicles (7.23%) daily. These data suggest that MMDA traffic enforcers have an increased frequency and duration of exposure to noise levels greater than 80 dB, despite them not reaching beyond 85 dB.[20] In general, continuous noise exposure over the years is more damaging than interrupted exposure to noise, which permits the ear to have a rest period.[14]

Noise levels to which MMDA traffic enforcers were exposed ranged from 70 to 93 dB. The average values of collected decibel meter readings per shift and per area did not exceed the safe level set by the WHO; however, all average values were above 80 dB. The prevalence for bilateral "indicative NIHL" was highest among the 41-50-year age group and among those who have been in service for 11 to 15 years. For bilateral "suspected NIHL", the prevalence was highest among the 31- 40-year age group and among those who have been in service for 6 to 10 years. Among the three roads, Quezon Avenue had the highest average noise level while Aurora Boulevard had the lowest average noise level.

Future studies can explore the relationship of NIHL to the noise level exposure, duration of service, age and shift schedules. The study is limited to determining the prevalence of noise-induced hearing loss among MMDA traffic enforcers working in selected roads in Quezon City using pure tone audiometry. A study involving several roads and intersections in Metro Manila that will be more representative of the working conditions of the MMDA traffic enforcers may reflect a more accurate estimate of the prevalence of NIHL. Early detection and timely intervention are recommended such as conducting annual audiometry testing to monitor any adverse effects on MMDA traffic enforcers. The use of personal protective equipment such as ear plugs or earmuffs will provide inexpensive and long-term benefits and may be made part of the traffic enforcer's gear. Occupational health authorities can educate the traffic enforcers regarding the potential health impacts of noise. Regular rotation of traffic enforcers to areas with different noise levels may be considered to lessen the risk of noise-induced hearing loss.

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# Interdigital pilonidal sinus: An occupational disease of pet groomers

Rachelle C. Ramilo, MD; Cindy Jao-Tan, MD; Camille B. Angeles, MD; Lian C. Jamisola, MD, and Maria Nina F. Pascasio, MD

## Abstract

***Introduction*** Interdigital pilonidal sinus is an acquired condition secondary to penetration of hair fragments into the skin of the web spaces of the hands commonly observed in hairdressers, and occasionally, among pet groomers. Local literature reports or guidelines to ensure practice of protective measures for this population of workers are currently lacking.

***Case Summary*** A 24-year old pet groomer consulted due to occasional white hair strands emerging from two openings in the third interdigital space of his dominant hand. Histopathologic examination of the sinus tract showed an acanthotic, hyperplastic epidermis with scale crust, and nodular dermal infiltrates composed of epithelioid histiocytes, plasma cells, lymphocytes, and eosinophils. Transepidermal extrusion of polarizable hair cortical material was also evident establishing the diagnosis of an interdigital pilonidal sinus. Sinusectomy and debridement with healing by secondary intention resulted in an optimal wound closure and full motion of the affected hand after one week and minimal scarring with no recurrence after seven months.

***Conclusion*** Surgical excision followed by proper wound care is essential to avoid recurrence. In conclusion, since interdigital pilonidal disease is a rare condition, awareness among physicians would lead to accurate diagnosis, optimal treatment, and proper patient education.

***Key words***: Pilonidal sinus, interdigital web space, pet groomer, occupational diseases

Pilonidal sinus is an acquired condition secondary to penetration of hair fragments into the skin.[1] Keratin is treated as a foreign body if it directly contacts the dermis, and the subsequent chronic inflammatory response results in the formation of a sinus or cyst, where more hairs may then become entrapped.[1,2]

This disease typically develops in the sacrococcygeal, and other hair-bearing areas.[1] It has also been observed in the interdigital web spaces of the hands commonly in barbers, but only among a few dog groomers.[2,3] Interdigital pilonidal sinuses do not contain the patient's own hairs, as is the case in other pilonidal sinuses that develop in other areas such as the scalp, ears, chest wall, umbilicus, or anal canal.[4] Reported here is a case of pilonidal disease in a pet groomer and its surgical management.

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## The Case

A 24-year old left-handed pet groomer sought consult due to occasional white hair strands emerging from

two 2-mm openings approximately 1 cm apart in the third interdigital space of his dominant hand (Figure 1). Histopathologic examination of the sinus tract showed an acanthotic, hyperplastic epidermis with scale crust, and nodular dermal infiltrates composed of epithelioid histiocytes, plasma cells, lymphocytes, and eosinophils. Transepidermal extrusion of polarizable hair cortical material was also evident establishing the diagnosis of an interdigital pilonidal sinus (Figure 2). Meanwhile, whitish hair strands taken from the sinus opening were sent for fungal culture, which revealed negative findings.

The patient was prepared for sinusectomy with interdigital local anesthesia. A stylet was inserted to serve as a guide in unroofing the interdigital sinus (Figure 3). A curette was used to debride the area, and an irregularly white fragmented tissue was removed, measuring about 5mm x 2mm x 2mm. A few strands of hair were found embedded in the tissue. The patient was given a non-steroidal anti-inflammatory drug for a week. Sinusectomy and debridement with healing by secondary intention resulted in an optimal wound closure and full motion of the affected hand after one week. Seven months after sinusectomy, there was minimal scarring with no note of recurrence (Figure 4). He was advised to wear gloves during work and to wash his hands after each grooming to prevent recurrence.

Histopathologic examination of the specimen removed during sinusectomy revealed a hyperplastic stratified squamous with an area exhibiting an epidermal inclusion cyst, which was lined by thin, flattened squamous cells, and supported by a fibrous wall (Figure 5). The content consisted of lamellae of keratinous material. Scattered neutrophils were seen in some areas of the epithelium.

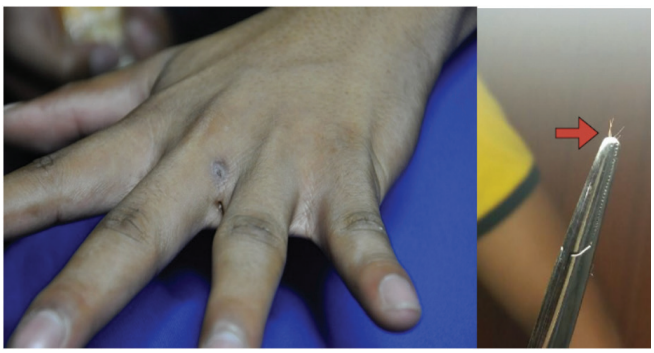

**Figure 1.** External openings of a sinus in the third interdigital space of the left hand (left); extracted white hair strands emerging from the sinus

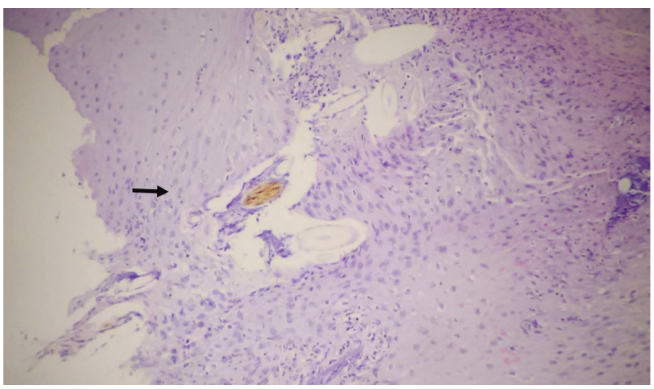

**Figure 2.** Transepidermal extrusion of polarizable hair cortical material (arrow) with surrounding dermal infiltrates composed of epithelioid histiocytes, plasma cells, lymphocytes, and eosinophils (H & E stain, 40x magnification)

## Discussion

According to the United Kingdom Dog Grooming Association, pilonidal sinuses are a well-recognized

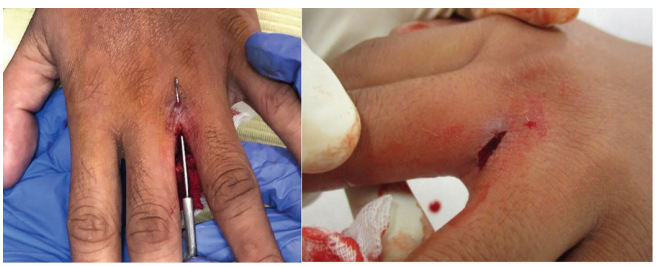

**Figure 3.** Probe insertion prior to sinusectomy (left) and appearance of the interdigital space after incision

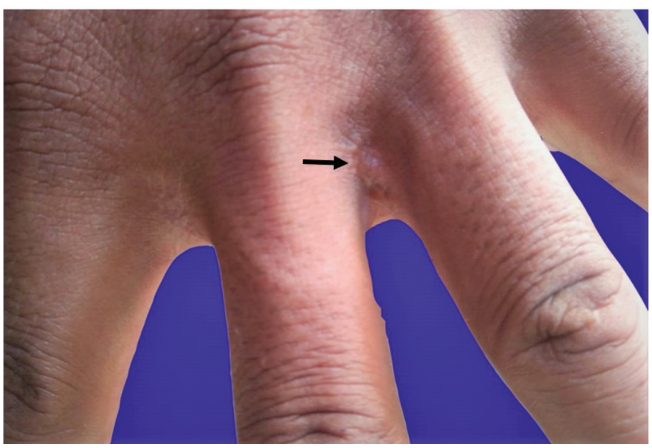

**Figure 4.** Minimal scarring seven months after sinusectomy

occupational hazard among groomers, and their members have encountered this condition in various areas -- subungual region, interdigital spaces of the hands and feet, the popliteal fossa and the breasts.[5] However, local literature reports on this condition among pet groomers, and guidelines to ensure practice of protective measures for this population of workers are currently lacking. This could be due to cases not being reported, unawareness of physicians of such condition, or affected groomers not seeking consultation.

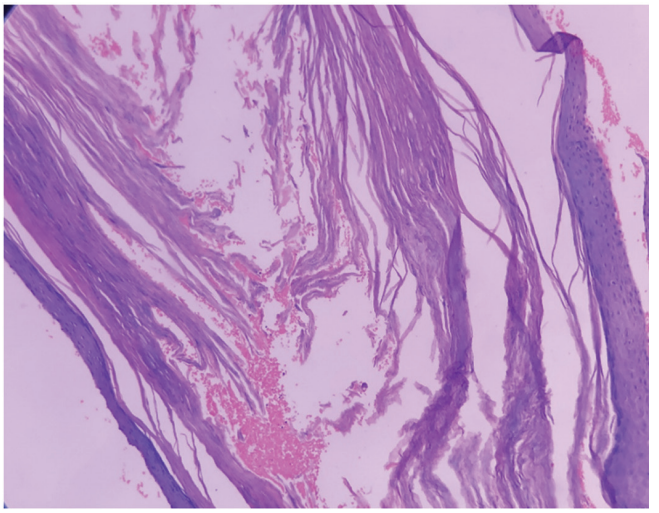

**Figure 5.** Hyperplastic stratified squamous with an area exhibiting an epidermal inclusion cyst (H & E stain, 40x magnification)

Dog hairs are similar to human male-type hair, which has been reported to predispose to interdigital pilonidal sinuses among barbers.[5,6] Dog hairs are usually thick, stiff and straight, with minimal pliability.[5] During grooming, clipped hairs could be sharp as a needle, and there may be tile-like formation of the cuticle that can act as a barbed hook. The hairs may also have increased adhesiveness since these are usually moist and/or electrostatic.[7] Meanwhile, the interdigital space is susceptible to hair penetration because the epidermis in this area is very thin and easily irritated by shampoos or solutions routinely used by pet groomers.[7] These factors aid in easier penetration, adhesion, and accumulation of clipped dog hairs into the interdigital space causing a foreign body reaction and subsequent sinus formation.

In symptomatic disease, conservative approaches such as removal of hairs from the sinus, drainage of abscess, and antibiotic administration are not effective. Most authors agree that total excision of the involved tissue is curative.[8-11]

The clinical course is usually self-limited, but osteomyelitis and repeated infections may occur.[2,5] Treatment considerations include cost, healing period, scar tissue formation, and recurrence, with the latter being the most significant.[4,12] After pooling data from 16 studies, the recurrence rate of pilonidal disease was reported to be 6.9%.[12] Although scar tissue formation and a prolonged healing period may be observed with open healing by secondary intention after surgical intervention, this technique was reported to reduce the risk of recurrence by 35% when compared with any method of primary closure.[4,12]

Pet groomers should be advised proper measures to prevent formation or recurrence of a sinus. These methods include wearing gloves and prompt removal of embedded hairs during the working day.[3,5,10] In conclusion, since interdigital pilonidal disease is a rare condition, awareness among physicians would lead to accurate diagnosis, optimal treatment, and proper patient education.

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