Seasonality sway birth and hearing loss?

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Background
Birth is a biological process that involves the emergence of an offspring. A seasonal variation in the frequency of births is reported as a universal phenomenon in the human population. In review to outline of birth, newborns may yield seasonality in the occurrence of congenital hearing loss. Congenital hearing loss is one of the most common birth defects affecting ~3/1000 newborns.

Aim
The aim of this study was to rule out seasonality of birth and percentage of hearing loss in early days of newborns.

Patients and methods
Seasonality of birth was analyzed across the years and newborns born per month were numbered to surpass the subjective and objective Universal Neonatal Hearing Screening Program before 1 month of age.Combined results of the subjective and objective tests were analyzed and compared to make the final decision as Pass or Refer.

Results
Statistical analysis revealed that birth frequency and newborn hearing loss do not follow seasonality pattern.

Conclusion
Similarly, there was no correlation between the birth frequency and percentages of newborns with refer impression.

Keywords:
birth rate, hearing loss, newborn, pass, percentage, refer, seasonality, Universal Neonatal Hearing Screening Program

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Introduction

Birth is a biological process that involves the emergence of an offspring. This process is initiated by hormones causing contractions of the muscular walls of the uterus, expelling the fetus when at term. The birth rate worldwide is 18.7 births/1000 populations, of which India has 19.89 births/1000 populations [1]. Similar to many species, human birth also has seasonality. A seasonal variation in the frequency of births is reported as a universal phenomenon in human population [2]. A survey in Ballabgarh block in Haryana, India (1972), revealed a birth rate of 45/1000 in a village with a total population of 40 000. However, with a population size of 70 079 in the year 1997, the birth rate was counted to be 28.4/1000 births. Similarly, birth rate was highest in the month of August and September and least in the month of April for the year 1972–1990 [3]. There is a variation in the seasonality of birth and is not confined to a single factor. The possible explanations evidenced by Bobak and Gjonca [4] are temperature or photoperiod (affecting hormonal concentrations, sperm quality, or sexual activity), seasonal variation in pregnancy loss, and/or cultural factors. However, there is no one-to-one correlation between the cause and effect of variation in seasonality of birth. In support to the seasonality of birth, newborns may yield seasonality in the occurrence of congenital hearing loss.

Hearing is the ability to perceive the presence of sound. The ability to hear enables an individual to socialize, interact, and communicate. Loss of hearing may have an adverse effect on the child's speech, language, communication, and cognitive abilities. Congenital hearing loss is one of the most common birth defects affecting ~3/1000 newborns [5]. Similarly, the literature quotes that severe bilateral sensorineural hearing loss affects 1–3/1000 live births in the healthy baby nursery population and 5–9/1000 newborns in the neonatal intensive care unit population [6].

It is well understood that hearing is fundamental for the development of speech language, communication, and cognitive learning [7]. Children with hearing loss may be left unidentified or underserved. The earlier the

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occurrence of hearing impairment the more severe are the effects. Similarly, the earlier the hearing impairment is identified and rehabilitated, the less severe the ultimate impact.

Hearing loss can be identified as early as in its fetal stage. However, the Joint Committee on Infant Hearing USA [8] has reported early identification to be initiated at 3 months of age or before, followed by intervention within 5–6 months of life. Hence, the Universal Neonatal Hearing Screening Program (UNHSP) has been widely used by audiologists for the early detection of hearing loss and early management helps in reducing the severity of adverse consequences on the quality of life.

Today, in the field of audiology, the UNHSP has gained wide acceptance. In addition to seasonality of birth, chances of seasonality in the occurrence of hearing loss can be also seen. With reference to the literature, there is dearth of information as regards the seasonality of birth and the presence of hearing loss in the early days of newborns. Hence, the study was undertaken.

Aim

The aim of this study was to rule out seasonality of birth and percentage of hearing loss in early days of newborns.

Participants and methods

The current study was conducted in Multidisciplinary Teaching Hospital, Mangalore, during the year 2012 and 2013. All newborns born in the hospital per month were included as participants of the study and were considered for the UNHSP. The neonatal high-risk register screening was excluded during the test procedure to eliminate any bias toward the participant group. The birth frequency was analyzed and the newborns born per month were numbered to surpass the UNHSP before 1 month of age. The UNHSP was carried out in two trials (initial screen before discharge and rescreen after discharge from hospital).

The UNHSP included the collection of information on prenatal, perinatal, and postnatal history of the newborns. Subjective procedures such as visual inspection of the head, neck, and ears of the newborns were carried out to rule out any asymmetry or deformity if present. Otoscopic examination was carried out using Swan Otoscope (Model: SW-1200), to know the status of the external auditory canal and the tympanic membrane. Subjective Pediatric audiometry screening test involved the mother/caregiver who was instructed to sit comfortably on a chair placed in a well-illuminated sound-treated double room setup, and the newborn was placed on the lap of the mother/caregiver. The head of the newborn was kept toward the midline of the calibrated hand-held paediacometer (Arphi Held AP2). The auditory stimuli used were narrow-band noise at 50 dBHL and warble tone of 500, 1000, and 2000 Hz at 50, 70, and 90 dBHL. Speech stimuli containing a range of low and high frequencies were delivered through an Arphi free field speaker connected to GSI-61 clinical audiometer, monitored through a sound level meter at 50, 70, and 90 dBHL. Four third-year students of Bachelors in Audiology and Speech Language Pathology traced the possible behavioral responses to sound stimuli.

To obtain more valid results, with the end of subjective tests, objective audiological screening evaluations such as immittance audiometry using calibrated Interacoustics AT-235 Impedance Audiometer was applied to check middle-ear status using 678 or 1000 Hz probe tone and ipsilateral acoustic reflexes were attained at 500, 1000, 2000, and 4000 Hz. Single-peaked or double-peaked tympanograms with present acoustic ipsilateral reflexes were considered to fall in pass criteria. On achieving pass impression, distortion product otoacoustic emission with screening protocol using GSI Audera was administered to rule out outer hair cell functioning. A 6 dB signal-to-noise ratio was required.

The obtained combined results of subjective and objective audiological screening tests were analyzed and compared to make the final decision as Pass or Refer. The testing was carried out for two trials with a follow-up of 2 months. Newborns with pass impression were called after 6 months for follow-up, and those with refer impression in initial screen were rescreened in 2 months' time period from initial screen. On rescreening, newborns with refer impression were directed toward detailed diagnostic audiological evaluation.

Statistical methods

Statistical analysis was carried out using the following formulae:

$$\text{Birth frequency} = \text{Total number of births in a month or year},$$

$$\text{Percentage of hearing impairment} = \frac{\text{Number of newborns with refer impression in a month}}{\text{Total number of newborns born in the same month}} \times 100.$$

Correlation between the birth frequency and percentage of newborns with refer impression was analyzed using the Karl–Pearson coefficient of correlation.

This analysis estimated the possible correlation between seasonality of birth frequency and percentages of newborns with refer impression in the UNHSP for the year 2012 and 2013.

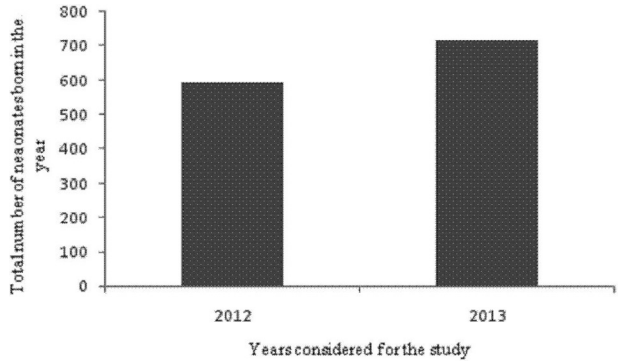
Results

A total of 1308 newborns were born in the Multi-disciplinary Teaching Hospital, Mangalore, during the year 2012 and 2013. The collected neonatal data underwent statistical analysis to reveal the presence of seasonality in the frequency of birth and percentages of newborns with refer impression in UNHSP. Further correlation between the seasonality in birth frequency and percentage of newborns with fail impression in UNHSP was carried out.

The number of births in the year 2012 and 2013 was 593 and 715 births, respectively. Figure 1 presents the overall birth frequency for the year 2012 and 2013 each.

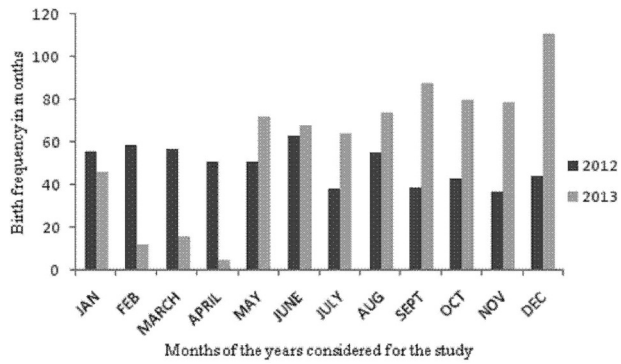
As per the Fig. 1, 2013 concluded with higher birth frequency in comparison with year 2012.

Figure 1



The graphical representation of overall birth frequency for the year 2012 and 2013.

Figure 2



The graphical representation of seasonality of birth frequency in months for the years 2012 and 2013.

Further, to reveal the seasonality of birth frequency, the number of births in months was tabulated in each year (Fig. 2).

The year 2012 and 2013 showed highest birth frequency in the month of June and December, respectively, with the months of November and April with least birth frequencies, respectively.

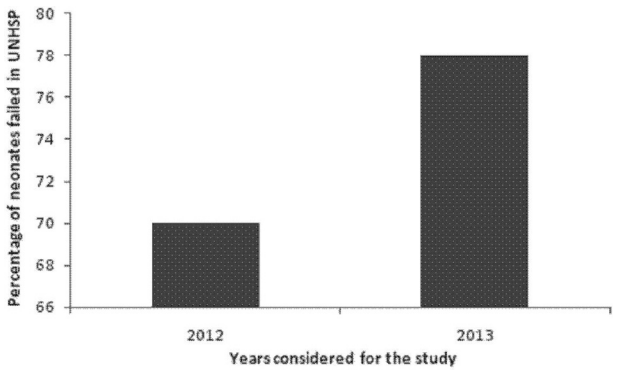
In addition, with birth frequency and its seasonality, hearing loss in newborns was also focused upon to know the frequency and seasonality of occurrence of hearing loss in newborns (Fig. 3).

From the Fig. 3, we can conclude that 2013 yielded a higher percentage of newborns with refer impression in UNHSP compared with the year 2012 after rescreen step. However, we obtained false-positive response for 43/593 newborns and 51/715 newborns in 2012 and 2013, respectively. In addition, 27/593 newborns and 41/715 newborns showed false-negative response for the year 2012 and 2013, respectively, in the initial screen before hospital discharge. This was further narrowed down with rescreen after hospital discharge in 2 months' time period, leading to total of 70/593 and 78/715 newborns with refer impression in UNHSP for the year 2012 and 2013, respectively.

Similarly, the data were further analyzed to rule out the seasonality in the percentage of newborns with refer impression in the UNHSP. Seasonality in the percentage of newborns with refer impression was obtained by dividing the total number of newborns with refer impression per month to total number of newborns born per month multiplied by 100 (Fig. 4).

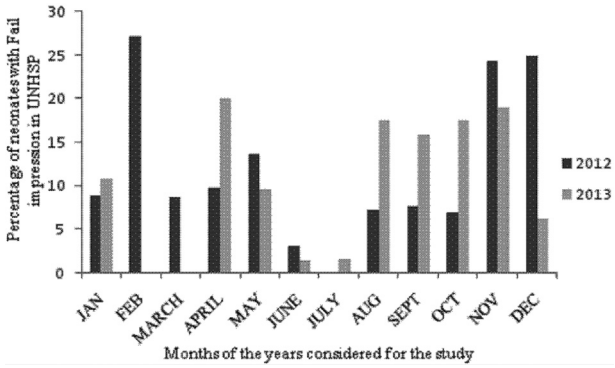
The obtained percentage of the newborns with refer impression in the year 2012 and 2013 for each month

Figure 3



The total number of newborns with refer impression in the Universal Neonatal Hearing Screening Program (UNHSP) for the year 2012 and 2013.

Figure 4



The graphical representation of seasonality in the percentage of newborns with refer impression in the Universal Neonatal Hearing Screening Program (UNHSP) for the year 2012 and 2013.

revealed that February and April had the highest percentage of newborns with refer impression in the UNHSP in the year 2012 and 2013, respectively, and the month of June in the year 2012 and June and July in the year 2013 had the least percentage of newborns with refer impression in the UNHSP. No occurrence of refer impression in the UNHSP was found in the month of July 2012 and February and March 2013 was observed.

Further, the data were analyzed to establish seasonality in birth frequency, seasonality in the percentage of newborns with refer impression in the UNHSP, and to know the correlation between seasonality in birth frequency and percentage of newborns with refer impression for the year 2012 and 2013. The Karl–Pearson correlation of coefficient test was used to establish the correlation. Seasonality in birth frequency for the year 2012 and 2013 showed no correlation (r=–0.537, P>0.05). Similarly, seasonality in the percentage of newborns with refer impression was also not seen (r=–0.537, P>0.05). Finally, no correlation between the seasonality of birth frequency and seasonality in the percentage of newborns with refer impression in UNHSP for the year 2012 (r=–0.064, P>0.05) and in the year 2013 (r=0.228, P>0.005) was found. Hence, there is no seasonality observed in birth frequency, percentages of newborns with refer impression in UNHSP, and there is no relation between seasonality of birth frequency and percentage of newborns with refer impression in UNHSP.

Discussion

The statistical analysis revealed no seasonality in birth frequency throughout 2 years. The variation in the results of current study from the earlier literature can be attributed to the following reasons. From past 5 years, because of global warming and the depleting ozone layer, variations in temperature has been experienced by Indian population and thus even by the people from the rural parts of Mangalore. These variations in temperature could have led to alterations in sexual activity and also reduction in the viability of sperm count. This is supported by various authors who showed profound effect of weather on birth rates with changes in sperm counts [9], and high temperatures reducing sexual activity or having an adverse effect on the viability of sperm count [10]; moreover, a supporting review by Chang *et al.* [11] stated that female fertility was affected by high temperatures.

Moreover, the other possible factors contributing to variations in birth frequency could be the religious months chosen for marriages and the possible holidays obtained from work in a secular country like India, which could have led to increased birth frequency in some specific months. Literature supports the seasonality of marriages [12], frequency of coitus [13], secular and religious holiday's leading to in higher conception peaks [14].

Sometimes several factors may overlap to cause the changes in birth peak, such as both the exhaustion of the agricultural work season and heat of the summer months causing reduced frequency of intercourse in agricultural societies or due to the anxiety for the coming harvest [15]. Harvesting and sowing seasons, seasonality of food intake, and workload [16] could have resulted in variation in seasonality of birth frequency.

According to Bronson [2], populations experiencing seasonal variation in food availability ovulation may regulate seasonality – that is, either inadequate food intake and/or increased energy expenditure required to obtain food can delay menarche, restrain the frequency of ovulation in the nonlactating adult, and extend lactation amenorrhea in these populations on a seasonal basis. Similarly, in rural tropical regions of Mangalore where food availability varies greatly due to seasonal variation in rainfall, it could often result in a correlation of births in these populations with rainfall, and population in middle-to-higher latitude photoperiod may regulate some degree of reproduction.

Thus, the variations in birth frequency for the year 2012 and 2013 would have been obtained due to severe variations in temperature, rainfall, possible leisure time from work, and availability of food to the parents from the rural parts of Mangalore.

Further, the high prevalence of hearing impairment in the regional part of Mangalore can be related to the

maternal exposure to chemical fertilizers and pesticides during the gestational period, as during the months of May, June, and July Kharif crop is sowed. Similarly, the rural parts of Mangalore are also involved in the cultivation of various vegetables and crops throughout the year. Thus, the use of insecticides and pesticides could have played a role in the hearing loss of the newborns.

Similarly, the presence of vernix caseosa in the external ear canal, presence of residual mesenchyma and amniotic fluid in the middle ear [17], otitis media with effusion, and birth weight less than 1500 g [18] could have been the established factors in obtaining refer impression for newborns in the UNHSP.

In addition, individual placement of probe while carrying out immittance audiometry, internal background noise caused due to breathing pattern and any physiological movements present during the distortion product otoacoustic emission screening test, emotional status of the parent/caregiver and the neonate during the screening procedure, and subjective variations in interpreting the test results could have posed the neonate to have refer impression in the UNHSP.

Conclusion

The study aimed at observing the seasonality in birth frequency and percentage of newborns with refer impression in the UNHSP. The study showed no specific seasonality to birth frequency and percentages of newborns with refer impression in the UNHSP; instead, it showed a very high variation. Similarly, there was no correlation obtained between the birth frequency and the percentages of newborns with refer impression in the UNHSP. However, further studies are warranted as the sample size used in the current study is small.

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Conflicts of interest

There are no conflicts of interest.

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