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Research Article

The Effect of Ramadan Fasting During Pregnancy on an Offspring's Central Auditory Processing: A Retrospective Study on Children Suffering from Auditory Processing Disorders

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Abstract

Objectives: Many pregnant Muslim women fast daily during the daylight hours of the Holy month of Ramadan. Some studies have suggested that an impoverished diet during pregnancy affects the birth weight and the development of their off springs. This study was designed to determine whether Ramadan fasting by pregnant women had a long-term effect on the auditory processing abilities of their children. Moreover, this will have a great impact upon the listening abilities, language development and learning skills of these children.

Methods: A retrospective observational study was performed. Children were classified into two groups. The first group, contained children with Auditory Processing Disorder (APD), while the second group was made up of normal children. Basic audiological evaluation (pure tone audiometry, speech audiometry and tympanometry) as well as behavioral psychophysical central auditory tests (low pass filtered speech test for children, speech in noise test, dichotic digits test, gap in noise test and auditory memory subtests) were completed on both groups. In addition, a history of Ramadan fasting of the mothers was explored in both groups.

Results: There was no statistically significant difference between either the Control and Study groups regarding history of Ramadan fasting. Moreover, insignificant difference was also found between children of fasting and non-fasting mothers in APD group regarding the central auditory processing test results. According to the history of Ramadan fasting of the mothers in both groups, each group was subdivided into two subgroups (subgroup A: children with positive history of maternal fasting during Ramadan and subgroup B: children with negative history of maternal fasting during Ramadan).

Conclusion: Ramadan fasting during pregnancy does not adversely affect central auditory processing after the birth of the off springs.

Keywords: Ramadan Fasting; Maternal Fasting; Auditory Processing Disorder; Off Springs

Introduction

Auditory processing is defined as a specific deficit in the processing of auditory information along the central auditory nervous system, including bottom-up and top-down neural connectivity [1]. It is the processing of complex sounds following the initial transduction of sound energy into neural activity in the cochlea [2]. Broadly, stated, central auditory processing (CAP) refers to the efficiency and effectiveness by which the central nervous system (CNS) utilizes auditory information. Narrowly defined, CAP refers to the perceptual processing of auditory information in the CNS and the neurobiologic activity that underlies that processing and gives rise to electrophysiologic auditory potentials [3].

CAP includes the auditory mechanisms that underlie the following abilities or skills: sound localization and lateralization; auditory discrimination; auditory pattern recognition; temporal aspects of audition including temporal integration, temporal discrimination, temporal ordering, and temporal masking; auditory performance in competing acoustic signals and auditory performance with degraded acoustic signals [1,2,4].

Although APD is attracting increasing interest and recognition as a clinical entity among clinicians in the field and scientific organizations throughout the world [1,5,6,7], there is ongoing debate regarding its diagnosis and management. However, it can be classified into both acquired and congenital forms [8]. It has been proposed that this disorder may be differentiated as (i) developmental APD, (ii) acquired APD (e.g., because of infections, neurologic trauma, stroke, or excessive noise exposure), and (iii) secondary APD [5]. Moreover, the true cause of CAP is yet not clear to clinicians.

Many risk factors were reported to have a role in central auditory processing disorders in children, like developmental, genetic or past history of recurrent OME, but a positive history of maternal fasting for pregnant woman during Ramadan has not yet been explored. Accordingly, this study was designed to examine this point.

Design

This was a retrospective observational study.

Settings

This study was conducted at the Audiology Unit, Ain Shams University Hospital, Cairo, Egypt. It consisted of 120 children with an age range of 6 - 12 years. These children were divided into 2 groups;

- **Control group (Group 1):** 60 children with no complaint regarding scholastic achievement, listening and/or language problems. This group was further subdivided into Subgroup 1a (Normal children of fasting mothers) and subgroup 1b (Normal children of non-fasting mothers).
- **Auditory processing disorders group (APD) (Group 2)**: 60 age-matched children with APD were recruited from Ain Shams University Hospital outpatient clinic complaining of poor scholastic achievement, listening and/or language problems. This group was further subdivided into Subgroup 2a (APD children of fasting mothers) and subgroup 2b (APD children of non-fasting mothers).

All the study and control groups have:

- Age range 6 - 12 years.
- Normal peripheral hearing.
- Average intelligence based on Hiskey Nebraska test.
- No neurological disorder or behavioral disorder.
- Negative prenatal, natal and postnatal history.

Equipment

- Two channel Audiometer, Grason- Stadler Inc (GSI) model.
- Sound-proofed room I.A.C model 1602.
- Immittance meter, GSI model 33.
- Compact discs (CD) containing Arabic central auditory testing materials.

Method

All children in this study were evaluated by:

1. Full historical records.
2. Otological examination.
3. Basic Audiological Evaluation:
   - Pure tone audiometry including air and bone conduction (age-based hearing threshold determination).
   - Speech audiometry including:
     - Speech Reception Threshold (S.R.T): Using Bisyllabic words for children [9].
     - Speech Discrimination (S.D): Using Arabic Phonetically-balanced Kindergarten (PBKG) words [9].
   - Immittancemetry?? including tympanometry and acoustic reflex threshold.
4. Behavioral Psychophysical tests include:
   - Arabic Low Pass Filtered Speech (LPF) test [10].
   - Arabic Speech Intelligibility in Noise (SPIN) test [10].
   - Arabic dichotic digits test version II [11].
   - Gap in noise test (GIN) [12].
   - Arabic Memory tests for recognition, content and sequence [13].
5. Psycho-social evaluation (IQ testing):
   - This was completed using the Arabic Hiskey Nebraska of Learning Aptitude test. This test consists of 12 subtests to be applied on an age range of 3 - 18 years [14].

Results

	Normal age matched group	Auditory processing disorders (APD) group
Fasted mothers	24	27
Not fasted mothers	36	33
Chi	0.307	
P	0.579	

Table 1: Number of children in both the Control group (Group 1) and Study group (APD) (Group2).

No significant difference was found between the APD group and normal age matched children regarding the frequency of Ramadan fasting during their mother's pregnancy.

	Fasted (Subgroup 2a)	Not fasted (Subgroup 2b)	Total (APD)
Male	19	27	36
Female	8	6	14
Total	27	33	60

Table 2: Gender distribution in both fasted (Subgroup 2a) and non-fasted (subgroup 2b) groups.

There are more males than females in APD group.

Figure 1: Number of children in both APD and control groups regarding the history of fasting during their mothers' pregnancy.

Figure 2: Distribution of fasting trimester in the Control group mothers. Most of the mothers fasted during the second trimester.

Table 3 Number of normal and abnormal scores of LPF test, SPIN test, DD test (version II), temporal tests and memory subtests in both fasted and non-fasted groups of APD children.

Figure 3: Showed that the majority of mothers fasted the second trimester during pregnancy in APD group.

Figure 4: Showed normal versus abnormal scores of psychophysical tests in both fasted and non-fasted mothers of APD children.

Test	LPF		SPIN		Dichotic		Temporal		Memory	
Subgroup	2a	2b	2a	2b	2a	2b	2a	2b	2a	2b
Normal scores	26	33	24	33	19	23	15	9	9	10
Abnormal Scores	1	0	3	0	8	10	12	14	16	13
Chi	0.5887		2.6654		0.0032		1.3424		0.2801	
P	0.443		0.102		0.9548		.246605		.5966	

Table 3: Showed that children of both fasted and not fasted mothers had encountered both memory and temporal disorders more frequently followed by dichotic disorders.

No significant difference between both groups regarding the pattern of abnormality in Central test scores.

Discussion and Conclusion

This study was designed to explore the effect of fasting Ramadan mothers on the results of different central auditory processing abilities in their offspring. The APD group of children was 60 (36 males and 14 females) (table 2), with age range 6 - 12 years. Both APD group and control group were divided according to the past history of positive Ramadan fasting mother or not during the pregnancy into two subgroups (a and b).

There was no significant difference between the APD group and normal age matched children regarding the frequency of Ramadan fasting during mothers' pregnancy (Table 1 and Figure 1).

Auditory processing evaluation in the clinical setting is largely based on psychoacoustic test batteries of verbal and non-verbal stimuli [15-17] and may be ancillary completed with electrophysiological or objective audiological measures, such as acoustic reflex

thresholds, tympanometry, ABR (speech and noise ABR included), or OAEs (suppression included).

In this study, central auditory processing abilities were evaluated using different psychophysical tests that included Low pass filtered speech test for children that measures auditory closure ability, Speech in noise test that assesses selective auditory attention and Dichotic digits test version II that assesses dichotic integration ability. Auditory temporal Gap in noise test and finally auditory memory subtests which assess the auditory memory. These behavioral psychophysical tests are important for children in language development and learning achievement.

Table 3 and figure 4 demonstrates that children of either fasted or not fasted mothers had encountered both memory and temporal abilities more frequently followed by dichotic listening disorders. There was no significant difference between both APD subgroups regarding the pattern of abnormality in Central test scores (Table 3).

There is no previous research that explores this point for discussion. However, a few studies have suggested that pregnant women who were well nourished may have nutritional reserves to support fetal adaptations during Ramadan fasting. However, longitudinal information on fetal growth was not available; the only feasible measure recorded was birth weight. Furthermore, little is known about postnatal growth and development in infancy and childhood.

Salleh (1989) [18] used a linear regression study to examine the effects of Ramadan fasting on birth weight and Boskabadi., *et al*. (2014) [19] also looked at birth weight, however, they presented their data as medians and interquartile ranges; there was no control group in the study.

It should also be noted that geographical location may alter the number of hours of fasting, and thus the physiological challenge on the developing fetus, as the timing of the daily fast is determined by sunrise and sunset. Data showed significant heterogeneity for some outcomes. This variation may also relate to the trimester of fasting. The majority of studies were from Asia and the Middle East (8 studies from Iran) [20-27], (6 studies from Turkey) [28-33], (2 studies from Egypt) [34,35], (one study from Indonesia) [36] one study from Saudi Arabia [37] and (one study from Lebanon) [38] with three included studies [39-41] from the UK.

In our study, most of the mothers fasted Ramadan during the second trimester in both APD and control groups (Figure 2 and 3) at this stage most of Auditory system completed its development. Alwasel., *et al*. [42] showed significant associations between fasting Ramadan in the second and third trimesters but not the first trimester and birth weight, while Makki [43] found no relationship between the number of fasting days and the incidence of low birth weight.

Conflicts of Interest

No conflict of interest.

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