INTRODUCTION

Children with hearing loss experience greater difficulty understanding speech in noise and in reverberation conditions (1). The effects of these conditions on individuals with hearing loss are not well understood. It is also not known how these conditions may be related to stress and fatigue in children with hearing loss. This study aimed to measure stress and fatigue in children with hearing loss and compares them to adults with normal hearing (2). The reduction in available processing resources is thought to cause increased levels of stress and fatigue (3).

Purposive sample data from children with hearing loss showed that cognitive processing was affected by a decrease in processing resources (4). It is not unreasonable to believe that children with hearing loss may show greater negative effects of noise on stress and fatigue.

METHODS

Data were obtained as part of a larger ongoing study examining listening effort and fatigue in school-aged children with hearing loss. Participants included:

- Children with normal hearing (n=30, 18 males)
- Children with mild to severe sensorineural or mixed hearing loss. Mild hearing loss was defined as average thresholds of the 0.5, 1, 2, 4 kHz frequencies of 26 dB HL or less (5).
- Children with normal hearing (n=12, 6 males)

Mean = 8.27 years (Range = 6-12 years)

RESULTS

Figure 1. Classroom noise levels obtained during morning and afternoon visits on both school days are shown in this figure. The average recorded classroom noise level was 64.78 dBA (SD=1.74). In general, classroom noise was consistent across days. These levels are consistent with past research showing noise levels exceeding minimal standards (6.7).

Figure 2. Mean cortisol levels (standard error bars) at all times of collection for children with normal hearing (filled squares) and with hearing loss (open squares). This includes children with missing data points. These data show a decreasing cortisol. In our small sample of children with hearing loss, 5/9 children show an increase in cortisol after awakening is a phenomenon referred to as the cortisol awakening response.

Figure 3. One child with hearing loss showed a cortisol pattern that deviated from the rest of the children with hearing loss. The child’s data averaged across both days, are shown along with the mean data from children with normal hearing and children with hearing loss. It is unknown if the child was using hearing technology, at the time of data collection and activity during the school day were reported as typical.

Figure 4. Individual classroom noise levels obtained during morning and afternoon visits on both school days are shown in this figure. The average recorded classroom noise level was 64.78 dBA (SD=1.74). In general, classroom noise was consistent across days. These levels are consistent with past research showing noise levels exceeding minimal standards (6.7).

Figure 5. Difference in cortisol levels at 10:00am and 2:00pm are shown as a function of average classroom noise level for children with normal hearing (filled squares) and children with hearing loss (open squares). As the noise level decreased as the day progressed, whereas data below zero indicate the child’s recorded cortisol level increased from morning to afternoon visits. Based on typical cortisol patterns in humans, we would expect cortisol levels to decrease from morning to afternoon, thus showing a cortisol awakening response-normal values and confounds.

In general, children showed varied cortisol changes in response to classroom noise levels. In our sample, a greater percentage of children with normal hearing showed the expected pattern of decreasing cortisol. In our small sample of children with hearing loss, 9 children showed an increase of cortisol from morning to afternoon. These patterns do not appear to be related to the level of classroom noise.

RESULTS

Table 2. Characteristics of device use for children with hearing loss during 10:00am and 2:00pm data collection on both school days. Children ages 7–12 years were consistent users of hearing technology, whereas children ages 11 and 12 years used hearing aids sporadically and rarely used FM systems in the classroom.

SUMMARY & CONCLUSIONS

Children with hearing loss showed elevated cortisol awakening responses, suggesting the possibility of chronic stress and resultant fatigue.

Cortisol levels continued to exceed minimal recommended standards for classroom execution.

Cortisol levels did not appear to affect changes in cortisol levels from morning to afternoon. Although cortisol levels are expected to fall throughout the day, preliminary data suggested this pattern may be reversed for some children with hearing loss. Further research is needed to determine factors that may influence the abnormal cortisol pattern such as age, severity of hearing loss, technology use, and classroom noise levels.

Younger children with hearing loss in this study were consistent users of hearing aids and FM systems in the classroom, regardless of the severity of hearing loss.

KEY REFERENCES