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# INDIVIDUAL FACTORS AND ITS ASSOCIATION WITH EXPERIENCED NOISE ANNOYANCE IN SWEDISH PRESCHOOLS

## 1. INTRODUCTION

Studies have shown that preschool teachers often report having a troublesome working environment in terms of high noise levels (Grebennikov, 2006; Grebennikov & Wiggins, 2006; F. Sjödin, Kjellberg, Knutsson, Landström, & Lindberg, 2012b). Although the noise levels seldom reaches levels that may cause an instant hearing impairment the levels often exceeds 75-80 dB(A) during a working day for some teachers (F. Sjödin et al., 2012b). Even though the levels usually do not exceed the occupational health limits, in Sweden, the number of reports regarding hearing related ill health has been increasing from teachers working in the preschool (Arbetsmiljöverket, 2006). Beside the risk of developing hearing related ill health high noise levels also affect the everyday work being carried out by the teachers. With a high background level the teachers also need to raise their voice make themselves heard when trying to communicate with the children. This may in term lead to voice related ill health (Åhlander, Rydell, & Löfqvist, 2011).

Beside the risk of developing hearing related ill health, working in noisy condition may also lead to physiological ill health in terms of stress and burnout (Grebennikov & Wiggins, 2006; F. Sjödin, Kjellberg, Knutsson, Landström, & Lindberg, 2012a). It is highly likely that noise annoyance is one an important link between stress related ill health and noise exposure. Noise annoyance is also often reported from employees working under poor acoustical conditions (F. Sjödin et al., 2012b). The definition of noise annoyance is not well defined and differs between studies. However, Hall, Taylor and Birnie (Hall, Taylor, & Birnie, 1985), showed that noise annoyance may be closely linked to experienced disturbance in ones activities. With this in mind it is likely that annoyance is more of a secondary reaction to the noise. Others claim that noise annoyance may also be driven by the attitude to the noise source as shown by Jonsson and Sörensen (Jonsson & Sörensen, 1970). The attitude towards the noise source may also be driven by the exposed individual's prior knowledge of the noise. If the exposed individual know that the noise exposure may cause harm or long term ill-health the person is more likely to report noise annoyance (Crichton, Dodd, Schmid, & Petrie, 2015).

But it is of importance to know that the noise in the preschool differs from traditional noisy work places since the noise is highly fluctuant and mainly based on the children's voices. The noise also consists of several noise sources such as falling chairs, footsteps, toys etc, thus making the soundscape rather complex. High fluctuating noise level with a low degree of control has been shown to capture people's attention (Kjellberg, 1990). Added to this is the preschool teacher's responsibility and care taking of the children. This responsibility make it impossible to ignore sudden changes in the noise because a sudden sound level peak may signal that a child need help or need the teacher's assistance. A consequence of experiencing high noise annoyance may be unnecessary worrying about whether the noise level is harmful or not for the hearing. Today we know that the noise levels in the preschool is rather high and that many teachers report high levels of noise annoyance. When preschool teachers report noise annoyance the sound level is often measured to control whether the sound levels exceeds the levels stated in the work environment legislation.

Usually the investigations regarding the sound environment in the preschools end with these measurements since they seldom show that the sound levels stated in the work legislation has been exceeded. But is of high importance to understand whether experienced noise annoyance is actually associated with the noise levels or if there are other factors that need to be address too.

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## 2. AIM

The aim of the study is to investigate whether there is an association between rated noise annoyance and actual noise exposure for Swedish preschool teachers.

Furthermore the study is also aimed to investigate whether preschool teachers with different individual characteristics differs in their rated noise annoyance at work.

## 3. METOHD

### A. PARTICIPANTS

An invitation to participate in the study was sent out by the municipal school authority to the principles of all preschools. In meeting with preschools that agreed two participate in the study two departments at each preschool were selected. All participating teachers were working as preschool teachers (three years academic preschool teacher education) or child care workers (no university education). Teachers working less than 30 hours per week were excluded from the study. The selection criteria resulted in the inclusion of 90 participants (77 women and 13 males) with a mean age of 41 years (SD 10.0).

### B. SOUND LEVEL MEASUREMENT

#### i. Personal sound level measurements

Individual noise level measurements were made using Brüel and Kjaer 4445 noise dosimeters and Larson Davies 706-Atex noise dosimeters. All dosimeters were set to log equivalent dB(A), Max dB(A) and peak value dB(C). All preschool teachers were also instructed to how to start and stop the noise dosimeter at the beginning and at the end of each working day during the work week (Monday to Friday) All noise dosimeters were calibrated before the start of each work week using a Brüel & Kjaer Sound Calibrator – Type 4231.

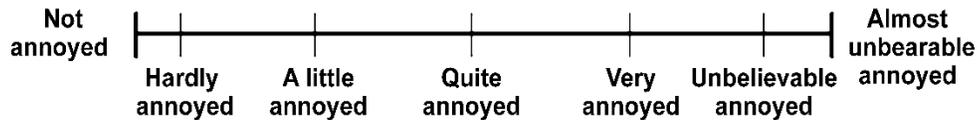
To reduce the risk of the preschool teachers own voice to contribute to the measured sound level the microphone was positioned behind the head of the participants using a headband (Fredrik Sjödin, Landström, Kjellberg, & Lindberg, 2012).

### C. QUESTIONNAIRES

All participants answered a questionnaire during the work week. The questionnaire included questions regarding descriptive data such as age, gender, work position, years in occupation and education level. Furthermore, questions were also asked regarding their physical work environment. Questions were also asked regarding physical health (headache, shoulder problems, hearing status etc.) and psychological health (stress and burnout). Hearing status was assessed using the question “How is your hearing?” using a three step scale (1 = Fine, no problems, 2 = slightly reduced, 3 = strongly reduced). This questions was conformed into two groups in the analyses having one group with no hearing problems and one group with hearing problems. Tinnitus was evaluated with a Yes and No answer on the question “Do you experience tinnitus?”. The participants were also asked whether they worry about their hearing using a four step scale (1 = not at all, 2 = To some extent, 3 = To a high extent, 4 = In a very high extent). This question was conformed into two groups in the analyses where not at all or to some extent answer formed the no / low worry group and the to a high extent and very high answers formed the high / very high worry group. Burnout was asses using the Shirom Melamed Burnout questionnaire (Melamed, Kushnir, & Shirom, 1992; Melamed et al., 1999). The data from this questionnaire is calculated giving a total burnout score for each participant.

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General noise annoyance at work was assessed by the preschool teachers using a visual analogue scale (VAS) used in previous studies (Lundquist, Holmberg, & Landstrom, 2000; Lundquist, Kjellberg, & Holmberg, 2002). The VAS scale ranges from 0 (not annoyed) to 100 mm (almost unbearable annoyed) with five anchor points, see Figure 1. The participants were instructed to mark their answer anywhere on the scale.



*Figure 1. Visual analogue scale ranging from not annoyed (0 mm) to almost unbearable annoyed (100 mm) used in the study.*

#### **D. ETHICS**

This study was approved by the regional ethical review board in Uppsala, Sweden (2008/273). In accordance with ethical guidelines all participants were informed about the purpose of the study and that their participation was voluntarily. Furthermore, they were also informed that they at any time could end their participation. All preschool teachers gave their written consent to participate in the study.

#### **4. RESULTS**

The sound level recording using personal carried noise dosimeters revealed that the average equivalent noise level during a work week varied between individuals from 66,8 dBA to 74.4 dBA. The average A weighted maximum sound level varied between 92,5 dBA and 108,1 dBA. C weighted peak values varied between 116 dBC and 128,5 dBC. Noise annoyance ratings varied between 23,0 to 90,0 on a 0-100 mm scale see Table 1 .

*Table 1. Average  $dBA_{Leq}$ , average  $dBA_{Max}$ , and average  $dBC_{Peak}$  during five work days and rated noise annoyance by the participants.*

	<b>N</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>SD</b>
$dBA_{Leq}$	88	66,8	74,4	70,6	1,4
$dBA_{Max}$	88	92,5	108,1	100,5	4,0
$dBC_{Peak}$	88	116,2	128,5	121,6	2,5
Noise annoyance rating	88	23,0	90,0	56,7	17,7

Noise annoyance and its association with the different sound level measurements were analyzed using Pearson's correlation coefficient. The analyses revealed that  $dBA_{Leq}$  was statistically significant correlated with the preschool teachers experienced noise annoyance at work ( $r = 0,23$ ,  $P = 0,07$ ) see Table 2. No other measured sound variables showed any significant correlation with the teachers rated noise annoyance at work.

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**Table 2. Correlation analyses between Average  $dBA_{Leq}$ , average  $dBA_{Max}$ , and average  $dB_{C_{Peak}}$  during five work days and rated noise annoyance by the participants.**

	<i>N</i>	<i>R</i>	<i>P</i>
$dBA_{Leq}$	88	0,23	<b>0,03*</b>
$dBA_{Max}$	88	-0,07	0,56
$dB_{C_{Peak}}$	88	-0,05	0,66

\* =  $P < 0.05$

Analyses regarding age, gender as well as physical and psychological characteristics were analyzed using one way ANOVA analyzes and independent T-tests. No statistically significant group differences regarding age, gender, education level, hearing status, tinnitus prevalence were observed regarding experienced noise annoyance at work or noise exposure ( $dBA_{Leq}$ ) see Table 3.

Statistically significant differences regarding noise annoyance and burnout were however observed regarding preschool teachers that worry about their hearing compared to preschool teachers not worrying. Teachers worrying about their hearing reported higher noise annoyance at work ( $t = - 4,66$ ,  $df = 86$ ,  $P < 0,05$ ) but with no statistical significant difference in noise exposure ( $t = - 0,12$ ,  $df = 86$ ,  $P = 0,83$ ). Statistical differences were also observed regarding burnout symptoms and rated noise annoyance. Preschool teachers reporting burnout syndrome also reported a higher noise annoyance at work ( $t = - 2,88$ ,  $df = 86$ ,  $P < 0,05$ ) but no statistical significant differences were observed regarding noise exposure for the two burnout groups ( $t = - 0,63$ ,  $df = 86$ ,  $P = 0,53$ ).

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**Table 3. Descriptive statistics for regarding average rated Noise annoyance and Noise exposure (dBA<sub>Leq</sub>) separated by Age, Gender, Education level, Hearing status, Tinnitus, Worry about hearing and Burnout syndromes.**

		N	Percent	Noise annoyance	SD	dBA <sub>Leq</sub>	SD
Age	youngest to 30	16	18,2	55,2	17,8	70,2	1,6
	31-40	32	36,4	56,6	19	70,5	1,3
	41-50	22	25,0	54,6	18,2	70,6	1,4
	51 to oldest	18	20,5	61,1	15,2	71	1,4
Gender	Female	76	86,4	57,9	17,5	70,6	1,4
	Male	12	13,6	49,7	18,5	70,2	1,2
Education level	Preschool teacher	51	58,0	57,9	17	70,6	1,4
	Child care worker	31	34,1	53,8	19,1	70,5	1,3
Hearing status	No problem	41	46,6	55	17,7	70,8	1,1
	Reduced hearing	47	53,4	58,2	17,8	70,3	1,6
Experiencing tinnitus	Yes	53	39,1	59,9	14,8	70,5	1,6
	No	34	60,9	54,5	19,2	70,5	1,3
Worrying about hearing	No or low worry	60	68,2	<b>51,3*</b>	16,4	70,5	1,2
	High or very high worry	28	31,8	<b>68,3</b>	14,9	70,6	1,9
Burnout	Healthy or low burnout	65	73,9	<b>53,6*</b>	17,7	70,5	1,5
	High or pathological burnout	23	26,1	<b>65,5</b>	14,7	70,6	1,4

\* =  $P < 0.05$

Burnout and its association with noise annoyance was analyzed using Pearson's correlation coefficient. The analyses revealed that the degree of burnout symptoms was statistically significant correlated with the preschool teachers experienced noise annoyance at work ( $r = 0,33$ ,  $P = 0,01$ ) see Table 4.

**Table 4. Correlation analyses between burnout symptoms and rated noise annoyance by the participants.**

	<i>N</i>	<i>R</i>	<i>P</i>
Burnout symptoms	88	0,33	<b>0,01*</b>

\* =  $P < 0.05$

Chi-Square test was performed to examine the relation between reported hearing and worry about hearing. No statistical significant results regarding this distribution was revealed for this population,  $X^2(1, N = 88) = 1.95, p = 0.16$

**Table 5. Cross tabulation of the Chi-square test showing the number of preschool teachers reporting being worried or not for their hearing and their reported hearing status.**

		No hearing problem	Some hearing problem	Total
No or low worry	N	31	29	60
	%	52 %	48 %	100 %
High or very high worry	N	10	18	28
	%	36 %	64 %	100 %
Total N		41	47	88

## 5. DISCUSSION

This study aimed to investigate what factors that may explain differences in experienced noise annoyance among preschool teachers. The noise exposure measured by use of personal carried noise dosimeter during one work week revealed that the noise exposure can vary largely between the preschool teachers regarding average  $dB_{A_{Leq}}$ ,  $dB_{A_{Max}}$ , and average  $dB_{C_{Peak}}$ .

Interestingly the analyses only revealed a weak statistical significant correlation between average  $dB_{A_{Leq}}$  during a work week and rated noise annoyance at work. This association was expected to be stronger. Other factors of interested and their possible association with experienced noise annoyance at work were also analyzed. The hypothesis was that having a hearing impairment or experiencing tinnitus would be associated with a higher reported noise annoyance. This hypothesis was however not supported by the data. The data showed that preschool teachers reporting reduced hearing or having tinnitus generally reported higher noise annoyance at work, however the group differences were not statistically significant.

This study however, shows that other individual factors may be of higher importance regarding the preschool teachers' experienced noise annoyance. The results shows that the group of preschools teachers that worry about their hearing also reports higher noise annoyance. This may be due to the fact that by their worry regarding their hearing, they also pay more attention the actual sound environment at their preschool and are thus are more annoyed. It may also be due to the possibility that noise is a common problem within the preschool and that the preschool teachers today have better knowledge and understanding regarding the risks of high noise levels. This is supported by the findings in Crichtons study (Crichton et al., 2015) showing that having knowledge of the sounds being bad for your well-being will increase noise annoyance. This assumption is also further supported by the data that shows that preschools teachers with a hearing

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reduction also experience more noise annoyance, although the Chi-Square analyses was not statically significant. A different study design is however needed to fully investigate this further.

However, the findings regarding the association between worry and noise annoyance in this study is not supported by the study by Guski and Felscher-Suhr (Guski, Felscher-Suhr, & Schuemer, 1999). They concluded that health risks and fear is less important than disturbance or interference with ones activities regarding experienced noise annoyance. The sound environment in the preschool is complex and further questions regarding interference and masking effects from sounds should be included in future studies.

This study also revealed that teachers with a higher degree of burnout was associated with a higher experienced noise annoyance. It is likely that long term job strain and stress may lead to burnout symptoms. Working in a noisy environments with burnout symptoms may impair the teachers coping capability regarding the noise in the preschool, thus explaining this association.

The overall result from this study do suggest that equivalent sound levels in preschool is a weak indicator for whether the noise elevates the teachers experienced noise annoyance. Complaints from teachers in the preschool regarding noise annoyance may very well be due to psychological factors such as burnout symptoms or worry about hearing. Hearing status may also play a role in their experience of whether they perceive the noise in the preschool as annoying.

However, conducting sound level measurements in preschools are not unnecessary when complaints are reported by the teachers since it highly important to investigate whether the sound levels exceeds levels that may cause hearing disorders. Furthermore, sound level measurements also provides information of the sound levels and may therefore be an important tool to reduce the worry some teachers have regarding their hearing. To further lower the degree of worry, education and information about noise and how noise can be prevented is of high importance. Future studies need to further focus on psychological factors and their association with the teacher's experience of the complex sound environment in the preschool.

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