Perceptions Towards Sound Levels, Music Volumes and Noise-Induced Hearing Loss Among Churchgoers in Singapore

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Aims

- To find out the differences in the perceptions and knowledge towards sound levels, music volumes and noise-induced hearing loss among four main groups of churchgoers

Groups

1 – Pastors, Elders, Church Leaders

2 – Song Leaders, Vocalists, Musicians

3 – PA, Sound/Audio Engineers

4 – Normal Churchgoers

5 Hypotheses

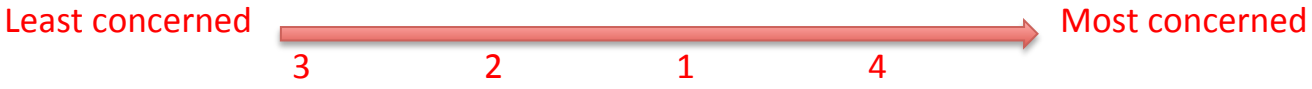
1. Different preferences in music volumes

2. Different knowledge regarding sound levels, sound safety standards, hearing health, and hearing protection and preservation

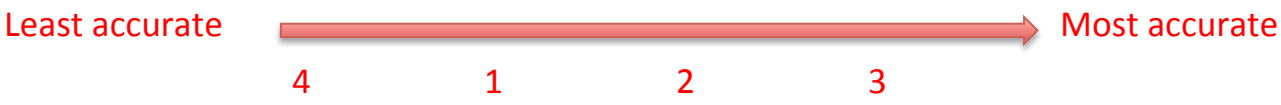
3. Different views regarding how the accompanying music affects the spirituality of the worship service

5 Hypotheses

4. Different concerns regarding the safety of their hearing with regards to sound exposure that they receive from their church service



5. Differ in the accuracy of their perceived risk of hearing loss from the sound exposures experienced during their church service



Background (1)

- Noise exposure of priests in churches

International Journal of Occupational Safety and Ergonomics (*JOSE*) 2011, Vol. 17, No. 1, 79–86

Noise Exposure Levels of Priests and Worshippers in Protestant Churches

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Context. *Worship in Protestant churches in Brazil is very noisy. Thus, this practice may pose a hearing risk.* ***Aims***. *To evaluate the priests' and worshippers' noise exposure during worship.* ***Settings and design***. *The analysis was carried out in 5 churches located in the city of São José dos Campos, Brazil.* ***Methods and material***. *To estimate the worshippers' noise exposure, an author of this study was also submitted to dosimetry. The methodology was based on Fundacentro's Occupational Hygiene Standard No. NHO-01 (2001). Weekly noise exposure was estimated according to the priest's information about the number of services in the period.* ***Results***. *The priest's noise exposure was over the recommended limits. The normalized exposure level varied between 95.4 to 99.5 dB(A). In 2 of the churches, the noise exposure registered, with values of 85.3 and 86.5 dB(A), may also pose risk to the worshippers.* ***Conclusions***. *Worship in the churches generated sound pressure levels that imply health risk, especially to priests, so hearing conservation programs with adequate acoustical sanitation measures must be implemented there.*

Background (2)

- The controversy of “worship wars” regarding loudness of church music. Is it too loud?

Websites/Blogs

- http://audiovisualtn.com/loudness-standards-for-church-sound-systems/
- http://www.experiencingworship.com/worship-articles/sound/2001-9-How-Loud-is.html
- http://blog.mattsatorius.com/touring/audio/worship-music-spl-levels-its-too-loud/
- http://www.thegospelcoalition.org/article/how-to-make-an-appropriately-loud-joyful-noise
- http://www.musicademy.com/2011/11/loudness-war-music-church-loud/
- https://marshill.com/2013/09/05/could-you-turn-it-down-please
- http://thomrainer.com/2013/04/17/how-loud-should-our-church-music-be/

Questionnaire

- English, 2 pages, 14 questions, less than 5mins
- Some questions based on Dangerous Decibels© programme's questionnaire
- Assess perceptions and knowledge of churchgoers
- Each hypothesis have at least one question to address it
- Responses will prove/disprove hypotheses
- Participants ages 18 and above

Dosimetry

- Done with 3M Quest NoisePro Dosimeter
- Record SPLs, calculate Lavg and TWA
- Readings will validate perceptions of churchgoers and responses on one of the questions

<u>Dosimeter Settings</u>

Slow response, dBA weighting, 40-110dB range, 85dB criterion level for 8 hours, 3dB exchange rate, 80/70dB threshold, 110dB upper limit.

Research Timeline

- IRB submission – 1 Sep 2014
- IRB approval – 15 Oct 2014
- Recruitment of Churches – July 2014 to Jan 2015
- Data Collection Start – 19 Oct 2014 to 8 Mar 2015
- Thesis writing – October 2014 to 29 Mar 2015

Research Details

- Collected 446 questionnaires from all 4 groups of churchgoers from ages 18-76 across 5 churches
- English-speaking church services that uses contemporary Christian music and rock band set up with sound amplified through speakers

Research Obstacles or Limitations

- Privacy issues & questionnaire controversy
- Dosimetry varies in different churches
- Only one dosimetry location per church
- Long correspondence time with churches
- Some churches take longer time, some take shorter time (weeks) to complete dosimetry
- Distributing questionnaires after services may drag into the next service

Research Findings

- Dosimetry readings

Figure 4. Average L_{avg} and duration, time-weighted averages (TWA), percentage doses (P_{dose}), and L-peak (L_{pk}) values across the five churches

Church	Average L_{avg} (L_{eq} T)	*SD*	Time (s)	*SD*	Time (m)	TWA (dBA)	P_{dose} (%)	Max L_{pk} hit (dB)	Total no. L_{pk} in 5 services	Avg. no. of L_{pk} > 120dB
A	82.64	1.64	5552	689.58	92.53	75.4	11%	122.6	5	1
B	91.25	2.13	6164	315.96	102.73	84.6	92%	127.3	233	46.6
C	88.22	1.06	6066	413.74	101.10	81.4	44%	125.4	211	42.2
D	85.15	2.39	6272	347.95	104.53	78.6	23%	122.4	12	2.4
E	84.09	1.52	6380	774.44	106.33	77.6	18%	122.4	1	0.2
Total	86.27	-	6086.8	-	101.45	79.7	29%	-	-	-

- Church B the loudest church, exceeded P_{dose}, sound levels at certain locations harmful
- Church C might have exceeded P_{dose} in some locations

Research Findings

- Participant demography – Age

Figure 1. Means and standard deviation of age in each group and in each church

	Group 1		Group 2		Group 3		Group 4		All groups	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Church A	47.08	9.087	35.77	7.528	32.67	3.042	43.15	6.588	40.78	13.517
Church B	31.43	7.815	31.14	7.520	32.00	5.632	31.82	7.506	31.68	7.381
Church C	48.11	12.283	32.65	9.773	40.17	10.667	40.93	10.902	39.40	11.503
Church D	37.71	7.158	30.24	4.944	34.67	6.282	31.92	7.871	32.28	7.327
Church E	44.33	8.563	34.12	14.097	36.80	10.281	44.63	13.433	41.48	13.433
All churches	39.92	11.208	33.08	9.242	35.84	8.871	37.27	12.351	36.60	11.479

Research Findings

- Participant demography – Age

Figure 2. Age group distribution in each group across all five churches

	Group 1		Group 2		Group 3		Group 4	
	No.	%	No.	%	No.	%	No.	%
Age 50 and below	50	80.65%	92	93.88%	32	86.49%	212	85.14%
Age 51 and above	12	19.35	6	6.12%	5	13.51%	37	14.86%
Total	62	100%	98	100%	37	100%	249	100%

- Generally, Group 1 oldest, Group 2 youngest

Research Findings

- Participant demography – Gender

Figure 3. Gender distribution in each group across all five churches

	Group 1		Group 2		Group 3		Group 4	
	No.	%	No.	%	No.	%	No.	%
Male	40	64.52%	42	42.86%	30	81.08%	117	46.99%
Female	22	35.48%	55	56.12%	7	18.92%	132	53.01%
Unknown	0	0%	1	1.02%	0	0%	0	0%
Total	62	100%	98	100%	37	100%	249	100%

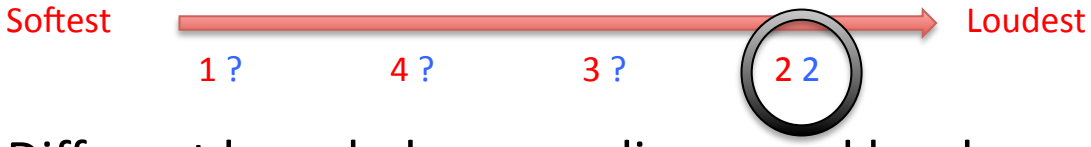
- Generally, more males in Group 1 and 3

Research Findings

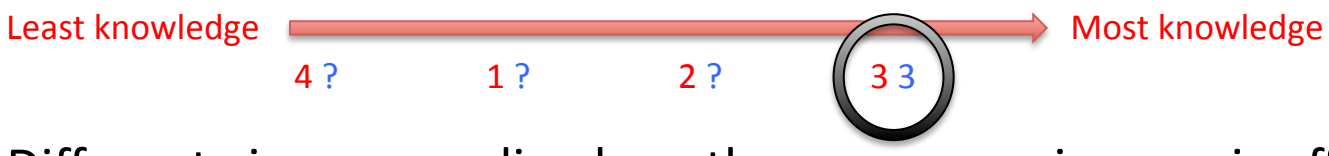
- Questions from the questionnaire were scored and responses analysed statistically between the 4 groups
- Results were compared to the 5 hypotheses

Hypotheses Findings

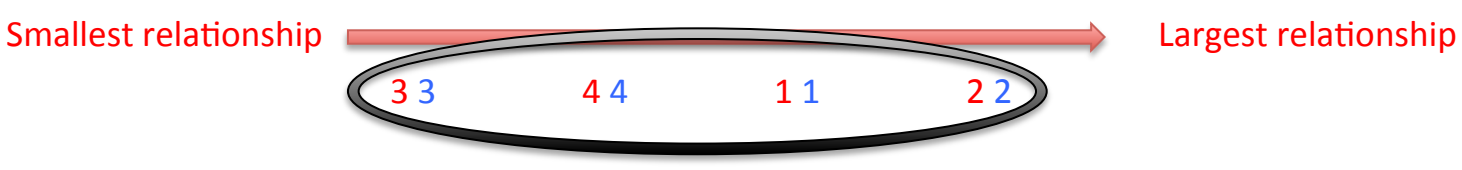
1. Different preferences in music volumes – **Disproved**



2. Different knowledge regarding sound levels, sound safety standards, hearing health, and hearing protection and preservation – **Disproved**

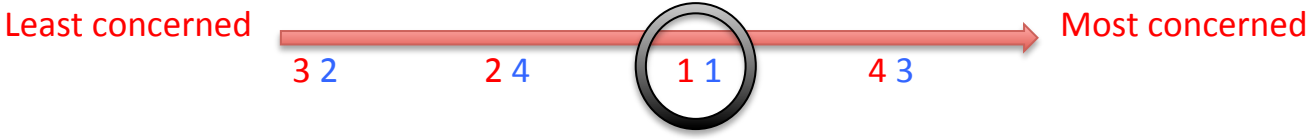


3. Different views regarding how the accompanying music affects the spirituality of the worship service – **Cannot prove (not sig enough)**



Hypotheses Findings

4. Different concerns regarding the safety of their hearing with regards to sound exposure they receive from their church service - **Disproved**



5. Differ in the accuracy of their perceived risk of hearing loss from the sound exposures experienced during their church service – **Disproved**

Research Conclusions

- All 5 hypotheses disproved.
- From recorded dosimetry, all churches within safe sound level limits. However, considering sound level variations in worship halls, at least some members in Church B would be exposed to harmful levels of sound.
- From recorded dosimetry, Church B exceeded P_{dose}. Highly possible that some Church C members would have exceeded the P_{dose} if they were sitting nearer to the speakers.
- Possible that in larger churches (mega churches), the sound levels are much higher, hence increasing the risk of hearing damage.

Research Conclusions

- Participants from the 5 churches generally displayed a lack in knowledge regarding hearing health, noise exposure safety limits, and noise-induced hearing loss issues. Certain groups had more or less knowledge than the others.
- There is need to educate the public on hearing health issues, especially regarding noise exposure safety limits.
- Having these knowledge will influence behavior and motivate individuals to protect their hearing, thereby reducing the risk of noise-induced hearing loss.

Further Research

- Multiple dosimeter locations
- Cover more churches of various sizes, musical and worship styles
- Online version of questionnaire
- Efficacy of educational programmes (such as Dangerous Decibels©) to change behaviours and improve hearing health knowledge

Acknowledgements

- God
- 3M for dosimeter
- Friends who referred churches
- Friends who provided various forms of assistance

Thanks!

- Q&A