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Audio and Visual Response Time of Type 2 Diabetics and Non-Diabetics

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Abstract

Aim: To study the audio and visual response time of type 2 diabetics and non-diabetics. *Materials & Method:* Thirty type 2 diabetics (age 49±7 years) and thirty non- diabetics (45±5 years) males volunteered to participate in this study as subjects. Response Analyzer was used to measure the audio and visual response times. *Result:* Audio-1 (0.960 ± 0.34ms), Audio-2 (1.043±0.79ms), Audio-3 (1.082±0.86ms), Audio-4 (0.986±0.46ms) and combined auditory response time (1.048±0.57ms) of type 2 diabetics. Audio-1, Audio-2, Audio-3, Audio-4 and combined auditory response time of non-diabetics was 0.841±0.23ms, 0.782±0.35ms, 0.762±0.40ms, 0.793±0.25ms and 0.797±0.17ms respectively. Visual-1 (0.736±0.28ms), Visual-2 (0.653± 0.27ms), Visual-3 (0.649 ± 0.34ms), Visual-4 (0.654± 0.21ms) and combined visual response times (0.679± 0.25ms) of type 2 diabetics and Visual-1, Visual- 2, Visual-3, Visual-4 and combined visual response time of non-diabetics was 0.618 ± 0.14ms, 0.571 ± 0.07ms, 0.604 ± 0.10ms, 0.631 ± 0.14ms, and 0.604 ± 0.07ms respectively. The absolute and percent difference between various audio and visual response time of type 2 diabetic and non-diabetics were statistical significant. *Conclusion:* It was concluded that type 2 diabetics respond slowly to the various audio and visual stimuli as compared to non-diabetics. Thus, auditory and visual response time can be considered as an ideal tool for measuring audio-visual sensory motor association in type 2 diabetics and to highlight the importance of auditory and visual response time testing in routine examination of type 2 diabetics. We can manage the complications of neuropathy in type 2 diabetics which may lead to morbidity in them.

Introduction

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The Diabetes mellitus is becoming more and more prevalent in Indian society. In India, it is estimated that approximately 2% of the population, 15 million people have diabetes *(Swami, 1984).* The number of cases is said to be rising by 5%-6% each year and an estimated 300,000 people die from diabetes and its complication *(Herman et al., 1984).* There are about 3.5crore diabetics in India and the figure will rise to about 5.2 crore by 2025. Every 5th patient visiting a consulting physician is a diabetic, and, every 7th patient visiting a family physician is a diabetic. Keeping in view the alarming increase in the incidence and prevalence of diabetics in India, WHO has declared India as the "Diabetic Capital of the World" *(Vijay, 2002).* The most common neuropathy affecting individuals with diabetes is diffuse neuropathy of the distal symmetric sensor motor type *(Brown & Asbury 1984).* Diabetic retinopathy, a secondary microvascular complication of diabetes mellitus is the leading cause of blindness in the United State amongst individuals age 20 to 64 *(National Institutes of Health 2007 and World Health Organization 2007).* Diabetes retinopathy is most concerning since it poses the greatest threat of vision loss *(International Diabetes Federation 2005).* All persons with diabetes are at risk of developing retinal complication. Diabetes mellitus is responsible for abnormality in various organs, as well as hearing system and sudden deafness *(Fukiui et al., 2004).* The sense organ of hearing- the organ of corti has complex components and arrangement which makes it a potential target for hyperglycemic damage. Damage of any part of the hearing mechanism can lead to hearing loss. Studies have shown positive correlation between hearing loss and Diabetes Mellitus *(U.S Department of Health and Human Services 2010).* Rosen and Davis, who sought a possible correlation between sensor-neural hearing loss and microangiopathy in diabetic patients, conclude that hearing loss is definitely common in diabetes patients *(Rosen & Devis 1971).* Vascular changes in the inner ear are regarded as the most important changes in diabetes *(Schuknecht, 1993; Tomisawa, 2000).* Several authors reported a higher incidence of hearing loss in diabetic patient in comparison to the general population *(Tomisawa, 2000; Kasemsuwan at al, 2001).* Auditory and visual response time is considered as an ideal tool for measuring sensory motor association *(Shenvi & Balasubramanian 1994; Griard & Peronnet 1999; Ashok et al., 2014).* There is paucity of data relating to the auditory and visual response time among Punjabi type 2 diabetics, therefore the study was undertaken to highlight the importance of auditory and visual response time in routine examination of type 2 diabetic subjects and to reduce the neuropathy related morbidity *(Porciatti et al., 1999; Perryman & Fitten 1996; Lewis and Brown 1994; Brooke et al., 1989).* The aim of the present study was to observe and compare the audio-visually response time of type 2 diabetics and non diabetics.

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Material and Methods

Sixty males voluntarily participated in this study as subjects. Out of sixty subjects, thirty were type 2 diabetic and thirty non-diabetics and their age ranged from 40 to 60 years. All the subjects were right handed, non-smokers and non-alcoholic. The audio-visual response time in milliseconds was measured with help of digital response analyzer. The audio response time was recorded for very high frequency (Audio-1), high (Audio-2), medium (Audio-3) and low (Audio-4) sound stimuli. The visual response time was recorded for red (Visual -1), green (Visual -2), blue/indigo (Visual -3) and yellow/amber light stimuli (Visual -4). The subject was required to respond to the stimulus by pressing an appropriate button. The display screen of digital response analyzer indicated the response time in milliseconds. All subjects were given practice trials and instructed to respond as quickly as possible. The average of the three readings was taken as the value for audio and visual response times.

Statistical Analysis: Data were statistically analyzed with an appropriate tests by using the SPSS Software (SPSS 16.0 free trial version for Windows, SPSS Inc., Chicago, IL, USA). Results were represented as mean and standard deviation.

Result and Discussion

Table 1 shows mean of audio response times for different frequency sounds in Type 2 diabetics and Non-diabetics.

Table 1. Audio Response Time of Type 2 diabetics & Non-diabetics

Variable	Group	Mean	SD	Difference	%
Audio 1 (Very high Freq. Sound), msec	T2D	0.960*	0.34	-0.119	-12.39
	ND	0.841*	0.23		
Audio 2 (high Freq. Sound), msec	T2D	0.986*	0.46	-0.203	-20.68
	ND	0.782*	0.35		
Audio 3 (Medium Freq. Sound), msec	T2D	1.043*	0.79	-0.281	-26.84
	ND	0.762	0.40		
Audio 4 (Low Freq. Sound), msec	T2D	1.082*	0.86	-0.289	-26.70
	ND	0.794*	0.83		
Combined (Audio 1,2,3 & 4)), msec	T2D	1.048*	0.57	-0.251	-23.95
	ND	1.097*	0.17		

T2D: Type 2 Diabetics, ND: Non Diabetic, * significant at the 0.05 level

The mean audio response time of type 2 diabetics for audio 1-very high frequency sound, audio 2-high frequency sound, audio 3- medium frequency sound, audio 4-low frequency sound and combined audio response times were 0.960±0.34msec, 0.986±0.46, 1.043±0.79, 1.082±0.86msec and 1.048±0.57msec respectively. The mean audio response time of non-diabetics for audio 1 sound, audio 2 sound, audio 3 sound, audio 4 sound and combined audio response times were 0.841±0.23msec, 0.782±0.35msec, 0.762±0.40 msec, 0.793±0.24 msec and 0.797±0.17msec respectively. The absolute (and percent) mean difference between Type 2 diabetics and Non-diabetics for audio 1, audio 2, audio 3, audio 4 and combined audio response time were -0.119 msec (-12.39%), -0.203msec (-20.68%), - 0.281msec (-26.94%), - 0.289msec (-26.70%) and -0.251msec (-23.95%) respectively. The differences in

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various audio response times between type 2 diabetics and non-diabetics were statistically significant with diabetics taking significantly greater time to respond to different frequency of audio stimuli.

Table 2 shows mean of visual response times for different colour lights in Type 2 diabetics and Non-diabetics. The mean visual response time of type 2 diabetics for visual 1-red light, visual 2-blue/indigo light, visual 3- green light, visual 4-yellow/amber light and combined visual response time were 0.736±0.28msec, 0.653±0.27, 0.649±0.34, 0.654±0.21 and 0.679±0.25msec respectively. The mean visual response time of non-diabetics for visual 1 light, visual 2 light, visual 3 light, visual 4 light and combined visual response time were 0.618±0.13msec, 0.571±0.07msec, 0.604±0.10 msec, 0.631±0.14 msec and 0.604± 0.07msec respectively. The absolute (and percent) mean difference between Type 2 diabetics and Non-diabetics for visual 1-red light, visual 2-blue/indigo light, visual 3-green light, visual 4-yellow/amber light and combined visual were -0.117msec (-16.03%), -0.082msec (-14.36%), -0.045msec (-6.93%), -0.022msec (-3.51%) and -0.075msec (-11.04%) respectively. The differences in various visual response times between type 2 diabetics and non-diabetics were statistically significant with diabetics taking significantly longer time to respond to different colours of light stimuli.

Table 2. Visual Response Time of Type 2 diabetics & Non-diabetics

Variable	Group	Mean	SD	Difference	%
Visual 1 (Red Light), msec	T2D	**0.736***	**0.28**	**-0.117**	-16.03
	ND	0.618*	0.13		
Visual 2 (Blue/Indigo), msec	T2D	0.653*	0.27	-0.082	-14.36
	ND	0.571*	0.07		
Visual 3 (GreenLight), msec	T2D	0.649*	0.34	-0.045	-6.93
	ND	0.604	0.10		
Visual 4 (Yellow/Amber), msec	T2D	0.654*	0.21	-0.022	-3.51
	ND	0.631*	0.14		
Combined (Visual 1,2,3 & 4)), msec	T2D	0.679*	0.25	-0.075	-11.04
	ND	0.604*	0.07		

T2D: Type 2 Diabetics, ND: Non Diabetic, * significant at the 0.05 level

Table 3 shows comparison of audio and visual response time for different sound and colour light stimulus of Type 2 diabetics. The absolute (and percent) mean difference for audio 1- very high frequency sound vs. visual 1-red light, audio 2- high frequency sound vs. visual 2-blue/indigo light, audio 3- medium frequency sound vs. visual 3-green light, audio 4- low frequency sound vs. visual 4-yellow/amber light and combined audio vs. combined visual were -0.224msec (-23.33%), -0.333msec (-33.77%), -0.394msec (-37.77%), -0.428msec (-39.55%) and -0.369msec (-35.20%) respectively. The differences in various audio and visual response times of type 2 diabetics were statistically significan with diabetics taking significantly greater time to respond to different frequency of audio stimuli & different colours of light stimuli.

Table 4 shows comparison of audio and visual response time for different sound and colour light stimuli in non-diabetics. The absolute (and percent) mean difference for audio 1- very high frequency sound vs. visual 1-red light, audio 2- high

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frequency sound vs. visual 2-blue/indigo light, audio 3- medium frequency sound vs. visual 3-green light, audio 4- low frequency sound vs. visual 4-yellow/amber light and combined audio vs. combined visual was -0.223msec (--26.51%), -0.211msec (-26.98%), -0.158msec (-20.73%), -0.162msec (-20.42%) and -0.193msec (-24.21%) respectively. The differences in various audio and visual response times of non- diabetics were statistically significant.

Table 3. Comparison of Audio and Visual Response Time of Type 2 diabetics

Variables	Mean	SD	Absolute difference	Difference %
Audio 1 (very high frequency sound) (msec)	0.960*	0.34	-0.224	-23.33
Visual 1 (red light) (msec)	0.736*	0.28		
Audio 2 (high frequency sound) (msec)	0.986*	0.46	-0.333	-33.77
Visual 2 (blue/indigo light) (msec)	0.653*	0.27		
Audio 3 (medium frequency sound) (msec)	1.043*	0.79	-0.394	-37.77
Visual 3 (green light) (msec)	0.649*	0.34		
Audio 4 (low frequency sound) (msec)	1.082*	0.86	-0.428	-39.55
Visual 4 (yellow/amber light) msec)	0.654*	0.21		
Combined Audio (1+2+3+4) msec	1.048*	0.57	-0.369	-35.20
Combined Visual(1+2+3+4) (msec)	0.679*	0.25		

***significant at the 0.05 level**

Table 4. Comparison of Audio and Visual Response Time of Non- diabetics

Variables	Mean	Std. Deviation	Absolute difference	%Percent Difference
Audio 1 (very high frequency sound) (msec)	0.841*	0.23	-0.223	-26.51
Visual 1 (red light) (msec)	0.618*	0.13		
Audio 2 (high frequency sound) (msec)	0.782*	0.35	-0.211	-26.98
Visual 2 (blue/indigo light) (msec)	0.571*	0.07		
Audio 3 (medium frequency sound) (msec)	0.762*	0.40	-0.158	-20.73
Visual 3 (green light) (msec)	0.604*	0.10		
Audio 4 (low frequency sound) (msec)	0.793*	0.24	-0.162	-20.42
Visual 4 (yellow/amber light) msec)	0.631*	0.14		
Combined Audio (1+2+3+4) msec	0.797*	0.17	-0.193	-24.21
Combined Visual(1+2+3+4) (msec)	0.604*	0.07		

***significant at the 0.05 level**

Delayed audio-visual response time in Type 2 diabetics without clinical neuropathy symptom can be taken as a sensitive indicator of early nerve damage without clinical signs or symptoms. Diabetes mellitus is responsible for abnormality in various organs, as well as hearing system and sudden deafness *(Fukiui et al., 2004).* The sense organ of hearing- the organ of corti has complex components and arrangement which makes it a potential target for hyperglycemic damage. Damage of any part of the hearing mechanism can lead to hearing loss. Studies have shown positive correlation between hearing loss and Diabetes Mellitus *(U.S Department of Health and Human Services 2010).* Vascular changes in the inner ear are regarded as the most important changes in diabetes *(Tomisawa, 2000; Schuknecht, 1993).* Several authors reported a higher incidence of hearing loss in diabetic patient in comparison to the general population *(Kumar et al., 2014; Kasemsuwan at al, 2001; Tomisawa, 2000). Conclusion:* It was concluded that type 2 diabetics respond slowly to the various audio and

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visual stimuli as compared to non-diabetics that is audio-visual response time of type 2 diabetics were more than non-diabetics. Thus, auditory and visual response times can be considered as an alternative tools for measuring audio-visual sensory motor association in type 2 diabetics and to highlight the importance of auditory and visual response time testing in routine examination of type 2 diabetics. We can manage the complications of neuropathy in type 2 diabetics which may lead to morbidity in them.

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Reference

Kumar, Ashok; Kumar, Vishal and Kaur, Nariender. 2014. A Study of Auditory Response Time of Type 2 Diabetic and Non-Diabetics. In a book "*Women's Health and Empowerment*", editor Dr. Gobind Singh, Publised by Twentyfirst Century Publications Patiala (Punjab) in association with Kala Mandir Distributors, Delhi, pp. 54- 57.

Brooke, J.D.; Singh R.; Wilson M.K.; and Yoon P. 1989. Aging of human segmental oligosynaptic reflexes for control of leg movement. *Nuerobiolagy of Aging*, **10:** 721-725.

Brown, M.J. and Asbury, A.K. 1984. Diabetic Neuropathy. *Ann Neurol* 15:2-12.

Fukiui, M., Kitagawa, Y., Nakamura, N., Kadono, M., Mogami, S, and Ohnishi, M. 2004. Ididopatheic sudden hearing loss in patients with type 2 diabetes. *Diabetes Res. Clin. Pract.*, **63:** 204-11.

Giard, M. H.; and Peronnet, F. 1999. Audiotory-Visual Intergration during Multimodal Object Recognition in Humans; A Behavioral and Electrophysiological Study, *J. Cog. Neuroscin.*, **11(5):** 473-490.

Herman, W.H., Sinnock, P., Brenner, E., Brimberry, J.L., Langford, D., Nakashima, A., Sepe, S.J., Teutsch, S.M. & Mazze, R.S. 1984. An Epidemiologic model for diabetes mellitus: incidence, prevalence & mortality. *Diabetes Care*, **7:** 367-371.

International Diabetes Federation. Diabetes atlas. 2005. htt://www.eatlas.idf.org.

Kasemsuwan, L., Sriwanyong, S., Krittiyawong, S., Sunetrworakul, J., and Jiamsuchon, K. 2001. Hearing in young diabetic patients. *J. Med. Assoc. Thai.*, **84**: 1389-1394.

Lewis, R.D. and Brown, J.M.M. 1994. Influence of muscle activation dynamics on reaction time in the elderly. *Eur. J. Appl. Physiol*., **69:** 344-349.

National Institutes of Health. 2007. Available at: www.nei.nih.gov/eyedatap.

Perryman, K.M. and Fitten, J. 1996. Effects of Normal Aging on Performance of Motor-Vehile Operational Skills. *J. Geriatr. Psychiatry Neurol*., **9:** 136-141.

Porciatti, V., Fiorentini, A., Morrone, M.C., Burr D.C. 1999. The effects of ageing on reaction times to motion onset. *Vision Res*., **39:** 2157-2164.

Rosen, Z., and Devis, E. 1971. Microangiopathy in diabetics with hearing disorders. *Eye Ear Nose Throat Mon*., **50:** 479-482.

Schuknecht, H.F. 1993. *Pathology of ear* 2ed. Philadelphia, Baltimore, Hong Kong, London, Munich: Lea and Febiger, 312-314.

Shenvi, D. and Balasubramanian, P. 1994. A comparative study of visual and auditory reaction time in males and females. *Ind. J. Physiol. Pharmacol.* **38:** 229-231.

Swami Shankardevananda, Saraswati. 1984. *In Yogic management of asthma & diabetes*. Publisher: Bihar Scool of Yoga, Bihar, India.

Tomisawa, H. 2000. Diabetic changes in the strain vascularis in human-a study of PAS-stained temporal bone sections. *Nippon Jibinakoka Gakkai Kaiho*, **103(11):** 1227-1237.

U.S Department of health and human services. National institutes of health news. Hearing loss Is Common in people with Diabetes. Available at: htt://www.nih.gov/news/heath/jun2008/niddk-16.htm accessed on December 1st, 2010.

Gupta, Vijay 2002. Diabetes in Elderly Patients. *J. K. Practitioner*, **91(4):** 258-259.

World Health Organization.2007. Available at: htt://www.who.int/mediacentre/factsheets

Conflict of Interest None Declared

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