Assessment of the 3-D vision syndrome among the Spectators of Three-Dimensional (3-d) Movies in Karachi-Pakistan

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Abstract

Objective: To assess the three-dimensional vision syndrome among the viewers of three-dimensional movies.

Methods: This cross-sectional study was conducted at the Ziauddin University, Karachi, from July to November 2015 among viewers of three-dimensional movies. The frequency of three-dimensional vision syndrome during and at the end of a movie was assessed. A self-administered questionnaire was used to collect data immediately at the end of the movie. Data was analysed using SPSS 20.

Results: There were474 participants with an overall mean age of 25.6±10.1 years; 270(57%) participants were male and 204(43%) were female. Most common symptoms were tired eyes, blurred vision and headache found during the movie among 96(20.3%), 73(15.4%) and 43(9.1%) individuals, whereas at the end of the movie among 100(21.1%), 33(7.0%) and 35(7.4%) viewers, respectively. Movies with duration of 2 to 3 hours were also more likely to be associated with three-dimensional vision syndrome during and at the end of the movie (p= 0.001) and (p= 0.004).

Conclusion: Watching three-dimensional movies increased the likelihood of visual fatigue and visually-induced motion sickness.

Keywords: 3-D vision syndrome, Three-dimensional (3-D) movies, Visually-induced motion sickness, viewers of 3-D movie. (JPMA 67: 652; 2017)

Introduction

The advent of three-dimensional (3-D) movies in recent decades and their increasing influence on movie viewership have caused them to generate more revenue than two-dimensional (2-D) movies.[1] However, the concept of motion images in cinemas is not new; the first commercial movie was released in 1922 in Los Angeles,[2] and since then many different techniques have been adopted to make imaging more realistic and appealing.[3]

However, the "Pokemon Incident" of 1997 caused a stir when a number of Japanese children developed seizures, after watching the famous Pokemon TV show.[4,5] It can also not be ignored that gaming console giant Nintendo had "issued a warning that their new hand-held devices should not be viewed in stereoscopic mode by children aged 6 years and under."[6] Besides, related issues by other notable tech giants[6] may have provoked scepticism towards the wide spread use of 3-D technology.

It is now an accepted fact that stereoscopic images (3-D images) cause an "intense eye accommodation activity"[7] such as headaches, nausea, blurred vision, diplopia, asthenopia and visually-induced motion sickness(VIMS), which is characterised by tiredness, headache and soreness of the eye,[8,9] collectively known as the 3-D vision syndrome.[8,9] The phenomenon of the 3-D vision syndrome has been strengthened by researches conducted in Rome, Italy. The study by Solimini et al. reported frequency of headache, tired eyes and double vision among viewers of 3-D movies and these symptoms were also found positively associated with watching 3-D movies.[3] Another study also reported significant presence of eye strain, difficulty in focusing, headache and fullness of head among viewers of 3-D movies.[10]

The concept of watching 3-D movies was introduced comparatively late in Pakistan, with the first 3-D cinema opening in Karachi only a few years back. Its rousing success gave way to a few more of them propping up in the city, which continue to attract a large viewership. After a thorough literature search and with the best of our knowledge, no substantial data is available on this topic (3-D vision syndrome) in our region. The current study was planned to assess the 3-D vision syndrome among the viewers of 3-Dmovies.

Subjects and Methods

This cross-sectional study was conducted at the Ziauddin

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University, Karachi, from July to November 2015, and comprised viewers of 3-D movies. In Karachi, there are a number of cinemas but the 3-D facility is available only in few of them. For this purpose three cinemas with facility of 3-D cinema were identified and informed written permission was taken from the management of these cinemas after explaining the purpose of this study. Formal approval was taken from the institutional ethics review board.

The sample size was calculated by using the World Health Organisation's (WHO) sample size determination software. Keeping confidence level (CI) at 95%, proportion of VIMS 54.8%[3] and precision 0.05, the sample size was calculated as 387. However, to avoid data wastage more than 400 individuals were taken into account. Viewers of 3-D movies of both genders from 10-60 years of age and who had seen the 3-D movie within 2 hours were included in this study; the reasons were that the symptoms associated with viewing 3-D images would be present for only a short time and so the respondent might have difficulty in accurately recalling the symptoms. However, those who did not remember the movie title, watched an incomplete movie and those whose general health prior to the movie was not well were excluded from the study as the condition prior to the movie might influence the symptoms associated with watching the movie. Non-probability purposive sampling technique was used both for selection of cinemas and study participants. Study participants were informed prior to data collection about the purpose of the study. Formal consent was obtained from all participants; those who refused to participate were excluded.

Data was collected using a self-administered structured questionnaire. This questionnaire was adopted after informed permission from another study by Solimini AG et al.[11] However, certain modifications were incorporated according to our circumstances. A pilot survey was conducted for further improvement in the questionnaire among 50 individuals and these were not the part of original sample of the study. There were four sections in the questionnaire with four to six questions with close-ended options in each section. The first section was about demographic details; second was about health-related individual characteristics specifically to assess visual fatigue reasons and symptoms; the third section was about 3-D movie vision characteristics; and the fourth section was about health assessment before, during and after watching 3-D movies.

Data was analysed using SPSS 20. All qualitative variables were presented as frequency and percentages and all quantitative variables were presented as mean and standard deviation (SD). Count regression analysis was applied with some individuals. Three-D movie characteristics were taken as independent variables and the number of 3-D vision syndrome symptoms during and at the end of the movie as dependent variables. Association was presented as odds ratio (OR) with 95% CI.P<0.05 was considered significant.

Results

There were 474 individuals with an overall mean age of 25.6±10.1 years. Besides, 124(26.2%) participants were aged between 10-18 years, 215(45.4%) between 19-29 years, 86(18.1%) between 30-39 years, 31(6.5%) between 40-49 years and 18(3.8%) were aged 50 years or above. Moreover, 270(57%) participants were male and 204(43%) were females, while 311(65.6%) were single and 163(34.4%) were married. Regarding education status, 84(17.7%) had school level education, 169(35.7%) had college level and 221(46.6%) had

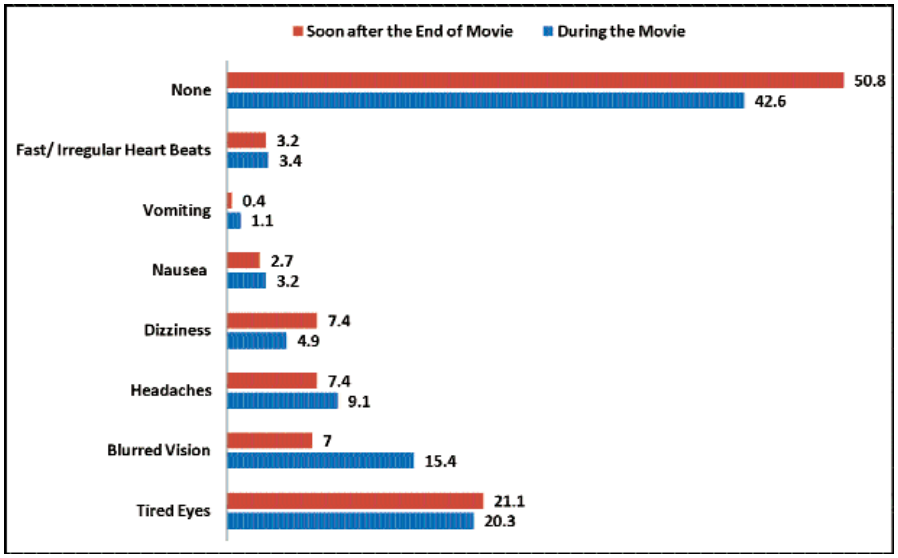


Figure-1: Symptoms of 3-D Vision Syndrome Experienced by Viewers of 3-D movies During and Soon at the End of the Movie (%).

Table: Association of 3-D Vision Syndrome Symptoms with Individual and Movie Vision Characteristics.

Characteristics	During the Movie			At the End of the Movie		
	Odds Ratio	95% CI	P-value	Odds Ratio	95% CI	P-value
Gender						
Male	1			1		
Female	1.38	(1.09-1.75)	0.007	1.36	(1.03-1.72)	0.027
Age	0.991	(0.97-1.03)	0.137	0.99	(0.97-1.0)	0.168
Motion Sickness						
Very Often	1.78	(1.09-2.91)	0.02	1.79	(1.05-3.06)	0.032
Often	1.79	(1.22-2.93)	0.003	1.83	(1.21-2.78)	0.004
Sometimes	1.44	(1.09-1.92)	0.01	1.62	(1.21-2.19)	0.001
Rarely	1			1		
Wear Glasses/Lenses while watching 3-D Movie						
Yes	1.10	(0.87-1.40)	0.41	1.09	(0.84-1.41)	0.48
No	1			1		
Genre of the Movie*						
1	0.616	(0.45-0.85)	0.004	0.67	(0.48-0.94)	0.02
2	0.775	(0.56-1.07)	0.117	0.58	(0.41-0.83)	0.003
3	1.03	(0.68-1.56)	0.877	0.93	(0.59-1.46)	0.775
4	0.8	(0.51-1.28)	0.359	0.6	(0.35-1.03)	0.06
5	1			1		
Duration of the Movie						
Less than 2 hours	1			1		
2 to 3 hours	1.51	(1.18-1.91)	0.001	1.46	(1.13-1.89)	0.004
Viewing Angle while watching Movie						
Lateral	1.69	(0.81-3.48)	0.159	1.9	(0.87-4.12)	0.1
Middle	1.42	(0.69-2.88)	0.34	1.29	(0.60-2.78)	0.5
Others	1.46	(0.63-3.37)	0.37	1.11	(0.43-2.83)	0.82
Do not remember	1			1		
Closeness to Screen while watching Movie						
First Few Rows	2.18	(1.10-4.28)	0.02	2.03	(0.99-4.15)	0.05
Last Few Rows	2.01	(1.05-3.84)	0.03	1.89	(0.95-3.74)	0.06
Others	1.95	(1.01-3.78)	0.04	1.9	(0.95-3.83)	0.07
Do not remember	1			1		
Health Status during last week						
Excellent	0.61	(0.24-1.56)	0.3	0.6	(0.23-1.54)	0.28
Very Good	1.32	(0.53-3.23)	0.54	0.98	(0.40-2.43)	0.98
Fairly Good	1.37	(0.58-3.37)	0.49	1.32	(0.54-3.26)	0.53
Not Good	2	(0.70-5.67)	0.19	1.16	(0.37-3.67)	0.79
Do not remember	1			1		

CI: Confidence interval

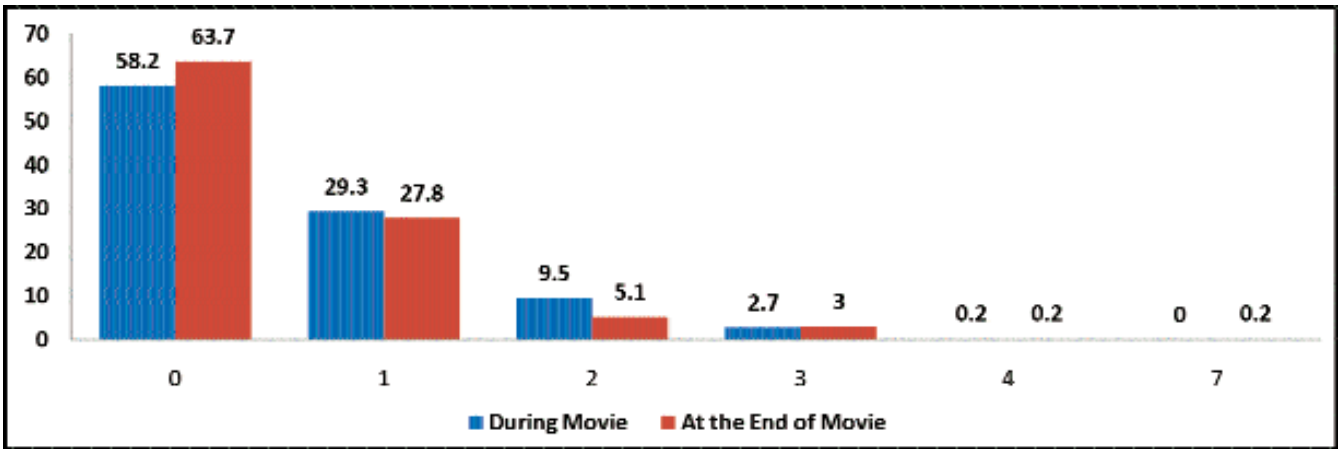
3-D: Three-dimensional

* Genre of the movie

1. Action, Science Fiction, Thriller. 2. Animation, Family Comedy. 3.Adventure, Biography, Drama. 4. Adventure, Family Fantasy. 5. Adventure, Comedy, Drama.

university level education. Furthermore, 255(53.8%) were unemployed, 216(45.6%) were employed and 3(0.6%) were retired.

Study participants were inquired about the frequency of motion sickness, headache and vertigo/dizziness they had suffered during the last three months. Motion sickness was found rarely in 314(66.2%), sometimes in 102(21.5%), often in 37(7.8%) and very often in 21(4.4%) individuals. Similarly, the occurrence of headache was found rarely in 225(47.5%), sometimes in 161(34%), often in 63(13.3%) and very often in 25(5.3%) individuals while dizziness/ vertigo was found rarely, sometimes, often and very often among 316(66.7%), 108(22.8%), 41(8.6%) and 9(1.9%) participants, respectively. Usual mode of transport was car among 428(90.3%) participants while for 21(4.4%), 11(2.3%) and 14(3%) it was public transport, college van/bus and motorcycle, respectively. Average time spent on electronic gadgets was more than 5 hours in 205(43.2%)



3-D: Three-dimensional.

Figure-2: Frequency of 3-D Vision Syndrome Symptoms among Viewers of 3-D movies During and at the End of Movie (%).

individuals, 4-5 hours in 78(16.5%), 2-3 hours in 81(17.1%), about an hour in 81(17.1%) and less than an hour in 29(6.1%).

The participants were asked if they wore glasses (other than 3-D glasses) or contact lenses while watching 3-D movies, 213(44.9%) were affirmative while 261(55.1%) were not. Of all, 461(97.3%) viewers reported that they wore 3-D glasses while watching 3-D movies and 13 (2.7%) did not. Regarding the genre of the movie that they watched last, 150(31.6%) watched a movie whose genres included action, science fiction and thriller; 130(27.4%) watched a movie whose genres included animation, comedy and family; 112(2.6%) watched a movie whose genres included adventure and comedy drama; 42(8.9%) watched a movie whose genres included adventure, biography and drama while 40(8.4%) watched a movie whose genres were adventure and family fantasy; the genres of each of the movie were taken from www.imdb.com, an online movie database. The duration of the movie was less than 2 hours as responded by 263(55.5%) viewers and 2 to 3 hours by 211(44.5%) viewers. As for the viewing angle, 297(62.7%) participants it was approximately in the middle of the rows, for 126(26.6%) it was lateral (last two seats in a row at right or left side), for 30(6.3%) it was others (all other seats in the row) whereas 21(4.4%) did not remember their seating position. Viewers were also inquired about the closeness of their seats while watching a movie; 216(45.6%) responded that they were seated within the last rows (away from the screen), 89(18.8%) were seated within first three rows (near the screen), 134(28.3%) sat on other seats while 35(7.4%) were unable to recall.

Of the total study participants, 211(44.5%) were hungry while watching a movie and 263(55.5%) were not. They were inquired about their health status during the last week when they watched a movie. For 133(28.1%), 182(38.4%), 137(28.9%) and 12(2.5%) individuals, it was excellent, very good, fairly good and not good, respectively; however, 10(2.1%) did not answer.

Regression analysis to assess association of 3-D vision syndrome with individual and movie vision characteristics revealed that 3-D vision syndrome symptoms during and at the end of movie was found more among females than males (OR=1.38, 95% CI= 1.09-1.75, p=0.00) and (OR=1.36, 95% CI= 1.03-1.72, p=0.03) respectively. Motion sickness and closeness to screen also showed positive association. Movies with duration of 2 to 3 hours were also more likely to be associated with 3-D vision syndrome during and at the end of the movie (OR=1.51, 95% CI= 1.18-1.91, p= 0.001) and (OR= 1.46, 95% CI= 1.13-1.89, p= 0.004), respectively (Table).

As for the symptoms that were observed individually by 3-D movie viewers during and soon after watching the movie, 96(20.3%), 73(15.4%) and 43(9.1%) said they observed tired eyes, blurred vision and headaches during the movie while 100(21.1%), 33(7%) and 35(7.4%) observed these symptoms at the end of the movie (Figure-1). A total of seven symptoms were included in 3-D vision syndrome and these symptoms were further counted together to assess the presence of all symptoms during and at the end of movie (Figure-2).

Discussion

The results were consistent with our study objective

and showed the occurrence of symptoms associated with the 3-D vision syndrome; the findings were also more or less similar to those reported in other researches.[3,10-13] However, it is important to note that the resulting symptoms were only associated with watching a 3-D movie that would subside, and could not be classified as something pertaining to a disease or a medical condition.[3,10] Tired eyes, blurred vision and headaches were found to be the top 3 symptoms occurring among viewers (Figure1); this goes on to show that visual fatigue has a substantial positive correlation with the viewing of 3-D imagery as confirmed by other researches.[14-16] Symptoms of dizziness, vomiting, palpitations were noted to a lesser degree but were also significant, reaffirming the role of VIMS with 3-D visuals.

The reason for collecting data directly from 3-D cinemas was due to the fact that the data could be collected right after the movie ended, and so would provide more authenticity to the recollection of symptoms, when filling in the questionnaire as opposed to Solimini et al., where data was collected from those students and co-authors enrolled in university courses who had seen a 3-D movie within the past 6 months.[3] The questionnaires administered to the respondents were short and well designed, did not take much of the respondents time and kept their interest going as opposed to Solimini et al. and Kuze et al., which made use of the Simulator Sickness Questionnaire (SSQ), which took a substantially longer time to fill.[10,12] The data provided through the questionnaire sought to link 3-D viewing with associated symptoms of visual fatigue and VIMS.

The research conducted is the first of its kind in Karachi, and provides a base for similar researches to be done on 3-D motion images. However, the research has had its fair share of limitations. The size of the data sample was small compared to other researches to find out 3-D associated symptoms.[3,4,10] A number of respondents from younger age groups had difficulty comprehending some of the questions and hence might have provided unreliable data. Another missed aspect was to find out whether the viewer enjoyed the movie or not; this would play a major role as the level of concentration could directly be associated with the onset of symptoms, this was thoroughly covered in Solimini et al., through a 5-point Likert scale.[3] The questionnaire was self-administered and no observational study was done, which might subject the outcome to bias. Due to constraints, it was also beyond the scope of this research to make use of the SSQ. The SSQ consists of a pre- and post-questionnaire that is divided into an oculomotor factor, disorientation factor and a nausea factor. It could have provided a more comprehensive symptom checklist which would have strengthened the study. Conversely, the outcome of this study may open new research avenues for future researchers as the topic itself is at growing trend.

Future researches on 3-D viewing, especially in Pakistan, should work towards an analytical study design in which the effects between 2-D and3-D movies can be compared. The use of the SSQ questionnaire is also recommended to provide more validity to the results. An analytical study between animated and non-animated 3-D movies should also take place. Researches can also include the effects of lighting and screen size in a 3-D cinema; variations in which can have an effect on the symptoms. As reported that "women with susceptible visual-vestibular system may have more symptoms when watching 3-D movies",[10] a similar study should also be conducted on children of younger ages to see its effect on them.

Conclusion

There were symptoms associated with viewing 3-D motion images, which might not seem to be a source of great concern. But as more 3-D movies are being produced and released, there is a possibility that it might be hazardous in the long run, with people developing life-threatening ailments. With 3-D developers working tirelessly to provide the most realistic experience for its audience, they should also 'realistically' try to work towards providing a symptom free experience for its viewers.

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Conflict of Interest: None.

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