

Evaluation of high myopia complications prevention program in university freshmen

Gow-Lieng Tseng, MD, Candidate for PhD^{a,b}, Cheng-Yu Chen, PhD^{b,*}

Abstract

High myopia is a global eye health problem because of its high incidence of sight-threatening complications. Due to the role of awareness, self-examination, and preventive behavior in prevention of morbidity of high myopia complications, promoting knowledge, capabilities, and attitude of high myopic personnel are required in this regard.

In this quasi-experiment study, 31 freshmen with high myopia in a national university were enrolled in 2014. The data were collected by validated and reliable questionnaire based on health belief model (HBM) and self-efficacy theory. The intervention program consisted of 1 educational session lasting 150 minutes by lecturing of high myopia complications, virtual reality experiencing, similarity modeling, and quibbling a film made on high myopia complications preventive concepts.

Implementing the educational program showed immediate effect in knowledge, perceived susceptibility, perceived severity, self-efficacy, and preventive behavior intention. While 6 weeks after the educational program, significant increases were observed in cues to action, self-efficacy, and preventive behavior intention.

This article provided that, after a single session, there was positive improvement in high myopia complication prevention behavior intention among participants. These positive effects confirmed the efficacy of the education program and will probably induce behavior change.

Abbreviations: ANOVA = 1-way analysis of variance, HBM = health belief model.

Keywords: health belief model, high myopia complications preventive program, high myopia, self-efficacy, university freshmen

1. Introduction

The apparent worldwide rise in the prevalence of myopia has been a public health impact because of the associated concomitant increase in potentially sight-threatening ocular complications. Persons with high myopia (spherical equivalent ≤ -6.0 D) are more susceptible to some ocular abnormalities. In several studies, higher risks of cataract and open-angle glaucoma were reported in myopic adults.^[1–3] And the risks of choroidal and retinal abnormalities such as choroidoretinal degeneration, lacquer cracks, subfoveal choroidal neovascularization, peripheral retinal degeneration or breaks, and rhegmatogenous retinal detachment,^[4] also increased with the degree of myopia and axial length elongation.^[5]

Editor: Massimo Tusconi.

Authors' contributions: G-LT carried out the design and coordinated the study, participated in all of the stages and prepared the manuscript. C-YC provided assistance in the design of the study, statistical analysis of the data and participated in manuscript preparation. All authors have read and approved the content of the manuscript.

The authors have no conflicts of interest to disclose.

^a Department of Ophthalmology, Taipei City Hospital, Renai Branch, ^b Department of Health Promotion and Health Education, National Taiwan Normal University, Taipei, Taiwan, ROC.

* Correspondence: Cheng-Yu Chen, Department of Health Promotion and Health Education, National Taiwan Normal University, No. 162, Sec. 1, Heping East Road, Taipei 10610, Taiwan, ROC (e-mail: t09004@ntnu.edu.tw).

Copyright © 2016 the Author(s). Published by Wolters Kluwer Health, Inc. All rights reserved.

This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

Medicine (2016) 95:40(e5093)

Received: 23 April 2016 / Received in final form: 13 September 2016 /

Accepted: 16 September 2016

<http://dx.doi.org/10.1097/MD.0000000000005093>

The early detection and treatment of possible pathological ocular complications are essential in preventing or reducing the morbidity of outcomes in high myopic patients. The impacts of high myopic complications cannot be underestimated especially in young adults. But people with high myopia are often unaware that their high myopia puts them at considerable increased risk of pathological outcomes. There are well-established preventive actions, such as regular check-ups of intraocular pressure, central and peripheral retina, optic nerve, and any pathological signs by a certified ophthalmologist; checking one's own vision and visual field for each eye with same target in same distance and wearing protection glasses during work or sports. However, people with high myopia usually will not perform these actions because of ignorance or negligence. Therefore, the prevention or reduction of ocular complications associated with high myopia, a public health issue in the regions with high prevalent rate of high myopia, needs to be treated in educational dimension.

Health belief model (HBM) was one of the efficient models in studying preventive behaviors.^[6] The model was first developed in the 1950s and cooperated with self-efficacy theory in 2008.^[7] The components of this model are perceived as severity, susceptibility, benefits, barriers, and self-efficacy. Behavior was explained by HBM as the combination and interaction results of perceived susceptibility (belief that high myopia persons are susceptible to develop some kind of ocular complications), perceived severity (belief that high myopic complications are serious sight-threatening diseases), perceived benefits and perceived barriers to perform actions (high myopic complications prevention behavior intention), and self-efficacy (judgments of own capabilities to organize and execute courses of action required to prevent high myopic complications). The HBM has been applied frequently in studies for breast cancer self-screening, quit smoking, drug abuse, and sexual behavior. However, information and instruction courses about high myopic complications prevention were few in colleges and communities. The

purpose of this study, based on the HBM and self-efficacy theory, was to evaluate the effectiveness of single session high myopic complications prevention program in promoting prevention behavior among high myopic university freshmen.

2. Methods

This was an 1-group pre- and posttest design of quasi-experiment study. The first-grade students of National Taiwan Normal University were recruited during freshman physical examination. Students with myopia spherical equivalent equal or more than 6 diopters, detected by auto-refractor machine (Topcon KR800, Tokyo, Japan), without any previous ocular trauma, diseases, or surgery were invited to join the study. Those students, who were willing to participate in the study, were arranged to receive cycloplegic refractory examination to make sure their myopic spherical equivalence fit with the criteria described above. According to Cohen study in 1988,^[8] the total number of 28 participants was needed to obtain a significant result at the given 2-tailed alpha value 0.05, effect size (r) 0.50, and power level equals 0.80. We estimated 20% drop-out rate, thus total 42 students were enrolled. Of these students, 5 students dropped out due to their absence for intervention program or did not complete secondary questionnaire (posttest). Furthermore, 6 students dropped out due to their inability to complete the third questionnaire (post posttest) 6 weeks after intervention program. Therefore complete data of 31 students were analyzed.

For gathering data, we designed a questionnaire based on the HBM and self-efficacy theory. The questionnaire was reviewed by 10 experienced colleagues (2 professors, 1 vice professor, and 4 assistant professors in health promotion and health education department, and 3 senior ophthalmologists) for revising its content and construct validity. Reliability analysis was conducted for knowledge, self-efficacy, preventive behaviors, and HBM components (perceived susceptibility, severity, benefits, barriers, and cues to action). Internal consistency of these sections of the questionnaire was tested in 30 sophomores with high myopia and calculated using Chronbach alpha technique (Chronbach α value was 0.55 for knowledge, 0.80 for self-efficacy, 0.89 for preventive behaviors, 0.92 for susceptibility, 0.88 for severity, 0.91 for

benefits, and 0.86 for barriers). The whole document was approved by the Research Ethics Committee of National Taiwan University on September 11, 2014 (ID code: NTU-REC No: 201407ES021).

The questionnaire included questions regarding the sociodemographic characteristics of students (such as sex, department of college). To assess knowledge, we used 16 items on knowledge about eye anatomy, high myopia definition, incidence and correlated symptoms/signs of complications, self-examination and prevention activity with multiple choice questions. Then, each correct response was scored 1 point and each wrong response was scored 0. To assess cues to action, we used 11 items on whether the students have ever got related messages from any resource. Then, each "yes" response was scored one point and each "no" response was scored 0. Other questions consisted of perceived susceptibility (7 items on estimation of the probability of high myopia complications that will happen to oneself), perceived severity (10 items on estimation of the possible impacts of high myopia complications to oneself), perceived benefits (7 items on the awareness of the benefits to take preventive actions), perceived barriers (12 items on the possible difficulties for oneself to perform preventive behaviors), self-efficacy (10 items on assessing one's capability to perform required behaviors), and intention of preventive behaviors (13 items on self-examination, self-protection, and medical consulting behaviors about high myopia complications preventive activities). They were scored on a 5-point Likert scale as totally agree, agree, not decided, disagree, and definite disagree, and responses gained 5, 4, 3, 2, and 1 scores, respectively.

A pretest was performed while students receiving cycloplegic refractory examination. Group intervention program was held 1 week after pretest completed. The intervention program consisted of an educational session lasting 150 minutes and separated into 4 parts. The first part was a lecture with Power Point presentation about eye anatomy, high myopia definition, incidence and prevalence of correlated complications, symptoms/signs of complications, simple self-examination methods, and daily prevention activity. In the second part, aimed at clarifying perceived threats of high myopia complications, students experienced the visual impacts of high myopia complications with virtual reality glasses (Fig. 1) simulating retinal detachment, macular degeneration, advanced glaucoma, and cataract. In the



Figure 1. Four types of virtual reality glasses used in intervention program. (1) Retinal detachment, with upper and lower visual loss. (2) Macular degeneration, with central blurred vision or scotoma. (3) Advanced glaucoma, with visual field severely constricted. (4) Cataract, with blurred or foggy vision. P.S. These 4 types of glasses were originally designed and made by author G-LT.

Table 1**Mean score and stander deviation of all variables in 3 tests.**

Variables	Pretest (mean \pm SD)	Posttest (mean \pm SD)	Post posttest (mean \pm SD)
Knowledge	6.226 \pm 0.289	8.452 \pm 0.196	6.677 \pm 0.348
Perceived susceptibility	27.613 \pm 0.709	30.129 \pm 0.742	28.710 \pm 0.875
Perceived severity	43.290 \pm 0.677	44.968 \pm 0.674	42.871 \pm 0.833
Perceived benefits	31.097 \pm 0.509	31.484 \pm 0.629	30.452 \pm 0.700
Perceived barriers	41.097 \pm 1.207	39.000 \pm 1.573	40.194 \pm 1.712
Cues to action	1.903 \pm 0.413	2.548 \pm 0.477	3.677 \pm 0.462
Self-efficacy	34.419 \pm 0.843	39.355 \pm 0.760	38.194 \pm 0.858
Preventive behavior	41.419 \pm 1.339	47.161 \pm 1.550	46.032 \pm 1.363

SD=standard deviation.

third part, aimed at enactive attainments, perceived similarity to models, and verbal persuasion, students had an informal discussion with someone who had overcome retinal detachment caused by high myopia. In the last part, aimed at internalizing of knowledge and promoting effort feedback, students jointed a fault-finding game in a 5-section video which was recorded based on high myopia complications preventive concepts. After the educational session, posttest was done immediately with the same questionnaire. Then, 6 weeks later, post posttest was done also with the same questionnaire.

The obtained data were analyzed by SPSS (version 20.0, Chicago, IL) using descriptive statistics and 1-way analysis of variance (ANOVA) at the significant level of $\alpha < 0.05$.

3. Results

Data from 31 freshmen of a national university who completed the whole program were studied. All of them had myopia (spherical equivalent) equaled or more than 6 diopters. There were 10 male and 21 female students in our study. Descriptive statistics on variations between pretest, posttest, and post posttest showed scores of posttest were the highest one in variables as knowledge, perceived susceptibility, perceived severity, self-efficacy, and preventive behavior. The scores of perceived benefits and perceived barriers in all 3 tests were almost the same, while the post posttest score of cues to action was the highest one compared to the other 2 (Table 1). ANOVA test on variations between pretest, posttest, and post posttest showed

Table 2**Results of ANOVA and post hoc comparison.**

Variables	SV	SS	df	MS	F	Post hoc comparison
Knowledge	Treatment	85.828	2	42.914	25.201***	(2) [†] > (1) [†] (2) > (3) [†]
	Effect					
Perceived susceptibility	Error	102.172	60	1.703	6.425**	(2) > (1)
	Treatment	98.666	2	49.333		
Perceived severity	Error	460.667	60	7.678	3.663*	(2) > (1) (2) > (3)
	Treatment	76.323	2	38.161		
Perceived benefits	Error	625.011	60	10.417	1.028	—
	Treatment	16.860	2	8.430		
Perceived barriers	Error	491.806	60	8.197	1.151	—
	Treatment	68.581	2	34.290		
Cues to action	Error	1786.753	60	29.779	10.369***	(3) > (1) (3) > (2)
	Treatment	50.000	2	25.000		
Self-efficacy	Error	144.667	60	2.411	21.992***	(2) > (3) > (1)
	Treatment	412.839	2	206.419		
Preventive behavior	Error	563.161	60	9.386	16.674***	(2) > (1) (3) > (1)
	Treatment	573.742	2	286.871		
	Error	1032.258	60	17.204		

df=degree of freedom, F=F-value, MS=mean of square, SS=sum of square, SV=source of variation.

* < 0.05.

** < 0.01.

*** < 0.001.

† (1): Pretest, (2): posttest, (3): post posttest.

significant difference ($P \leq 0.05$) in knowledge, perceived susceptibility, perceived severity, cues to action, self-efficacy, and preventive behaviors as described in Table 2. Post hoc comparison showed that posttest was significantly higher than the other 2 tests in knowledge, perceived susceptibility, perceived severity, self-efficacy, and preventive behaviors; while post posttest was significantly higher than pretest in self-efficacy and preventive behavior. In brief, immediate effect of education program was noted in knowledge, perceived susceptibility, severity, self-efficacy, and preventive behaviors, while delay effect only occurred in self-efficacy and preventive behavior.

The effect in cues to action did not happen until post posttest. There were no effect at all concerning perceived benefits and perceived barriers.

4. Discussion and conclusions

Early diagnosis and early treatment are the most important methods in treating high myopia complications. Personal awareness about high myopia complications is the key point of early diagnosis. Nevertheless, our public health system is short of resources for people to be aware of the symptoms or signs of high myopic complications and how to protect themselves from the complications. In the year of 2006, about 16.85% of third grade high school students in Taiwan were high myopia, and the prevalence was more than 35% in university freshmen at the same time.^[9] Thus, university or college became the most important community to promote health education of high myopia complications prevention.

In this study, the mean scores were increased significantly in knowledge about high myopia complications prevention immediately after educational program, but 6 weeks later there was no significant difference comparing with pretest. According to Ebbinghaus' forgetting curve there was a loss of about two-thirds of memory in a day and only 21.1% remained after 1 month.^[10] Thus, it was not surprising that, after 6 weeks, education information received from our program could not be saved too much to make a difference. It was said that both cognitive and neural mechanisms could support the permanent storage of memory traces.^[11] From a cognitive perspective, Averell and Heathcote^[11] concluded that some memories remain free from the unfavorable effects of interference and recovery cues provided by the environment may provide a mechanism that reduces the interference. Thus, it seemed that multiple or repeated education programs may not be more effective in reviving memory than a warm-care phone call from important others or an environmental cue.

Turning to the results of our study, we found that perceived susceptibility and perceived severity had only immediate effect, while perceived benefits and barriers had no effect at all. An important review of HBM in health behavior studies conducted between 1974 and 1984 revealed perceived barriers was the only one and most powerful predictor of all health behaviors.^[6,7] However it was not quite the story with the respect of perceived barrier under different medical care system. A study in Taiwan, 2.6% of patients had visited specialist of the same department at different hospitals on the same day and such a doctor-shopping behavior ratio increased up to 23.5% in a 7-day time setting.^[12] The main reason was that patients in Taiwan can go to any hospitals or clinics for their own convenience without any transfer or appointment. And the reimbursement based on a fee-for-service is not high enough (ranging from 1.5 USD to 15 USD) to be a barrier for people who want to seek more consultations.^[12,13]

We would speculate that those results for perceived susceptibility, perceived severity, and perceived benefits in our study may be due to difficulties that study respondents have in conceptualizing these dimensions. These difficulties may be caused by the respondents being asymptomatic, not perceiving the health threats, or having little or no personal experience in such medical conditions.^[7] Temporary rise in perceived threats may just due to images introduced in our education program, especially in part 1 and 2. It seemed that, according to the discussion above, HBM model may not suitable for predicting preventive behavior if the respondents are asymptomatic and the causal relationships are more complicated or specialized.^[13]

In our study, cues to action showed significant difference in post posttest. It was probably due to sleeper effect. The works of Pratkanis et al,^[14] which were examined and verified by Kumkale and Albarracín,^[15] produced data that documented and explained the sleeper effect. They found that memory of the "discounting cue" (information that the messenger was unreliable) disappeared more quickly than memory of the message. Naturally, when the negative information about the source was forgotten, but the message itself was remembered, the message gained more credibility. Thus, after a period of time, persuasive message of intervention program will make respondents pay more attention to information of high myopic complications and prevention issues.

Self-efficacy refers to people's judgments regarding their ability to perform a given activity^[16,17] and is proposed to influence individual choices, goals, emotional reactions, effort, ability to cope, and persistence.^[18] Many researches have shown that self-efficacy is the main determinant of preventive health behaviors.^[19,20] According to studies of Bandura^[17] and Schunk,^[21] there are 4 types of interventions could affect self-efficacy: enactive attainments, perceived similarity to models, verbal persuasion, and feedback. Observing a coping model improved more self-efficacy for learning, motivation, and long lasting self-efficacy and skill, than observing a mastery model did.^[21] One type of the coping models, coping-emotive model, directed to the highest self-efficacy for learning because subjects viewed themselves more competent than or not inferior to the model.^[21] The belief that one is more talented than a model can raise self-efficacy and motivation to engage task.^[21] In the third part of our program, students had informal talks with 2 patients who had overcome retinal detachment caused by high myopia. It was speculated that through the interventions of perceived similarity to models and feedback, the respondents raised their self-efficacy and motivation.

According to Bandura's theory,^[16] one's sense of efficacy is the single and the most necessary motivational element, moving individuals to action. However, self-efficacy is not the only influence on behavior. High self-efficacy will not produce a competent performance when requisite knowledge and skill are lacking.^[21] In our study, from picking wrong moves in a 5-section video which was recorded based on high myopia complications preventive concepts, self-efficacy and preventive skill of respondents were promoted.

Also, outcome expectations, or beliefs concerning the probable outcomes of actions, are important because people always go for positive outcomes. There were studies provided evidence that both outcome expectancies and perceived self-efficacy were the best couple predictors of the motivation in regular breast cancer detection behaviors,^[22,23] and prostate cancer screening.^[24] In our study, through lecturing and informal discussion with victims of high myopia complications, respondents realized the benefits of regular check-ups and good outcome expectations were speculated to enforce self-efficacy.

As in high myopia complications, early detection and early treatment will reveal good prognosis. In our education program, we not only clarified knowledge about high myopic complications and prevention methods, but presented real models of high myopic complications patients who went through the task of examinations and treatments with good outcomes. Post hoc comparison showed only self-efficacy and preventive behavior intention had delay effect 6 weeks after intervention program. It was probably, according to the discussion above, due to improvement of knowledge, outcome expectancy, and self-efficacy after intervention program.

In conclusion, 1 session of education program could transmit prevention knowledge of high myopia complications, rise temporary perceived threats, induce a sleeper effect of cues to action, and promote a 6 weeks' self-efficacy coupled with prevention behavior intentions. Long-term changes in behavior could be expected with repeated education programs, goal progress feedback, and appropriate environmental cues. Major variables of HBM (perceived susceptibility, perceived severity, perceived benefits, and perceived barriers) were not quite distinguishable in our study. Unlike the well-established causal relationships studies (such as breast self-examination and early detection of breast cancer,^[25] condom use and reduced sexual transmission diseases^[26]), theories other than HBM may be more suitable in predicting some highly specialized preventive behavior of asymptomatic respondents. Further educational programs should be designed with more emphasis on positive aspects of high myopic complications prevention behavior and with the aims of raising knowledge, attitude, and self-efficacy level of individuals. Besides, repeat sessions and environmental cues after educational programs would be also valuable.

There are several limitations of our study, as the sample size was not large enough, self-estimate and repeated questionnaire may be interfered by memory, interpretation error, or questionnaire itself. This was a study of a group of college freshmen with high myopia, the results could only represent the behavior changes of the population.

References

- [1] Wong TY, Klein BEK, Klein R, et al. Refractive errors and incident cataracts: the beaver dam eye study. *Invest Ophthalmol Vis Sci* 2001;42:1449–54.
- [2] Younan C, Mitchell P, Cumming RG, et al. Myopia and incident cataract and cataract surgery: the blue mountains eye study. *Invest Ophthalmol Vis Sci* 2002;43:3625–32.
- [3] Marcus MW, de Vries MM, Montolio FJ, et al. Myopia as a risk factor for open-angle glaucoma: a systematic review and meta-analysis. *Ophthalmology* 2011;118:1989–94.
- [4] Perkins ES. Morbidity from myopia. *Sight Sav Rev* 1979;49:11–9.
- [5] Ohno-Matsui K, Yoshida T, Futagami S, et al. Patchy atrophy and lacquer cracks predispose to the development of choroidal neovascularization in pathologic myopia. *Br J Ophthalmol* 2003;87:570–3.
- [6] Janz NK, Becker MH. The health belief model: a decade later. *Health Educ Q* 1984;11:1–47.
- [7] Champion VL, Skinner CS, Glanz K, Rimer BK, Viswanath K. The health belief model. *Health Behavior and Health Education: Theory, Research, and Practice*. San Francisco: Jossey-Bass Publisher; 2008. 45–66.
- [8] Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. 1988; New Jersey: Hillsdale, 273–406.
- [9] Wang TJ, Chiang TH, Wang TH, et al. Changes of the ocular refraction among freshmen in National Taiwan University between 1988 and 2005. *Eye* 2008;2:1168–9.
- [10] Murrie JM, Dros J. Replication and analysis of Ebbinghaus' forgetting curve. *PLoS ONE* 2015;10:1–23.
- [11] Averell L, Heathcote A. The form of the forgetting curve and the fate of memories. *J Math Psychol* 2011;55:25–35.
- [12] Chen TJ, Chou LF, Hwang SJ. Patterns of ambulatory care utilization in Taiwan. *BMC Health Serv Res* 2006;6:1–8.
- [13] Tseng GL, Chen CY. Doctor-shopping behavior among patients with eye floaters. *Int J Environ Res Public Health* 2015;12:7949–58.
- [14] Pratkanis AR, Greenwald AG, Leippe MR, et al. In search of reliable persuasion effects: III. The sleeper effect is dead: long live the sleeper effect. *J Pers Soc Psychol* 1988;54:203–18.
- [15] Kumkale GT, Albarracín D. The sleeper effect in persuasion: a meta-analytic review. *Psychol Bull* 2004;130:143–72.
- [16] Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev* 1977;84:191–215.
- [17] Bandura A. Self-efficacy mechanism in human agency. *Am Psychol* 1982;37:122–47.
- [18] Gist ME, Stevens CK, Bavetta AG. Effects of self-efficacy and post-training intervention on the acquisition and maintenance of complex interpersonal skill. *Pers Psychol* 1991;44:837–61.
- [19] Schwarzer R. Schwarzer R. Self-efficacy in the adoption and maintenance of health behaviors: theoretical approaches and a new model. *Hemisphere, Self-efficacy: Thought Control of Action*. Washington, DC:1992.
- [20] Schwarzer R, Fuchs R, Conner M, Norman P. Self-efficacy and health behaviors. Open University Press, *Predicting Health Behaviors*. Buckingham, UK:1996.
- [21] Schunk DH. Self-efficacy, motivation, and performance. *J Appl Sport Psychol* 1995;7:112–37.
- [22] Meyerowitz BE, Chaiken S. The effect of message framing on breast self-examination attitudes, intentions, and behavior. *J Pers Soc Psychol* 1987;52:500–10.
- [23] Seydel E, Taal E, Wiegman O. Risk-appraisal, outcome and self-efficacy expectancies: cognitive factors in preventive behavior related to cancer. *Psychol Health* 1990;4:99–109.
- [24] Cormier L, Kwan L, Reid K, et al. Knowledge and beliefs among brothers and sons of men with prostate cancer. *Urology* 2002;59:895–900.
- [25] Moodi M, Mood MB, Sharifrad GR, et al. Evaluation of breast self-examination program using Health Belief Model in female students. *J Res Med Sci* 2011;16:316–22.
- [26] Asare M, Sharma M, Bernard AL, et al. Using the health belief model to determine safer sexual behavior among African immigrants. *J Health Care Poor Underserved* 2013;24:120–34.