Article ▸ Cell Phone Viewing Distance and Age in a Chinese Population

Min Lan, MS, Department of Optometry & Visual Science, West China Hospital, Sichuan University, Chengdu, China

Mark Rosenfield, MCOptom, PhD, SUNY College of Optometry, New York, New York

Longqian Liu, MD, Department of Optometry & Visual Science, West China Hospital, Sichuan University, Chengdu, China

ABSTRACT

Background: A previous study from our laboratory demonstrated that the average viewing distance adopted when viewing a smartphone in American subjects was closer than the reading distance typically found when viewing printed materials. Given the very high prevalence of myopia in China (approaching 90% in some areas), the aim of this investigation was to measure the mean cell phone viewing distance in a Chinese population, and to examine the effect of age on this parameter.

Methods: 207 Chinese subjects were instructed to view a text message on their cell phone, and to hold the device as if they were about to read the text. The distance from the phone to the spectacle plane was measured using a rigid tape measure.

Results: The mean viewing distance was 33.95cm (SD = 5.90cm, range 19.0 - 51.3cm). A weak but significant positive correlation ($r = 0.24$, $p < 0.0001$) was found between age and viewing distance. No significant difference in viewing distance was observed when comparing spectacle (N=84) versus non-spectacle (N = 123) wearers ($p = 0.91$).

Conclusions: These findings confirm the previous results that modern cell phones are held at closer viewing distances than printed materials. Further, the mean viewing distance adopted in a Chinese population was over 2cm closer than that found in American subjects. This increased demand on both ocular accommodation and vergence compared with hardcopy materials could be responsible for symptoms of digital eye strain commonly experienced in many individuals.

Keywords: accommodation, cell phone, computer vision syndrome, digital eye strain, myopia

Introduction

In recent years, the use of computers and digital electronic devices for both vocational and non-vocational activities including e-mail, internet access, and entertainment has become almost universal in the developed world.[1] A recent study estimated that approximately 95% of Americans own some kind of cell phone, and about 77% of the population own smartphones.[2] When considering individuals between 18 and 29 years of age in Spain, the percentage owning a cell phone or smartphone is approximately 100% and 92%, respectively.[3] In China, it is estimated that there are over 600 million smartphone users.[4] It has been suggested that the extended periods of time that many young individuals spend viewing small fonts on digital screens at relatively close distances may be a factor in the development of a variety of symptoms, which have collectively been referred to as either computer vision syndrome or digital eye strain (DES).[5] The latter term is preferable, since many users do not consider hand-held devices such as smartphones, tablet computers, and electronic reading devices to be computers.

In addition, it has been hypothesized that the sustained viewing of digital screens may play a role in the development of myopia.[5] A previous study from our laboratory demonstrated that the average viewing distance adopted when viewing a smartphone in American subjects between 18 and 39 years of age was 36.2cm.[6] This is closer than the reading distance typically found when viewing printed materials,[7] and therefore represents a higher stimulus to both ocular accommodation and convergence. Given the very high prevalence of myopia in China (approaching 90% in some areas[8]), the aim of this study was to examine whether the mean cell phone viewing distance in a Chinese population was closer than that found in the U.S.A., and to examine the effect of age on this parameter.

Methods

Two hundred and seven subjects from Chengdu, Sichuan Province were tested. They ranged in age from 16 to 74 years, with a mean age of 34 years (SD = 10.9 years). Subjects wore their habitual refractive correction (either spectacles or contact lenses) and were asked if they used a smart phone. If they replied in the affirmative, they were asked to show the examiner a typical text message (in Chinese characters) on their own personal phone. Subjects were instructed to hold the device as they normally would if they were about to read the text. All subjects wore their habitual refractive correction during the trial. The distance from the phone to the spectacle plane was measured using a rigid tape measure.

Results

The mean viewing distance was 33.95cm (SD = 5.90cm, range 19.0 - 51.3cm). A plot of the smartphone viewing distance as a function of age is shown in Fig. 1. A weak but

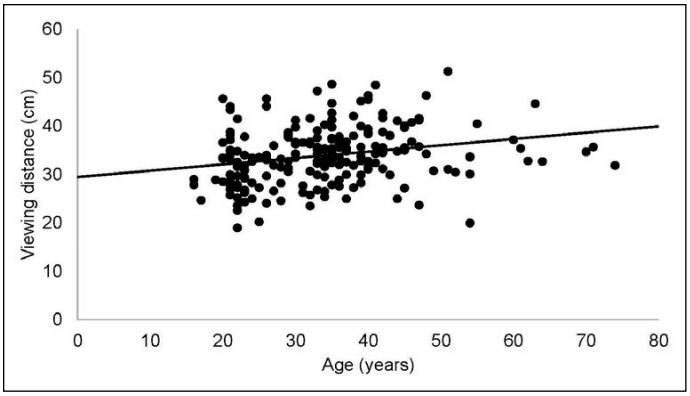

Figure 1. *Cell phone viewing distance as a function of age. A weak but significant correlation was observed (r = 0.24; p < 0.0001). The data can be described by the regression equation: viewing distance = (0.131 * age) + 29.49.*

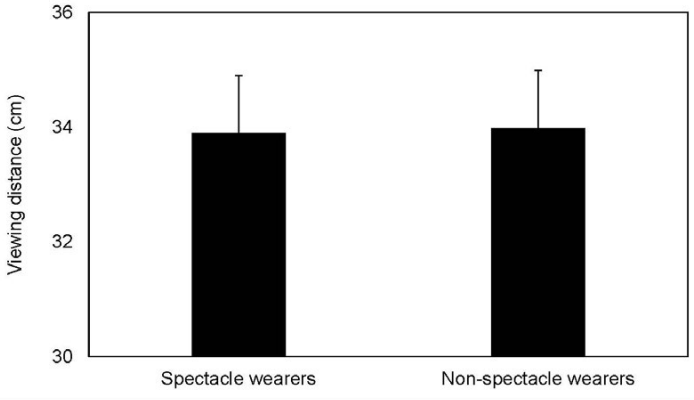

Figure 2. *Mean smartphone viewing distance for spectacle wearing (N = 84) and non-spectacle wearing (N = 123) subjects. Error bars indicate 1 SEM.*

significant correlation was observed (r = 0.24; p < 0.0001). The data can be described by the linear regression equation: viewing distance = (0.131 * age) + 29.49. In addition, the mean viewing distance for subjects wearing spectacles (N = 84) versus non-spectacle wearers (N = 123) is shown in Fig. 2. One-factor analysis of variance indicated that the difference between these two groups was not significant (F = 0.01; df = 1, 206; p = 0.91).

Discussion

These findings confirm our previous results that modern cell phones are held at closer viewing distances than the typical near working distance of 40cm (i.e., an accommodative and vergence stimulus of 2.50D or meter angles, respectively) for adults viewing hardcopy text.[4,6,7] This closer distance places increased demand upon both ocular accommodation and vergence. The mean distance observed here represents an accommodative and vergence demand of approximately 2.95D or meter angles, respectively. However, the exact value can only be approximated since some degree of uncorrected refractive error may have been present. Nevertheless, these closer viewing distances, especially if maintained for an extended period of time, could exacerbate symptoms when compared with printed materials.[7,8]

It should be noted that subjects wore their habitual refractive correction during the measurement procedure, and since they did not undergo a refractive examination, we did not determine whether this was the optimal correction either at distance or near. Accordingly, it is possible that closer working distances were adopted due to either uncorrected myopia (or overcorrected hyperopia) or a high near addition lens. On the other hand, it is equally possible that subjects adopted a longer working distance due to other uncorrected refractive errors.

The mean viewing distance found in a Chinese population was over 2cm closer than that previously observed in American subjects. Only a small increase in viewing distance was noted with age, presumably due to the onset of clinical presbyopia. Indeed, the mean age of subjects in the present investigation (34 years) was markedly higher than that of the previous United States-based study (mean = 23 years).[4] Based on the effect of age, one might have predicted a longer working distance in the older Chinese population, which is the opposite of what was actually observed. Given that an increased lag of accommodation is expected at higher accommodative stimulus levels, the closer distances adopted when using smart phones for an extended period of time, when compared with hardcopy text, may induce a larger accommodative error and possibly greater fatigue.

One might question whether the closer viewing distances found in Chinese subjects related to the higher prevalence of myopia in this population or were due to the greater complexity of Chinese characters. Unpublished data from our laboratory found no significant difference between the accommodative responses of native English, Korean, or Chinese observers viewing letters written in these 3 alphabets. Such a conclusion is consistent with the findings of both Yeo et al.[9] and Radhakrishnan et al.,[10] who also observed similar accommodative responses to Chinese and English letters. Although Chinese characters do not stimulate a shift in accommodation when viewed at the same working distance as English letters, their more elaborate formations may necessitate a closer viewing distance in order to improve visual resolution. This will, in turn, increase the stimulus to accommodation and vergence. Other environmental factors that could have influenced the working distance include screen size and luminance, font size, and ambient illumination. None of these were controlled in the present investigation. However, the aim of this study was to test subjects under natural viewing conditions, not in a controlled laboratory environment. Nevertheless, it is possible that the subjects did indeed adjust their working distance, knowing that it was going to be quantified.

In considering whether the closer viewing distance could be a precursor to myopia development, previous work has shown mixed results. For example, two investigations[11,12] of myopia development reported that greater myopia was associated with close reading distances (defined as <30cm[11]

and <20cm,[12] respectively). However, Lee et al. found that while anisometropic children were more likely to adopt closer viewing distances during near work, these associations became insignificant after adjustment for ocular, demographic, and parental factors.[13]

The use of electronic devices to view small type for many hours, frequently at close working distances, has become commonplace in modern society for patients of all ages. These present a variety of visual demands that are significantly different from those of printed materials in terms of working distances, gaze angle, and text sizes. It is no longer reasonable to assume that a patient will read text at a viewing distance of approximately 40cm with their eyes depressed. Accordingly, a careful history is required in patients of all ages to determine the working distance(s) being adopted, and practitioners should consider performing refractive and binocular testing at these distances during the clinical eye examination.

Acknowledgement

None of the authors has a financial interest in any of the devices tested in this study.

References

1. https://pewrsr.ch/2PSCx30
2. http://bit.ly/2ybd11w
3. Fernández-Montero A, Olmo-Jimenez JM, Olmo N, Bes-Rastrollo M, et al. The impact of computer use in myopia progression: A cohort study in Spain. Prev Med 2015;71:67-71.
4. Bababekova Y, Rosenfield M, Huang RR, Hue JE. Font size and viewing distance of hand-held smart phones. Opt Vis Sci 2011;88:795-7.
5. He M, Zheng Y, Xiang F. Prevalence of Myopia in Urban and Rural Children in Mainland China. Optom Vis Sci 2009;86:40-4.
6. Bailey IL. Visual acuity. In: Benjamin WJ (ed). Borish's Clinical Refraction (2nd ed). St Louis , MO: Butterworth Heinemann, 2006: 217-46.
7. Rah MJ, Mitchell GL, Bullimore MA, Mutti DO, Zadnik K. Prospective quantification of near work using the experience sampling method. Optom Vis Sci 2001;78:496-502.
8. Rosenfield M. Computer vision syndrome: A review of ocular causes and potential treatments. Ophthal Physiol Opt 2011;31,502-15.
9. Yeo ACH, Atchison DA, Schmid KL. Children's accommodation during reading of Chinese and English texts. Optom Vis Sci 2013;90:156-63.
10. Radhakrishnan H, Hartwig A, Charman WN, Llorente L. Accommodation response to Chinese and Latin characters in Chinese-illiterate young adults. Clin Exp Optom 2015;98:527-33.
11. Ip JM, Saw SM, Rose KA, Morgan IG, et al. Role of near work in myopia: Findings in a sample of Australian school children. Invest Ophthalmol Vis Sci 2008;49:2903-10.
12. Li SM, Ki SY, Kang MT, Zhou Y, et al, Anyang Childhood Eye Study Group. Near work related parameters and myopia in Chinese children: The Anyang childhood eye study. PLoS One 2015;10(8):e0134514.
13. Lee CW, Fang SY, Tsai DC, Huang N, et al. Prevalence and association of refractive anisometropia with near work habits among young schoolchildren: The evidence from a population-based study. PLoS One 2017;12(3):e0173519.

Correspondence regarding this article should be emailed to Mark Rosenfield, MCOptom, PhD, at mrosenfield@sunyopt.edu.

Lan M, Rosenfield M, Longqian L. Cell phone viewing distance and age in a Chinese population. Optom Vis Perf 2018;6(5):204-6.

The online version of this article contains digital enhancements.