

# Survey of satisfaction of contact lens wearers: Development, validation and reliability

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## Abstract

**Aim:** To develop and validate a survey for the measurement of the effect of contact lenses on ocular physiological parameters, visual functions, appearance, and socioeconomic and psychological factors.

**Material and Methods:** Between September 2018 and July 2019, 392 participants who applied to Erzincan University Faculty of Medicine Department of Ophthalmology were included in the study. All patients were contact lens users at least one year. Participants were aged 18 or above. A questionnaire containing 36 questions was created and distributed to contact lens users. All participants answered the questionnaire completely.

**Results:** Of the 392 respondents, 202 (51.5%) were male and 190 (48.5%) were female. The total scores of correlations of 36 items ranged from 0.310 to 0.598. Factor loads ranged from 0.359 to 0.770 and all were considered statistically significant. (KMO: 0.878  $p < 0.001$ ) The questionnaire was divided into three subgroups: ocular and visual effects, appearance and socioeconomic and psychological factors. Cronbach's  $\alpha$  for the correlation of items within the three subscales were 0.927 for ocular and visual effects, 0.929 for appearance and 0.892 for socioeconomic and psychological factors subscale and this shows the survey is reliable.

**Conclusion:** The contact lens satisfaction survey was meticulously developed using both exploratory factor analysis and Rasch analysis to assure good content validity, internal consistency, and a low answering load. Our contact lens satisfaction survey can be used for contact lens users aged 18 years and above who have been using contact lenses for at least 1 year.

**Keywords:** Contact lens; survey; satisfaction; wearer; development

## INTRODUCTION

The desire to correct the refractive errors is perhaps as old as human history. For centuries people have used a variety of tools to have good vision (1). In our era, the use of high-tech contact lenses is increasing day by day (2-6). In addition to correcting refractive defects, contact lenses cause various ocular surface problems, which leads to dissatisfaction in contact lens wearers (6,7). Patient satisfaction surveys are available in many medical branches (8-11). In ophthalmology, there are questionnaires evaluate the effects of visual function and contact lens wearing on quality of life (12-19).

The aim of our study was to create a questionnaire that measures the satisfaction of contact lens wearers.

## MATERIAL and METHODS

### Recruitment of participants and outcome variables

Contact lens wearers who applied to Erzincan University Ophthalmology Department between September 2018 and July 2019 were included in the study. Approval obtained from Ethics Committee of Erzincan University Faculty of Medicine. Informed consent was obtained from all patients. Participants were aged 18 and above. The principles of the Declaration of Helsinki were followed during the conducting of the study. The participants of survey answered the questions such as name, surname, gender, age, duration of wearing of contact lenses and level of the education before starting the questionnaire.

### Creation of the survey

A wide literature review and the opinions of corneal

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and ocular surface experts were also taken and survey questions were formed. As a result, a questionnaire containing 36 questions was created and answered to contact lens users. Participants who did not answer all questionnaire questions were not included in the study. After answering the questionnaire questions, a 3-factor questionnaire emerged as a result of factor analysis and no questionnaire questions were required to exclude as a result of the analyzes. Questions 1 through Question 16 were related to ocular and visual effects. Questions 17 to 23 were questions about appearance. Questions 24 to 36 were questions related to socioeconomic and psychological factors. Each question had five options. These options varied as very little, less, medium, more, too much. According to the characteristics of the questions, scores were given from 1 to 5 for each question from negative to positive.

### Statistical Analysis

Exploratory factor analysis was performed to test structural validity, using the robust weighted least squares mean and variance-adjusted estimator. Factor loadings and model fit were examined to confirm the tridimensionality of the survey. Factor loadings represent the correlation between the items in the survey and the factors (the underlying dimensions). Comparable to Pearson R, the squared factor loading is the percent of variance in that indicator variable explained by the factor. Factor loadings are generally considered to be meaningful when they exceed 0.30 or 0.40. KMO (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) and Bartlett's tests were performed. KMO test value > 0.6 and Bartlett's test significant value < 0.05 were considered significant for factor analysis. Test re-test reliability was then assessed using intraclass correlation coefficients (ICCs). ICC is calculated by dividing the variation in the population (inter-individual variation) by the total variation (the sum of inter-individual variation and intra-individual variation), and expressed as a ratio between 0 and 1. An ICC > 0.7 is often considered the minimum standard for reliability (20). Floor and ceiling effects are considered present if more than 15% of respondents achieve the lowest or highest possible score, respectively.

### Sample size

Factor analysis requires a relatively large sample size. Recommendations vary from 5–7 patients per item and at least 100 patients (21). In the study, the survey contains 36 questions which have five item answers. The numbers of participants were 392 and this was enough to analyze. This study aimed to recruit at least 180 patients. For test-retest reliability evaluation the survey should be re-filled in 2–4 weeks, a typical interval for reliability testing (22).

### Rasch rating scale model

A major drawback of Cronbach's  $\alpha$  in evaluating internal consistency is its sensitivity to covariance between matter pairs but not to the relative difficulties of different matters. Clearly, relative difficulty of the matters (reflected in the matter measures) is significant in determining whether two

questionnaires are similar. Rasch analysis was, therefore, applied to determine whether the item measures in the two questionnaires are similar (23). Person reliability was assessed by the Rasch rating scale model (RSM) and estimated parameters (item difficulties) were derived from the "eRm" package available on R software version 3.2.5 (The R Project for Statistical Computing, Vienna, Austria). All items in the RSM could be equally discriminant and have the same number of response categories (24). Infit and outfit mean square (MNSQ) statistics were used to explore the contribution adequacy of all items into their own domain. The infit MNSQ is a weighted mean square residual statistic that is sensitive to unexpected responses of persons whose abilities are near item difficulty, but outfit is an unweighted MNSQ residual being more sensitive to unexpected outlying observations (23). Infit and outfit MNSQ values > 1.4 indicate that the item fails to define the same construct as the other items do in a domain, values < 0.6 may be an indication of item redundancy, and values about 1.0 are ideal.

## RESULTS

Of the 392 respondents, 202 (51.5%) were male and 190 (48.5%) were female. When the education levels of the participants were investigated, 20 (5.1%) participants had primary education, 70 (17.9%) participants had secondary education, 192 (49%) patients had undergraduate and 110 (28%) patients had graduate education. When the participants were analyzed according to age groups, 54 (13.8%) participants were between 18-24 years old, 146 (37.2%) participants were between 25-32 years old, 134 (34.2%) participants were between 33-39 years old and 58 (14.8%) participants were 40 years old and above. When the participants were evaluated according to the contact lenses using time, 100 (25.5%) participants were using contact lenses between 1-2 years, 140 (35.7%) participants were contact lens users between 2-3 years, 58 (14.8%) participants were contact lens users between 3-5 years and 94 (24%) participants were using contact lenses more than 5 years.

Factor analysis including factor load for the three domains of the survey of satisfaction of contact lens wearers are shown in Table 1.

Item difficulty, item calibration, infit and outfit mean square (MNSQ) statistics for each item of the survey of satisfaction of contact lens wearers are shown in Table 2.

### Validity

To check structure validity, a factor analysis with a maximum 3-factor solution was developed to confirm factor loading of each item with its domain.

In order to perform factor analysis, KMO (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) and Bartlett's tests were performed. The total scores of correlations of 36 items ranged from 0.310 to 0.598. Factor loads ranged from 0.359 to 0.770 and all were considered statistically significant. (KMO:0.878  $p < 0.001$ ) (Table 1)

**Table 1. Factor analysis including factor load for the three domains of the survey of satisfaction of contact lens wearers**

| Domain  | Factor load |
|---|-------------|
| <b>Domain 1. Ocular and visual effects</b>                |             |
| Q1: Eye redness   | 0,598       |
| Q2: Eye grittiness  | 0,717       |
| Q3: Contact lens clinging to eye                          | 0,662       |
| Q4: Feeling tired of eyes                                 | 0,715       |
| Q5: Change in vision quality during the day               | 0,584       |
| Q6: Sensitivity to sunlight                               | 0,505       |
| Q7: Difficulty in activities under dim lighting           | 0,584       |
| Q8: Difficulty in driving in glare conditions             | 0,534       |
| Q9: Accomodation problem                                  | 0,600       |
| Q10: Need of using artificial tear drops                  | 0,562       |
| Q11: Lack of good vision                                  | 0,579       |
| Q12: Vision being not as good as it could be              | 0,367       |
| Q13: Eye irritation                                       | 0,613       |
| Q14: Blurry vision with focus on fixed point              | 0,591       |
| Q15: Contact lens adhesion to eye in hot environment      | 0,566       |
| Q16: Decreasing in vision and comfort later in the day    | 0,476       |
| <b>Domain 2. Appearance</b>                               |             |
| Q17: Self confidence                                      | 0,692       |
| Q18: Feel delighted                                       | 0,633       |
| Q19: Feel complimented                                    | 0,662       |
| Q20: Feel being approved by social environment            | 0,546       |
| Q21: Working easily in daily life                         | 0,770       |
| Q22: Wearing contact lens more comfortable                | 0,726       |
| Q23: Socializing easily                                   | 0,652       |
| <b>Domain 3. Socioeconomic and psychological factors</b>  |             |
| Q24: Difficulty in sport and trip                         | 0,509       |
| Q25: Difficulty in care of contact lenses                 | 0,593       |
| Q26: Difficulty in wear and remove contact lenses         | 0,600       |
| Q27: Wearing contact lens while traveling                 | 0,517       |
| Q28: Affording contact lens costs                         | 0,428       |
| Q29: Unexpected costs when using contact lenses           | 0,500       |
| Q30: Concern about eye infections                         | 0,517       |
| Q31: Concern about eye allergies                          | 0,476       |
| Q32: Buying contact lenses in short time when needed      | 0,686       |
| Q33: Difficulty in having proper number of contact lenses | 0,541       |
| Q34: Thinking to change the brand of contact lenses       | 0,638       |
| Q35: Regular eye exam for receiving contact lenses        | 0,359       |
| Q36: Difficulty in going to eye exam regularly            | 0,497       |

**Table 2. Item difficulty,item calibration, infit and outfit mean square (MNSQ) statistics for each item of the survey of satisfaction of contact lens wearers**

| Domain                             | Item | Infit MNSQ(SD) | Outfit MNSQ(SD) | Item difficulty | Item calibration(SE) |
|------------------------------------|------|----------------|-----------------|-----------------|----------------------|
|                                    | Q1   | 1,01(0.4)      | 1,12(0.5)       | 0,12            | 41.8(1.0)            |
|                                    | Q2   | 0,91(-0.7)     | 0,94(-0.6)      | 0,16            | 44.2(1.2)            |
|                                    | Q3   | 0,89(0.5)      | 0,90(1.1)       | 1,11            | 41.2(1.1)            |
|                                    | Q4   | 1,21(-1.1)     | 1,14(-0.9)      | 1,24            | 43.5(1.3)            |
|                                    | Q5   | 0.78(0.3)      | 0.87(0.2)       | 2.10            | 44.3(1.2)            |
|                                    | Q6   | 0,82(-2.0)     | 0.88(-1.3)      | -0.42           | 48.5(1.1)            |
|                                    | Q7   | 1.06(0.6)      | 1.19(1.4)       | 1.37            | 40.9(0.9)            |
| <b>Ocular &amp; visual effects</b> | Q8   | 1.10(0.5)      | 1.09(0.7)       | 1.12            | 44.6(1.2)            |
|                                    | Q9   | 1.29(0.7)      | 1.22(0.4)       | 4.12            | 43.8(1.0)            |
|                                    | Q10  | 1.18(0.8)      | 1.11(1.1)       | 1.60            | 53.3(1.1)            |
|                                    | Q11  | 1.27(0.9)      | 1.23(0.8)       | 1.50            | 40.1(0.8)            |
|                                    | Q12  | 1.09(-1.2)     | 1.03(0.3)       | 1.37            | 49.1(1.4)            |
|                                    | Q13  | 1.17(1.8)      | 1.16(1.6)       | 1.74            | 51.6(1.1)            |
|                                    | Q14  | 0.93(-0.6)     | 0.97(-0.5)      | 0.63            | 44.4(1.0)            |
|                                    | Q15  | 1.02(0.2)      | 1.01(0.1)       | 0.90            | 49.6(1.1)            |
|                                    | Q16  | 0.83(0.1)      | 0.88(0.3)       | 1.79            | 41.2(1.3)            |
|                                    | Q17  | 0.96(-0.3)     | 0.93(-0.2)      | -0.90           | 42.1(0.8)            |
|                                    | Q18  | 0.90(-1.2)     | 0.89(-1.1)      | -0.84           | 52.1(0.9)            |
|                                    | Q19  | 1.11(0.2)      | 1.14(0.4)       | -0.35           | 40.0(1.1)            |
| <b>Appearances</b>                 | Q20  | 1.09(0.4)      | 1.12(0.6)       | -0.12           | 48.5(1.3)            |
|                                    | Q21  | 1.17(1.8)      | 1.16(1.7)       | -1.36           | 51.7(0.7)            |
|                                    | Q22  | 1.24(-0.3)     | 1.09(-0.4)      | -0.42           | 48.5(1.1)            |
|                                    | Q23  | 1.00(0.0)      | 1.00(0.0)       | -0.03           | 54.2(0.9)            |
|                                    | Q24  | 1.02(0.3)      | 0.99(-0.2)      | 2.21            | 48.9(1.0)            |
|                                    | Q25  | 0.90(-1.1)     | 0.95(-0.9)      | 0.35            | 42.1(1.2)            |
|                                    | Q26  | 0.83(-2.0)     | 0.88(-1.3)      | 4.09            | 43.0(1.4)            |
|                                    | Q27  | 1.20(1.3)      | 1.15(1.2)       | 1.11            | 44.6(0.9)            |
|                                    | Q28  | 1.04(0.4)      | 1.05(0.5)       | 2.60            | 56.9(1.0)            |
|                                    | Q29  | 1.10(1.0)      | 1.08(1.1)       | 0.86            | 49.5(1.2)            |
| <b>Socioeconomic factors</b>       | Q30  | 0.73(2.8)      | 0.74(2.6)       | -1.36           | 47.3(0.9)            |
|                                    | Q31  | 0.92(-0.9)     | 0.95(-0.4)      | -1.00           | 54.8(0.9)            |
|                                    | Q32  | 1.15(-1.0)     | 1.17(-0.7)      | -0.03           | 52.1(1.1)            |
|                                    | Q33  | 1.25(-0.9)     | 1.18(0.2)       | 1.12            | 47.4(0.7)            |
|                                    | Q34  | 1.22(1.4)      | 1.48(1.3)       | 0.04            | 48.1(0.9)            |
|                                    | Q35  | 1.16(0.9)      | 1.18(0.8)       | 0.38            | 51.2(1.3)            |
|                                    | Q36  | 0.96(0.4)      | 1.2(0.5)        | 0.42            | 54.4(1.4)            |

## Reliability

Reliability touch on the degree to which the measurement instrument is free from measurement error (25). It estimates how much scores for patients in stable health conditions tend to change in repeated measurements, e.g. by using different sets of items from the same measurement instrument (internal-consistency) or across time (test–retest reliability) (26). Cronbach's  $\alpha$  for the correlation of items within the three subscales were 0.927 for ocular and visual effects, 0.929 for appearance and 0.892 for socioeconomic and psychological factors subscale.

## Floor and ceiling effects

No significant ceiling or floor effects were observed for appearance score.

## DISCUSSION

The availability and popularity of contact lenses keep being on the rise day by day for individuals with refractive errors (27,28). Furthermore, there is a sustained development in the contact lens technology and there is an extending range of varieties (4,5).

With the use of contact lenses becoming more common day by day, patients' comfort expectations and manufacturers' efforts to produce contact lenses suitable for ocular physiology are also increasing. Contact lens manufacturers also want to know the comfort of the contact lens they produce. For this purpose, it seems reasonable to ask specific questions to contact lens users after specific tests, expert opinions and detailed statistical analyzes.

Measuring the satisfaction of contact lens wearers is crucial to assessing the outcome of the developmental efforts for producing comfortable contact lenses. Pesudovs et al. prepared a 28-question questionnaire that evaluated the effect of contact lens use on quality of life in their study and these questionnaire questions were related to the comfort of use of the contact lenses in daily life and individual well-being (29). In our study, the questionnaire included more extensive questions such as ocular and visual effects, appearances and socioeconomic and psychological factors. Thus, it is possible to understand the comfort of the contact lenses more successfully in contact lens wearers.

When creating a questionnaire, it is important to base it on a strong and effective statistical analysis. As a result of exploratory factor analysis conducted during the questionnaire process, factor loads showed strong results (exceed 0.30, ranged 0.359 to 0.770). Even this study aimed to recruit at least 180 patients, 392 participants were accepted the study and this can be the cause of the strong statistical results. Also as a result of the test reliability analysis, Cronbach alpha reliability coefficients were 0.927 for ocular and visual effects, 0.929 for appearance and 0.892 for socioeconomic and psychological factors subscale. These represent the almost excellent results

for a reliability test of a questionnaire (Cronbach alpha  $\geq 0.9$ ). Item difficulty and infit and outfit MNSQ results determined by Rasch analysis showed that this contact lens questionnaire can be used in clinical practice easily. Infit and outfit mean square (MNSQ) statistics are used to explore the contribution adequacy of all items into their own domain. Infit and outfit MNSQ values  $>1.4$  indicate that the item fails to define the same construct as the other items do in a domain, values  $<0.6$  may be an indication of item redundancy, and values about 1.0 are ideal. In this study, infit and outfit MNSQ values ranged between 0.6 to 1.4 and the results showed the good structure of the questionnaire.

Another feature of the contact lens satisfaction survey that we created is that it is the first contact lens questionnaire created in Turkish. Thus, the lack of satisfaction survey of contact lens users in Turkish will be eliminated. It is thought that the satisfaction survey of the contact lens wearers is not a foreign language translation, but the one-to-one Turkish version provides ease of understanding and answering the questions for the respondents.

According to the assessments suggested by de Boer et al. the psychometric properties of survey of satisfaction of contact lens wearers were shown to be of high quality (30). Item selection included a thorough literature review and the input of patients, clinicians, and focus groups. As a result of the statistical analysis conducted in the 36-question questionnaire prepared for patients wearing contact lenses, no questions had to be removed and this is an indicator of how carefully the questions were prepared.

The major limitation of our study may be the lack of contact lens wearers who have been using contact lenses for less than 1 year. However, the fact that contact lens wearers have not been included in the study for a short period of 1 year is concerned that these people do not provide sufficient objectivity in the evaluation of the survey questions because they have little experience with the use of contact lenses.

## CONCLUSION

The contact lens satisfaction survey was meticulously developed using both exploratory factor analysis and Rasch analysis to assure good content validity, internal consistency, and a low answering load. Item selection included a thorough literature review and the input of patients, clinicians, and focus groups. Item selection was of high quality, as items that measured something different to the overall scale or redundant items were removed using infit and outfit Rasch statistics and items with ceiling and floor effects were also removed, if necessary. However, as a result of the analysis, none of these 36 questions which were prepared carefully were need to be removed. This contact lens satisfaction questionnaire which contains 36 questions can be used safely for contact lens users aged 18 and over who have been using contact lenses for at least 1 year.



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