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Sensitivity and specificity evaluation of refractive condition self-assessment

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Summary. — The self-report questionnaires could be used as alternative tests to detect refractive errors, although objective and subjective refraction are considered the gold standard procedure. This study evaluated the sensitivity and specificity of two self-questionnaires (Q1 and Q2) to identify refractive status. Q1 required to identify refractive error by only scientific term: myopia, hyperopia, astigmatism and presbyopia. In Q2, the options combine the scientific term with a descriptive explanation. A multi-center, randomized double-blind study was conducted. Two hundred and forty-five participants completed one of two questionnaires before a non-cycloplegic eye examination by an optometrist. Sensitivity and specificity were determined comparing the self-reported responses with the classification obtained from subjective refraction. For myopia, the Q1 and Q2 reported a good sensitivity and specificity. The relationship between the operating characteristics of Q1 and Q2 was evaluated by the ROC curve. Both the questionnaires used in the study resulted reliable for identifying myopia although they were not highly accurate for the identification of the remaining visual defects.

1. – Description

The assessment of refractive error is a relevant aspect in clinical practice and research, *e.g.*, in epidemiological studies. Refractive error can be determined using various methods, such as objective or subjective refraction, in-person interview and questionnaire responses. Although subjective refraction is considered the gold standard, it has disadvantages in terms of time and money requirements. The administration of questionnaires can reduce both costs and the time required for data collection [1-3]. The

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literature shows that no studies on the validity of refractive defect self-assessment questionnaires have been conducted using questionnaires in thr Italian language. The purpose of this study was to evaluate the operational characteristics, sensitivity and specificity of two self-questionnaires (Q1 and Q2) to identify refractive status. Q1 required respondents to identify refractive error by indicating only the scientific term of the visual condition (myopia, hypermetropia, astigmatism and presbyopia). In Q2, the options available to respondents combine the scientific term of the refractive error with a descriptive explanation.

2. – Methods

A multi-center, randomized double-blind study was conducted in six sites in Italy. Participants in the nationwide optometric studies were enrolled at a refractive examination by the staff of the optometric centers. Two hundred and forty-five participants (14–83 years of age; 66% female) were randomly asked to complete one of two questionnaires before a routine eye examination. The study followed the principles of the Declaration of Helsinki; after explanation of the nature of the study, but before any involvement, subjects completed an informed consent to the research and an authorization form to process personal data for scientific purposes. Each participant was assigned an alphanumeric code. Each participant's visual defect was determined with non-cycloplegic subjective refraction by an optometrist who did not see the completed questionnaire. To enroll subjects in the study, the following criteria of inclusion were used:

- being a native Italian speaker;
- not being affected by ocular disease;
- not being affected by ocular or systemic disease that affect refraction (cataracts and diabetes);
- not having undergone refractive surgery;
- not being under ocular or systemic pharmacological treatment;
- having undergone vision screening by opticians in the past, optometrists, ophthalmologists, orthoptists;
- having cognitive characteristics that enable them to complete the questionnaire.

Both questionnaires recorded the participants' demographic data (age, gender, educational qualification), and some information regarding the ocular and visual condition (previous eyesight examinations, presence of ocular pathologies eye diseases, any prescription of optical correction in the past, current use of the optical correction, age when wearing of the optical correction began, distance used for the optical correction). However, the difference between Q1 and Q2 was present in the last section of the questionnaire which assessed the subjects' knowledge of their refractive defect. In Q1, subjects had to indicate the presence or absence of a refractive defect by opting for one or more options identified only by scientific terminology: myopia, hypermetropia, astigmatism, presbyopia, other conditions (strabismus, "lazy" eye) and unidentified condition. In Q2, subjects had to indicate the presence or absence of a refractive defect by opting for one or more options identified with scientific terminology combined with a description of the symptoms induced refractive defect. In particular:

	Q1	Q2
N of sample	121	n124
Mean age	39.5 ± 17.7	38.8 ± 17.7
Age range	14-81	14-83
Gender (% Female)	63	68
Spherical equivalent range (D)	-12.38 a + 8.25	-9.50 a + 4.75

Fig. 1. – The descriptive data of the two questionnaires, Q1 and Q2 respectively. The mean and standard deviation and the range of age, the gender proportion of women, the range of spherical equivalent are reported.

- Myopia: without glasses or contact lenses one has difficulty seeing distance, driving, watching television or the cinema screen.
- Hypermetropia: without the use of spectacles or contact lenses one has difficulty in performing close-up activities, such as reading or working at a PC.
- Astigmatism: without the use of glasses or contact lenses one has difficulty in both close-up activities such as reading the newspaper and distant activities such as looking at the cinema screen.
- Presbyopia: with the passage of age, despite having sharp distance vision (possibly corrected with glasses or contact lenses), one experienced more and more and more difficulty in reading up close.
- Other conditions (strabismus, "lazy" eye, ...).
- Unidentified condition.

The descriptions of the symptoms induced by the refractive defect entered in Q2 were defined in a pilot phase.

3. – Results

The sample consisted of 245 subjects, of which 121 completed Q1 and 124 completed Q2. Specifically, the total sample was composed by 131 female (54%) and 114 male (46%) subjects, with a mean ± standard deviation age of 39.2 ± 17.4 years (range 14–83). In fig. 1 we reported the descriptive data separately of the two questionnaires.

The spherical equivalent refractive error was used to classify myopia as $\leq -0.25\,\mathrm{D}$, hypermetropia as $\geq +1.00\,\mathrm{D}$, astigmatism $\leq -1.00\,\mathrm{D}$, and presbyopia with a required near addition greater than or equal to $+1.00\,\mathrm{D}$. In the sample, the mean of spherical equivalent (MSE) taking both eyes was equal to -1.3 ± 2.9, with a maximum value of $+8.25\,\mathrm{D}$ and a minimum value of $-12.38\,\mathrm{D}$ (table I). Sensitivity and specificity were

TABLE I. – *Description of the sample refraction values of the subjects as the mean of the spherical equivalent value (MSE): mean, standard deviation, maximum value and minimum value.*

Mean OO MSE	−1.3 D ± 2.9
Max OO MSE	8.25 D
Min OO MSE	−12.38 D

Refractive Status	Questionnaire	Objective classification	SE	SP
Myopia	1	OO MSE ≤ -0,25	82	75
	2		88	75
Hyperopia	1	OO MSE ≥ +1,00	52	96
	2		48	81
Astigmatism	1	OO ≤ -1,00	58	71
	2		62	63
Presbyopia	1	ADD ≥ +1,00	58	97
	2		46	99

Fig. 2. – SE (sensitivity) and SP (specificity) values for each refractive condition calculated for Q1 and Q2, considered the objective classification. For myopia and hyperopia, the mean of the spherical equivalent for both eyes (MSE OO) was determined. For astigmatism considering the cylindrical diopter power (OO) and for presbyopia the near addition value (ADD).

determined for each questionnaire by comparing the self-reported answers with the classification obtained by subjective refraction.

Q1 reported a sensitivity of 0.82, 0.52, 0.58, and 0.58 for myopia, hyperopia, astigmatism, and presbyopia, respectively. In terms of specificity, it showed a value of 0.75, 0.96, 0.71, and 0.97 for myopia, hyperopia, astigmatism, and presbyopia, respectively. Q2 presented a sensitivity of 0.88, 0.52, 0.58, and 0.58 for myopia, hyperopia, astigmatism, and presbyopia, respectively. While in terms of specificity, it showed a value of 0.75, 0.81, 0.63, and 0.99 for myopia, hyperopia, astigmatism, and presbyopia, respectively, as shown in fig. 2. In the case of hypermetropia, on the other contrast, both questionnaires were extremely specific and non-sensitive. Both questionnaires were very specific and less sensitive in identifying presbyopic subjects. They were also unreliable for identifying astigmatic subjects, as they were not very sensitive or specific.

The relationship between the operating characteristics of Q1 and Q2 as a function of the discriminant threshold was determined by the construction of the ROC curve (fig. 3). Both the questionnaires used in the study resulted reliable for identifying myopia.

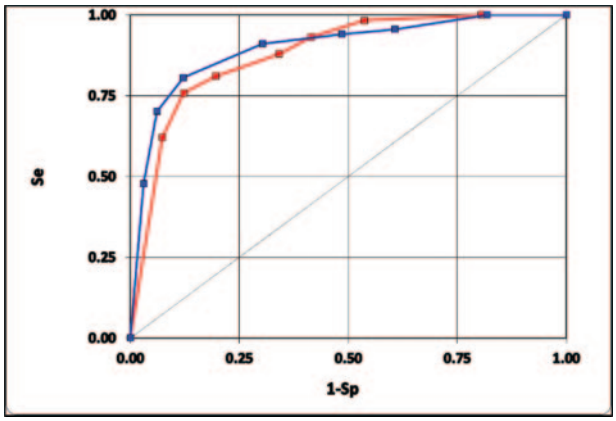

Fig. 3. – The ROC curve of Q1 (red line) and Q2 (blue line) for identifying myopia.

4. – Conclusions

For both questionnaires, sensitivity and specificity show values that allow Q1 and Q2 to be valid for the identification of myopia, indeed sensitivity and specificity have very high and balanced values (Q1: 0.82; 0.75. Q2: 0.88; 0.75). The results obtained from this research are quite in agreement with the studies in the current literature. In fact, other authors investigated the sensitivity and specificity of a questionnaire in which optometric terms, common terms and a definition of the refractive defect appeared to refer to the refractive defect. Sensitivity and specificity were obtained of 0.89 and 0.84 for myopia, comparable to Q1 and Q2 in the present study [4]. The data showed that the presence of a refractive defect explanation (Q2) could improve the measurement marginally. Italian-language self-report questionnaires for identification of refractive status are a good option for myopia, but not for the other refractive errors, for which only objective and/or subjective refraction should be considered.

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