

# Factors associated with refractive defects in an urban population of the peruvian andes

## *Factores asociados a los defectos refractivos en una población urbana de los andes peruanos*

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### ABSTRACT

**Objective:** To determine the factors associated with refractive defects in an urban population of the Peruvian Andes. **Methods:** A cross-sectional analytical study of secondary data analysis was performed, using all the records of the patients who attended the ophthalmological consultation between January and May 2015, the variables of type of ametropia (astigmatism, myopia and hyperopia), Sex, age, occupation and place of residence of the patients. P values, prevalence ratios and 95% confidence intervals were obtained using generalized linear models. **Results:** Of the 1815 attended, the average age was 30 years (standard deviation 10.9 years), 46% (829) were men, 93% (1692) lived in the city of Huancayo, the most frequent occupation was being Students, 38% (696). Increasing the frequency of hyperopia was more than 60 years old ( $p < 0.001$ , PR: 1.99, 95% CI: 1.48-2.67) and being a housewife ( $p < 0.001$ , PR: 1.56; 95% CI: 1.24-1.96), on the contrary, the students had lower percentages of hypermetropia ( $p: 0.009$ , PR: 0.78; 95% CI: 0.65-0.94). It was found that housewives had a lower frequency of myopia ( $p: 0.026$ ; PR: 0.80; IC95: 0.65-0.97); in addition, those over 60 also had lower frequencies of myopia ( $p: 0.002$ , PR: 0.64, 95% CI: 0.48-0.85). **Conclusion:** It was found that some of the socio-labor factors evaluated were associated with refractive defects in a population of the central Andes of Peru, these results can be taken into account for future research, preventive plans for ophthalmologic pathologies and as a basis for Future research in similar populations.

**Keywords:** Refractive errors; Vision disorders; Astigmatism; Myopia; Hyperopia; Ambulatory care facilities; Peru

### RESUMEN

**Objetivo:** Determinar los factores asociados a los defectos refractivos en una población urbana de los andes peruanos. **Métodos:** Se realizó un estudio transversal analítico de análisis secundario de datos, usando la totalidad de los registros de los pacientes que acudieron a la consulta oftalmológica entre enero-mayo del 2015, se capturó las variables de: tipo de ametropía (astigmatismo, miopía e hipermetropía), sexo, edad, ocupación y localidad de residencia de los pacientes. Se obtuvo los valores p, razones de prevalencia e intervalos de confianza al 95% mediante los modelos lineales generalizados. **Resultados:** De los 1815 atendidos, la media de edades fue 30 años (desviación estándar 10,9 años), el 46% (829) fueron hombres, el 93% (1692) vivía en la ciudad de Huancayo, la ocupación más frecuente fue el ser estudiantes, 38% (696). Incrementó la frecuencia de hipermetropía el tener más de 60 años ( $p < 0,001$ ; RP: 1,99; IC95%: 1,48-2,67) y el ser ama de casa ( $p < 0,001$ ; RP: 1,56; IC95%: 1,24-1,96), por el contrario, los estudiantes tuvieron menores porcentajes de hipermetropía ( $p: 0,009$ ; RP: 0,78; IC95%: 0,65-0,94). Se encontró que las amas de casa tuvieron una menor frecuencia de miopía ( $p: 0,026$ ; RP: 0,80; IC95%: 0,65-0,97), además, los mayores de 60 años también tuvieron menores frecuencias de miopía ( $p: 0,002$ ; RP: 0,64; IC95%: 0,48-0,85). **Conclusión:** Se encontró que algunos de los factores socio-laborales evaluados estuvieron asociados a sufrir de defectos refractivos en una población de los andes centrales de Perú, estos resultados pueden ser tomados en cuenta para futuras investigaciones, planes preventivos de despistaje de patologías oftalmológicas y como base para futuras investigaciones en poblaciones similares.

**Descriptor:** Defectos refractivos; Trastornos de la visión; Astigmatismo; Miopía; Hiperopía; Instituciones de atención ambulatoria; Peru

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## INTRODUCTION

**A**metropia is a very frequent condition diagnosed in the human population. <sup>(1)</sup> It causes refractive errors, which belong to a group of diseases that, according to the World Health Organization (WHO), currently affect 153 million individuals worldwide <sup>(2)</sup>; based on information provided by to the Ministry of Health (MINSA) <sup>(3)</sup>, it is the second cause of visual disability in Peru. Youngsters are often the most affected population; <sup>(4)</sup> sex and professional occupation are other influencing factors. <sup>(5)</sup>

Ametropia has also been reported among children. <sup>(6)</sup> Non-corrected refractive errors can reduce individuals' school performance, hinder their future opportunities and overall impair their quality of life; besides, they are one of the main causes of work and school failure. <sup>(7,8)</sup> Thus, it is essential promoting the early diagnosis of ametropia to help minimizing its effects on patients whose total or partial blindness cannot be avoided. <sup>(9)</sup> Furthermore, studies have reported special features of it in patients with astigmatism <sup>(10,11)</sup>, hypermetropia <sup>(12)</sup> or myopia. <sup>(13-15)</sup> However, there are no reports about this condition in individuals living in Central Andes, South America, who belong to special populations, given the geographic location of their settlements and the features of the environment they live in. Thus, the aim of the current study was to determine the factors associated with refractive errors in an urban population living in the Peruvian Andes.

## METHODS

### Study design and population

Analytical cross-sectional study carried out based on the database of optical units in Huancayo City, Peruvian central highlands. A census-type convenience sampling was adopted; it included patients with ametropia who were treated in the optical center from January to May 2015 and whose data were available in the database of the institution. Children younger than 10 years and the ones who underwent ophthalmic surgery at some point in life were excluded from the study (less than 3% exclusion).

### Instruments and variables

Having one of the three most common refractive errors (astigmatism, myopia, hyperopia) was the main herein analyzed variable, which was measured based on the monocular assessment technique, with the aid of a calibrated auto-refractometer of the "Autorefractor keratometer Topcom KR-8000" type - patients were not subjected to cycloplegia. A trial lens box and an optotype were used in all refractive measurements, which have followed international standards recommended by expert medical technologists.

Variables such as patients' age (categorized as younger than 18 years old, from 18 to 59 years old, and 60 years old or older), sex, professional occupation (based on categories such as students, housewives and teachers) and town (whether, or not, participants lived in Huancayo) were taken into consideration.

### Procedures

Data were collected in the database of the investigated institution, after it authorized such a procedure. Patients' data were inserted in cards generated for data collection purposes.

Information was double digitized and, subsequently, subjected to data quality control.

Collected data were handled in Microsoft Excel 2010® software (version for Windows 2010), but statistical results were generated in Stata software, version 11.1 (StataCorp LP, College Station, TX, USA).

Ethical aspects were always respected in order to assure data confidentiality; an identification code was assigned to each record and all data capable of identifying the assessed patients were deleted.

### Data analysis

Absolute and relative frequencies of categorical variables were subjected to descriptive statistics. Medians/ranges or means/standard deviations of quantitative variables were calculated based on the evaluation of numerical data normality in the Shapiro Wilk statistical test.

Analytical statistics adopted 95% confidence level. Bivariate statistics was used to calculate p values, prevalence ratios (PR) and their respective confidence intervals at 95% (CI95%). It was done by using generalized linear models, based on Poisson distribution and log link function, by taking into consideration robust models. P values < 0.05 were statistically significant.

## RESULTS

Based on 1,815 secondary data records, patients' mean age was 30 years (standard deviation = 10.9%), 45.7% (n = 829) of them were men and 93.2% (n = 1,692) lived in Huancayo City. Table 1 presents the other features of patients evaluated in Huancayo's optical units.

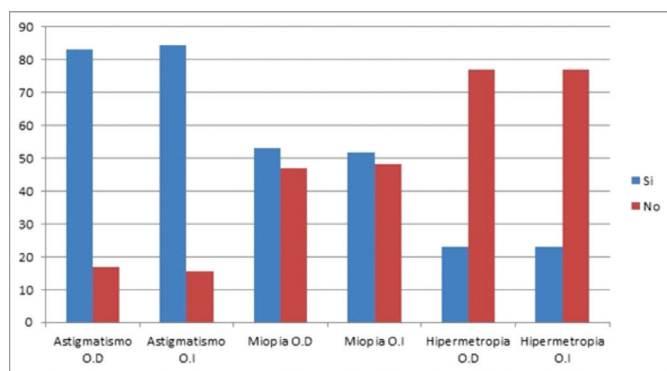
Eighty-three percent (83%; n = 1,506) of patients had

**Table 1**  
**Social features of patients treated in a network of optical units in Huancayo City (n=1,815)**

| Variable                  | n    | %    |
|---------------------------|------|------|
| Age (years) *             | 30   | 10.9 |
| Sex                       |      |      |
| Male                      | 829  | 45.7 |
| Female                    | 986  | 54.3 |
| Professional occupation** |      |      |
| Student                   | 696  | 38.4 |
| Housewife                 | 201  | 11.6 |
| Teacher                   | 138  | 7.6  |
| Health Sciences           | 70   | 3.9  |
| Law                       | 39   | 2.2  |
| Driver                    | 58   | 3.2  |
| Enginner                  | 77   | 4.2  |
| Management                | 59   | 3.3  |
| Others                    | 467  | 25.6 |
| Place of residence        |      |      |
| Huancayo                  | 1692 | 93.2 |
| Out of Huancayo           | 123  | 6.8  |

\*Mean and standard deviation

\*\*There was loss of 10 data



**Figure 1.** Percentage of patients with refractive errors living in a city in the Peruvian central highlands

astigmatism in the right eye and 84% (1470) of them, in the left eye; 52% (n = 943) and 51% (n = 925) had myopia in the right and left eye, respectively; 22% (n = 399) of patients presented hyperopia in both eyes. Figure 1 shows the percentage of patients with refractive errors, based on the assessed eye.

Astigmatism was not associated with factors such as sex, age, professional occupation or place of residence (Table 2).

Housewives recorded low myopia frequency (p: 0.026; PR: 0.80; CI95%: 0.65-0.97), as well as individuals older than 60 years (p: 0.002; PR: 0.64; CI95%: 0.48-0.85). The other evaluated factors were not associated with myopia. (Table 3).

The frequency of hyperopia has increased among patients older than 60 years (p < 0.001; PR: 1.99; CI95%: 1.48-2.67) and housewives (p < 0.001; PR: 1.56; CI95%: 1.24-1.96), whereas students recorded lower hyperopia rates (p: 0.009; PR: 0.78; CI95%: 0.65-0.94), as shown in Table 4.

## DISCUSSION

The current research was the first to determine the frequency of, and factors associated with, refractive errors diagnosed in patients living in a city in the Peruvian central Andes. It can be used to help identifying the manifestation of these visual issues in this population, as well as to provide reference for new information collection in future studies.

The analyzed variables were not associated with astigmatism, and it means that astigmatism equally affects participants of both sexes, belonging to all categorized age groups, regardless of their place of residence or professional occupation. This outcome can be explained by the fact that astigmatism is a congenital refractive error and that a large percentage of the population is born with this condition. Furthermore, studies have shown that patients can develop it at any age and that it is often associated with other refractive errors such as myopia and hyperopia. (16,17) However, it is essential investigating astigmatism because it was the most common pathology recorded in the current study. These data corroborate a study about the prevalence of astigmatism in a population living in the United States, whose most common diagnoses – recorded from the highest to the lowest frequency – were astigmatism, myopia, hyperopia and presbyopia. (18,19)

Patients older than 60 years and housewives recorded the lowest myopia frequency rates; this outcome confirmed that this pathology most often happens at early ages. (20) According to a North American study focused on investigating refractive disorders in the eyes of members of the United States Armed Forces, individuals younger than 30 years recorded the highest myopia incidence rates. (18) It is worth emphasizing that myopia stops progressing as individuals grow up and that it reaches a plateau when they are approximately 30 years old, (21) a fact that stops

**Table 2**  
**Factors associated with astigmatism in patients treated in optical units in Nuançado (n = 1,814)**

| Variable            | Astigmatism n (%) |           | P value                      | PR (IC95%)                         |
|---------------------|-------------------|-----------|------------------------------|------------------------------------|
|                     | Yes               | No        |                              |                                    |
| Sex*                |                   |           |                              |                                    |
| Female              | 888(54.4)         | 98(54.4)  | 0.994<br>Comparison          | 1.00(0.91-1.10)                    |
| Male                | 746(45.7)         | 82(45.6)  |                              |                                    |
| Age (years)*        |                   |           |                              |                                    |
| Younger than 18     | 228(14)           | 20(11.1)  | 0.757<br>0.735<br>Comparison | 0.98(0.85-1.13)<br>0.97(0.79-1.18) |
| Between 18 and 59   | 1248(76.4)        | 140(77.8) |                              |                                    |
| 60 or older         | 158(9.7)          | 20(11.1)  |                              |                                    |
| Living in Huancayo* |                   |           |                              |                                    |
| No                  | 116(7.1)          | 7(3.9)    | 0.609<br>Comparison          | 1.05(0.87-1.27)                    |
| Yes                 | 1518(92.9)        | 173(96.1) |                              |                                    |
| Student*            |                   |           |                              |                                    |
| Yes                 | 630(38.6)         | 66(36.7)  | 0.876<br>Comparison          | 1.01(0.91-1.11)                    |
| No                  | 1004(61.4)        | 114(63.3) |                              |                                    |
| Housewife*          |                   |           |                              |                                    |
| Yes                 | 185(11.3)         | 26(14.4)  | 0.696<br>Comparison          | 0.97(0.83-1.13)                    |
| No                  | 1449(88.7)        | 154(85.6) |                              |                                    |
| Teacher*            |                   |           |                              |                                    |
| Yes                 | 129(7.9)          | 9(5)      | 0.661<br>Comparison          | 1.04(0.87-1.25)                    |
| No                  | 1505(92.1)        | 171(95)   |                              |                                    |

P values, prevalence ratios (PR) and their respective 95% confidence interval (CI95%) were calculated through generalized linear models, based on Poisson distribution and log link function, by taking into consideration robust models.

\* There was statistical loss of 1 datum.

**Table 3**  
**Factors associated with myopia in patients treated in optical units in Huancayo (n=1,815)**

| Variable           | Myopia n (%) |           | p valor    | PR (CI95%)      |
|--------------------|--------------|-----------|------------|-----------------|
|                    | Yes          | No        |            |                 |
| Sex                |              |           |            |                 |
| Female             | 586(53.4)    | 400(55.8) | 0.525      | 0.96(0.85-1.08) |
| Male               | 512(46.6)    | 317(44.2) | Comparison |                 |
| Idade (years)      |              |           |            |                 |
| Younger than 18    | 148(13.5)    | 100(14)   | Comparison |                 |
| Between 18 and 59  | 882(80.3)    | 507(70.7) | 0.485      | 1.06(0.89-1.27) |
| 60 or older        | 68(6.2)      | 110(15.3) | 0.002      | 0.64(0.48-0.85) |
| Living in Huancayo |              |           |            |                 |
| No                 | 72(6.6)      | 51(7.1)   | Comparison |                 |
| Yes                | 1026(93.4)   | 666(92.9) | 0.772      | 0.97(0.76-1.23) |
| Student            |              |           |            |                 |
| Yes                | 436(39.7)    | 260(36.3) | 0.354      | 1.06(0.94-1.19) |
| No                 | 662(60.3)    | 457(63.7) | Comparison |                 |
| Housewife          |              |           |            |                 |
| Yes                | 104(9.5)     | 107(14.9) | 0.026      | 0.80(0.65-0.97) |
| No                 | 994(90.5)    | 610(85.1) | Comparison |                 |
| Teacher            |              |           |            |                 |
| Yes                | 87(7.9)      | 51(7.1)   | 0.689      | 1.05(0.84-1.30) |
| No                 | 1011(92.1)   | 666(92.9) | Comparison |                 |

P values, prevalence ratios (PR) and their respective 95% confidence interval (CI95%) were calculated through generalized linear models, based on Poisson distribution and log link function, by taking into consideration robust models.

**Table 4**  
**Factors associated with hyperopia in patients treated in optical units in Huancayo (n = 1,815)**

| Variable           | Hyperopia n (%) |            | p value    | PR (CI95%)      |
|--------------------|-----------------|------------|------------|-----------------|
|                    | Yes             | No         |            |                 |
| Sex                |                 |            |            |                 |
| Female             | 286(54.8)       | 700(54.1)  | 0.831      | 1.02(0.86-1.21) |
| Male               | 236(45.2)       | 593(45.9)  | Comparison |                 |
| Age (years)        |                 |            |            |                 |
| Younger than 18    | 75(14.4)        | 173(13.4)  | Comparison |                 |
| Between 18 and 59  | 340(65.1)       | 1049(81.1) | 0.097      | 0.81(0.63-1.04) |
| 60 or older        | 107(20.5)       | 71(5.5)    | <0.001     | 1.99(1.48-2.67) |
| Living in Huancayo |                 |            |            |                 |
| No                 | 39(7.5)         | 84(6.5)    | Comparison |                 |
| Yes                | 483(92.5)       | 1209(93.5) | 0.528      | 1.11(0.80-1.54) |
| Student            |                 |            |            |                 |
| Yes                | 171(32.8)       | 525(40.6)  | 0.009      | 0.78(0.65-0.94) |
| No                 | 351(67.2)       | 768(59.4)  | Comparison |                 |
| Housewife          |                 |            |            |                 |
| Yes                | 89(17.1)        | 122(9.4)   | <0.001     | 1.56(1.24-1.96) |
| No                 | 433(83)         | 1171(90.6) | Comparison |                 |
| Teacher            |                 |            |            |                 |
| Yes                | 41(7.9)         | 97(7.5)    | 0.829      | 1.04(0.75-1.42) |
| No                 | 481(92.2)       | 1196(92.5) | Comparison |                 |

P values, prevalence ratios (PR) and their respective 95% confidence interval (CI95%) were calculated through generalized linear models, based on Poisson distribution and log link function, by taking into consideration robust models.

the evolution of this refractive error. Women are less likely to be affected by this refractive error, although the exact reason why it affects a specific population remains unknown, some theories link it to patients' activities and visual efforts.<sup>(22)</sup> These theories can generate new hypotheses for future studies.

Hyperopia was mostly associated with individuals older than 60 years, mainly because it often happens after that age.<sup>(18,23)</sup> In addition, this pathology often affects housewives because they tend to strain their eyes to perform certain household activities.

<sup>(24)</sup> Finally, students recorded the lowest frequency of this type of

ametropia, since this condition disappears as vision development progresses<sup>(25)</sup>; this outcome corroborated a study carried out with schoolchildren in Tunisia, according to which the prevalence of hyperopia among school-age children was only 2.6%.<sup>(26)</sup>

It is important mentioning that the current study did not use cycloplegic drops in participants' eyes. This technique should be performed in children - mainly in strabismus cases - because it provides more reliable refraction, as well as in patients with high hyperopia levels because they may not be detected without cycloplegia.<sup>(27)</sup> In addition, the limitation of the current study lies on its

selection bias, since it performed secondary data analysis, whose results can only be extrapolated to the investigated population; furthermore, for this very reason, it was not possible associating a larger number of variables. Moreover, the literature lacks studies with populations who live in the mountains; thus, it was not possible making comparisons to populations living in these environments. Despite these limitations, the current results are relevant, since they were the first ones recorded in this field for the herein described population, a fact that generates hypotheses and sets the precedent for future investigations about this topic.

Based on data of a population living in Peruvian central highlands, it was possible concluding that housewives and individuals older than 60 years were less likely to have myopia and presented higher hyperopia frequency rates; students recorded the lowest hyperopia rates. Astigmatism was not associated with the evaluated factors.

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### ERRATA

■ In the scientific article “**Factors associated with refractive defects in an urban population of the Peruvian Andes**” by the authors Christian R. Mejia, Alfonso Roque-Román, Grace Torres-Santos, Candy Pérez-Osorio, Onice J. Caceres, published in the edition of number 3 - volume 79 of the *Revista Brasileira de Oftalmologia*, May-June 2020, pages 164-8, with DOI 10.5935 / 0034-7280.20200036. The affiliation of the following authors was incorrectly published, thus changing their numbering. **Where it reads:** Christian R. Mejia<sup>1,2</sup>, Alfonso Roque-Román<sup>1</sup>, Grace Torres-Santos<sup>1</sup>, Candy Pérez-Osorio<sup>1</sup>, Onice J. Caceres<sup>3</sup>  
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