

Age and Sex as Factors that Influence the Human Health

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Abstract. The study aimed to describe the prevalence of some health problems with a genetic component and to analyze their relationships with age and sex specificity. The sample size of the investigation included more than 900 persons aged 16-90 years (average age 32.3 years). Using a self-reported questionnaire, data were collected about the presence or absence of a physician-diagnosed health problem such as high blood pressure, migraine, allergies and refractive disorders (myopia and astigmatism). The data were analyzed through the IBM SPSS Statistics software package, version 22.0. Descriptive statistics analyses (frequencies, crosstabs) and the χ^2 -test were used. The prevalence of high blood pressure, migraine, allergies, myopia and astigmatism within the whole sample were 9.9%, 10.4%, 21.1%, 29.0% and 22.4%, respectively. High blood pressure and myopia have been found to be in statistically significant relations with the age of the individuals. In this aspect, data showed that the older people (aged 56 years or more) have more problems connected with the both diseases. Migraine, astigmatism and myopia have been found to be in statistically significant associations with the sex of the individuals and are expressed in a higher percentage of women in comparison with men. Due to the complexity of these interactions, and in order to better understand them, their dynamics needs research and analysis in the course of ontogenesis. In view of this, it is important to note that further targeted studies are needed to clarify the joint impact of age, sex and environmental factors on the human health status.

Key words: high blood pressure, migraine, allergies, myopia, astigmatism, sex and age specificities, statistical significance.

Introduction

Genetics as a science studies heredity and variability in various aspects. Of particular interest to the researchers are questions related to the emergence of complex phenotypic characteristics, including many diseases depending on both genotype and environmental factors. On the other hand, age, sex and hereditary are the main factors that influence the health. The

genetic perspective could be applied to certain multifactorial pathologies in humans with evidence for genetic conditionality such as refractory deviations - astigmatism, myopia and hyperopia (TEIKARI *et al.*, 1989; HAMMOND *et al.*, 2001; TONG *et al.*, 2002; GRJIBOVSKI *et al.*, 2006), high blood pressure (VASAN *et al.*, 2002, ROOM *et al.*, 2005; GO *et al.*, 2013; PAZOKI *et al.*, 2018), migraine (TAKESHIMA & NAKASHIMA, 2004; ANTTILA *et*

al., 2018), and allergies (HOLLOWAY *et al.*, 2010). These health problems are much interesting for research because of the combination of underlying biological and environmental factors such as sex, age, environmental pollution, noise, stress in the school and working environment, eating habits and the use of harmful food and drinks.

Recent reviews confirm that the changing environmental conditions, habits and behavior of people affect their health. In this regard, it is important to focus researches on the development process and on the interactions between the various factors and the health status in the perspective of lifespan.

The present study aims to describe the prevalence of health problems such as high blood pressure, migraine, allergies and refractive disorders (myopia and astigmatism) in the studied sample and to analyze the age and sex influence on the investigated health problems.

Materials and Methods

The sample included 945 persons aged 16-90 (average age 32.3 years) of whom 70.9% were women and 29.1% were men. Six age groups were differentiated: 16 to 25 years (N=424, 46.3%), 26 to 35 years (N=200, 21.8%), 36 to 45 years (N=116, 12.7%), 46 to 55 years (N=95, 10.4%), 56 to 65 years (N=50, 5.5%) and 66 or more years (N=31, 3.4%). In this investigation about two thirds of the participants (68.1%) were young people aged between 16 and 35 years.

Using a self-reported questionnaire, data were collected about the presence or absence of a physician-diagnosed health problem such as high blood pressure, migraine, allergies and refractive disorders (myopia and astigmatism). The data were analyzed through the IBM SPSS Statistics software package, version 22.0. Descriptive statistics analyses (frequencies, crosstabs) and the χ^2 -test were used.

Results and Discussion

The prevalence of high blood pressure, migraine, allergies, myopia and astigmatism

within the whole sample were 9.9%, 10.4%, 21.1%, 29.0% and 22.4%, respectively (Table 1).

The prevalence of the studied health problems within each of the six age groups was evaluated too. The percentage of self-reported high blood pressure ranged from 3.6% in the 26-35 years group to 50.0% in the 66+ years group (Table 2). Overall, the prevalence of high blood pressure in the first three age groups (people aged 16 to 45) was relatively low (between 3.6% and 8.1%), compared to the much higher prevalence in the older age groups (people aged 46 or more) - from 22.2% in the 46-55 years group, to 35.4% in the 56-65 years group and 50.0% in the 66+ years group.

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As regards the occurrence of migraine, no such vast differences between age groups were observed. Prevalence rates range from 6.3% (56-65 years group) to 16.7% (66+ years group), with people aged 16-45 years reporting about 9-10% incidence of migraine. Lowest percentage of allergies was registered in the 46-55 years group (14.8%), and highest percentage of allergies - in the 66+ years' group (26.7%). The prevalence of myopia was lower in the people aged 16-45 years (25.2% to 27.6%) and higher in the older age groups (about 37% in the 46-55 and 66+ years' groups and 53.5% in the 56-65 years' group). Prevalence rates of astigmatism range from 16.8% (36-45 years group) to 32.1% (66+ years group). In general, older people (aged 46 years or more) seemed to have more health problems. The relationships between the studied health problems and the age factor

were investigated in the whole sample, as well as within the subgroups. Statistically significant associations were found for the high blood pressure and for the myopia between the younger group (persons aged 16-45 years) and

the older group (persons aged 46-90 years) where χ^2 was 0.000 and 0.004, respectively (Table 2). No significant associations with age factor were found for migraine, allergies and astigmatism.

Table 1. Prevalence of high blood pressure, migraine, allergies, astigmatism and myopia (numbers in brackets represent the total number of individuals in groups).

Health problem		Frequency	Percent
High blood pressure (N=897)	presence	89	9.9
	norm	808	90.1
Migraine (N=895)	presence	93	10.4
	norm	802	89.6
Allergies (N=825)	presence	174	21.1
	norm	651	78.9
Myopia (N=854)	presence	248	29.0
	norm	606	71.0
Astigmatism (N=872)	presence	195	22.4
	norm	677	77.6

Prevalence of high blood pressure, migraine, allergies, astigmatism and myopia per both sex groups (males and females) is presented in Table 3 where it could be seen that the percentage of male individuals with high blood pressure, migraine, allergies, myopia and astigmatism was 12.4%, 6.9%, 19.3%; 28.7% and 17.4, respectively. The percentage of female individuals with the same health problems was correspondingly 9.1%, 12%, 21.6%, 32.2% and 24.5%.

The results show, that the men suffer more often from high blood pressure compared to the women. At the same time, the other studied diseases (migraine, allergies, astigmatism and myopia) are more common in women. Statistically significant associations were found for migraine, myopia and astigmatism, which have been observed as more common in the female group (12% and 6%; 32.2% and 28.7%; 24.5 and 17.4%, respectively) in comparison with the male one (Table 3).

High blood pressure, migraine and allergies are health problems of a multifactor nature. In addition to the genetic component responsible for their appearance, various factors

of the environment, such as diet, food and drink, harmful habits (alcohol, cigarettes, etc.), stress and over-pressure in and out of work, other professional hazards, medication use, etc are in relation with them.

According to the results of our study, the percentage of self-reported high blood pressure ranged from 3.6% in the 26-35 years group to 50.0% in the 66+ years group. According to the recommendations of the Bulgarian League for Hypertension (2013), the prevalence of hypertension among the adult population of European countries, including Bulgaria, is about 30-45%. Our study shows a similar prevalence of 31% in the older (46-90 years) group, 22.2% in the 46-55 years group, 35.4% in the 56-65 years group and 50.0% in the 66+ years group. The young group had a low prevalence of high blood pressure, which is in line with the tendency of high blood pressure prevalence to increase stepwise with age (KOLEVA & HRISTOVA, 2014). We found that general tendency for older people (particularly 46-90 years) to have more health problems in regard to all of the studied health problems.

Different studies have shown that men younger than 65 consistently have higher levels of hypertension compared to women

of the same age group. This difference is particularly pronounced in early adulthood—for instance, among 18- to 29-year-old adults, 1.5 to 4 percent of women and over 5 to 10 percent of men reported hypertension (HAJJAR & KOTCHEN, 2003; CUTLER *et al.*, 2008; EVERETT & ZAJACOVA, 2015). Observed sex differences in expression of high blood pressure are in connection with both biological (sex hormones,

chromosomal differences, and other biological sex differences) and behavioral (high body mass index (BMI), smoking, physical activity) factors (VITALE *et al.* 2009; SANDBERG & Ji 2012; EVERETT & ZAJACOVA, 2015). In our study we found slight, statistically not significant difference between prevalence of high blood pressure in males and females studied (12.4% and 9.1%, respectively).

Table 2. Prevalence of high blood pressure, migraine, allergies, astigmatism and myopia per age group: χ^2 for high blood pressure – 0.000*; for migraine – 0.673; for allergies – 0.428; for myopia – 0.004*; for astigmatism – 0.235; * – statistical significant relation presence.

Age (years)	Presence /norm	High blood pressure		Migraine		Allergies		Myopia		Astigmatism	
		N	%	N	%	N	%	N	%	N	%
16-25	presence	21	5.3	42	10.6	86	23.5	105	27.6	81	20.7
	norm	379	94.8	355	89.4	280	76.5	276	72.4	310	79.3
26-35	presence	7	3.6	18	9.3	33	19.0	49	26.2	46	24.1
	norm	185	96.4	175	90.7	141	81.0	138	73.8	145	75.9
36-45	presence	9	8.1	12	10.8	33	21.0	27	25.2	18	16.8
	norm	102	91.9	99	89.2	83	79.0	80	74.8	89	83.2
46-55	presence	20	22.2	12	13.3	13	14.8	32	36.8	23	27.7
	norm	70	77.8	78	86.7	75	85.2	55	63.2	60	72.3
56-65	presence	17	35.4	3	6.3	8	17.0	23	53.5	13	28.9
	norm	31	64.6	45	93.8	39	83.0	20	46.5	32	71.1
66+	presence	15	50.0	5	16.7	8	26.7	9	37.5	9	32.1
	norm	15	50.0	25	83.3	22	73.3	15	62.5	19	67.9

Table 3. Prevalence of high blood pressure, migraine, allergies, astigmatism and myopia per sex group: χ^2 for high blood pressure – 0.146; for migraine – 0.026*; for allergies – 0.473; for myopia – 0.002*; for astigmatism – 0.024*; * – statistical significant relation presence.

Sex	Presence /norm	High blood pressure		Migraine		Allergies		Myopia		Astigmatism	
		N	%	N	%	N	%	N	%	N	%
Male	presence	31	12.4	17	6.9	45	19.3	52	28.7	43	17.4
	norm	219	87.6	231	93.1	188	80.7	188	78.3	204	82.6
Female	presence	58	9.1	76	12.0	126	21.6	194	32.2	150	24.5
	norm	577	90.9	559	88.0	458	78.4	408	67.8	462	75.5

The results of our study demonstrated that 10.4% of the sample suffered from migraine, which is similar to the data of MITEV (2006). Concerning migraine our results showed not statistically significant differences between the studied age groups. At the same time, there were found significant relationships between expression of migraine and the sex of individuals - 6.9% and 12% respectively for males and females studied. Significant sex differences exist in migraine and other headache disorders. Several hypotheses have been proposed to explain these differences, including fluctuations in sex hormones and receptor binding, genetic factors, differences in exposure to environmental stressors, as well as differences in response to stress and pain perception (PETERLIN *et al.*, 2010; 2011). Different researches are focused to significant sex differences in the expression of migraine. Data from different studies indicate that migraine occurs three times more in women than in men and affects approximately 18% of women and 6% of men (WEITZEL *et al.*, 2001; PETERLIN *et al.*, 2008) - values higher than those found in our study concerning females.

According to statistics, about 10 percent of people seeking medical care show symptoms of food allergy or intolerance to environmental factors that are generally harmless to healthy people. At present, the percentage of people who have developed some type of allergy has increased threefold compared to the past century. Between 20% and 30% are people who have suffered from some type of allergy during a certain period of their life (BOZHKOVA, 2003). Similar results were observed in our study - 21.1% have reported a physician-diagnosed health problem associated with allergies. We did not find in our investigation statistically significant differences in the studied groups according to age (from 17% to 26.7%) and sex (19.3% and 21.6% for males and females, respectively) specificity. Worldwide, the number of people suffering from different allergies increases, and their relationship to sex remains unclear, which requires further research into the sex role in the pathogenesis of

these diseases (CAZZOLETTI *et al.*, 2015). There was observed that asthma, food allergies and anaphylaxis are more frequently diagnosed in females (JENSEN-JAROLIM & UNTERSMAYR, 2008) but in other studies the incidence rates of allergies in both sexes were similar (CAZZOLETTI *et al.*, 2015). Overall, there are not enough clear conclusions on this issue.

Refractive disorders astigmatism and myopia are common in human populations. Over 30% of people wearing glasses or lenses suffer from astigmatism that may be inherited and inborn or develop after an eye disease, injury or surgery. Frequency of myopia varies between 30% and 40% in Europe and increases in individual development, especially among reading and educated people. In the studied sample 22.4% and 29% of persons suffer from refractory disorders astigmatism and myopia, respectively which is lower or similar to that found for Europe (DIRANI *et al.*, 2006; 2008). This is understandable given the fact that many of the studied individuals are from the group of learners. Feeding, noise, lack of sleep, stress, smoking, computers and mobile phones are among the factors of the environment that are related to myopia. The relationship of refractive errors (myopia, hyperopia and astigmatism) with sex factor seems to be a complex as it is reported in inconsistent findings of various studies (CZEPITA *et al.*, 2007; PEET *et al.*, 2007; PREMA *et al.*, 2008; REZVAN *et al.*, 2012). Reason for this probably lies in the fact that, in addition to exerting genetic influence, sex factor might influence some lifestyle characteristics. Most reports do point towards a higher prevalence of myopia in the females (SOOD & SOOD, 2012). HUANG *et al.* (2014) reported slight differences concerning the interactions between astigmatism and sex of individuals. Results of our study showed that myopia is statistically significant associated with the factors age and sex and that astigmatism is in statistically significant relation with the sex of individuals. Both refractive disorders were more often expressed in females, and the prevalence of myopia was lower in the group of younger (up to 45 years) and higher - in the

older age groups (over 46 years).

Conclusions

High blood pressure and myopia are in statistically significant relations with the age of the individuals. A general tendency is found for older people (particularly 46-90 years) to have more health problems in regard to all of the studied diseases.

Migraine, astigmatism and myopia are in statistically significant associations with the sex of the individuals and are expressed in a higher percentage of women in comparison with men.

Due to the complexity of these interactions, and in order to better understand them, further targeted studies are needed to clarify the joint impact of age, sex and environmental factors on the human health status.

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References

- ANTTILA V., M. WESSMAN, A. PALOTIE. 2018. Genetics of migraine. - *Handbook of Clinical Neurology*, 148: 493-503.
- BOZHKOV B. 2003. *Allergy and asthma. How to Live with...* 3. ISBN: 9545283904, Sofia.
- CALEB K., VENU G. 2009. Sex Disparity in Food Allergy: Evidence from the PubMed Database. - *Journal of Allergy*, 159845: 7.[DOI].
- CAZZOLETTI L., FERRARI M., OLIVIERI M., VERLATO G., ANTONICELLI L., BONO R., CASALI L., CERVERI I., MARCHETTI P., PIRINA P., ROSSI A., VILLANI S., MARCO R. 2015. The gender, age and risk factor distribution differs in self-reported allergic and non-allergic rhinitis: a cross-sectional population-based study. - *Allergy, Asthma & Clinical Immunology*, 11 (1) [DOI].
- CUTLER J.A., P.D. SORLIE, M. WOLZ, T. THOM, L.E. FIELDS, E.J. ROCCELLA. 2008. Trends in hypertension prevalence, awareness, treatment, and control rates in United States adults between 1988-1994 and 1999-2004. - *Hypertension*, 52 (5): 818-27.
- CZEPITA D., A. MOJSA, M. USTIANOWSKA, M. CZEPITA, E. LACHOWICZ. 2007. Role of gender in the occurrence of refractive errors. - *Annales Academiae Medicae Stetinensis*, 53(2): 5-7.
- DIRANI M., M. CHAMBERLAIN, S.N. SHEKAR, A.F. ISLAM, P. GAROUFALIS, C.Y. CHEN, R.H. GUYMER, P.N. BAIRD. 2006. Heritability of refractive error and ocular biometrics: the Genes in Myopia (GEM) twin study. - *Investigative Ophthalmology & Visual Science*, 47(11): 4756-4761. [DOI].
- DIRANI M., A. ISLAM, S.N. SHEKAR, P.N. BAIRD. 2008. Dominant genetic effects on corneal astigmatism: the genes in myopia (GEM) twin study. - *Investigative Ophthalmology & Visual Science*, 49(4): 1339-1344. [DOI].
- EVERETT B., ZAJACOVA A. 2015. Gender differences in hypertension and hypertension awareness among young adults. - *Biodemography and Social Biology*, 61(1): 1-17. [DOI].
- FEIJEN M., J. GERRITSEN, D.S. POSTMA. 2000. Genetics of allergic disease. - *British Medical Bulletin*, 56(4): 894-907.
- GO A. S., D. MOZAFFARIAN, V. L. ROGER *et al.* 2013. The American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics - 2013 update: a report from the American Heart Association. - *Circulation*, 127: 6-245.
- GRJIBOVSKI A.M., P. MAGNUS, A. MIDELFART, J.R. HARRIS. 2006. Epidemiology and heritability of astigmatism in Norwegian Twins: an analysis of self-reported data. - *Ophthalmic Epidemiology*, 13: 245-252.
- HAJJAR I., T. KOTCHEN. 2003. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988-2000. - *JAMA*, 290(2): 199-206.
- HAMMOND C.J., H. SNIEDER, C.E. GILBERT, T.D. SPECTOR. 2001. Genes and environment in refractive error: the twin eye study. - *Investigative Ophthalmology & Visual Science*, 42(6): 1232-1236.

- HOLLOWAY J.W., I. YANG, S.T. HOLGATE. 2010. Genetics of allergic disease. – *Journal of Allergy and Clinical Immunology*, 125(2): 81-94. [DOI].
- HUANG J., M.G. MAGUIRE, E. CINER, M.T. KULP, L.A. CYERT, G.E. QUINN, D. ORELBIXLER, B. MOORE, G.S. YING. 2014. Vision in Preschoolers (VIP) Study Group. Risk factors for astigmatism in the Vision in Preschoolers Study. – *Optometry and vision science: official publication of the American Academy of Optometry*, 91(5): 514-21.
- JENSEN-JAROLIM E., UNTERSMAJR E. 2008. Gender-medicine aspects in allergology. – *Allergy*, 63(5): 610-615.
- KOLEVA G., I. HRISTOVA. 2014. Risk factors for arterial hypertension. – *Scientific papers of the University of Rousse*, 53 (8.3): 93-98.
- MITEV G., 2006. Migraine. – *MedInfo*, 9. Available at: [medinfo.bg]. (In Bulgarian).
- PAZOKI R., A. DEGHAN, E. EVANGELOU, H. WARREN, H. GAO, M. CAULFIELD, P. ELLIOTT, I. TZOULAKI. 2018. Genetic Predisposition to High Blood Pressure and Lifestyle Factors. – *CIRCULATIONAHA*, 137: 653–661. [DOI].
- PEET J. A., COTCH M. F., WOJCIECHOWSKI R., BAILEY-WILSON J. E., STAMBOLIAN D. 2007. Heritability and familial aggregation of refractive error in the Old Order Amish. – *Investigative Ophthalmology & Visual Science*, 48(9): 4002-4006. [DOI].
- PETERLIN B.L., G. ALEXANDER, D. TABBY, E. REICHENBERGER. 2008. Oligomerization state-dependent elevations of adiponectin in chronic daily headache. – *Neurology*, 70: 1905–1911.
- PETERLIN B.L., S. GUPTA, T.N. WARD, A. MACGREGOR. 2011. Sex matters: evaluating sex and gender in migraine and headache research. – *Headache*, 51(6): 839-842.
- PETERLIN B.L., A.I. ROSSO, A.M. RAPOPORT, A.I. SCHER. 2010. Obesity and migraine: The effect of age, gender and adipose tissue distribution. – *Headache*, 50: 52–62.
- PREMA R., R. GEORGE, V.R. SATHYAMANGALAM, A. HEMAMALINI, M. BASKARAN, G. KUMARAMANICKAVEL, M. CATHERINE, L. VIJAYA. 2008. Comparison of refractive errors and factors associated with spectacle use in a rural and urban South Indian population. – *Indian Journal of Ophthalmology*, 56(2): 139-144.
- REZVAN F., M. KHABAZKHOOB, A. FOTOUHI, H. HASHEMI, H. OSTADIMOGHADDAM, J. HERAVIAN, E. AZIZI, A. KHORASANI, A. YEKTA. 2012. Prevalence of refractive errors among school children in Northeastern Iran. – *Ophthalmic & Physiological Optics*, 32 (1): 25-30.
- ROOM R., T. BABOR, J. REHM. 2005. Alcohol and Public Health. – *Lancet*, 365: 519-30.
- SANDBERG K., JI H. 2012. Sex differences in primary hypertension. – *Biology of Sex Differences*, 3(1): 7.
- SOOD R. S., SOOD A. 2012. Influence of gender on the prevalence of myopia in young adults. – *International Journal of Basic and Applied Medical Sciences*, 2(1): 201-204. Available at: [cibtech.org].
- TAKESHIMA T., K. NAKASHIMA. 2004. Genetics of Migraine Headache. – *JMAJ*, 47(3): 140–145.
- TEIKARI J., J.J. O'DONNELL, J. KAPRIO, M. KOSKENVUO. 1989. Genetic and environmental effects on oculometric traits. – *Optometry and Vision Science*, 66(9): 594–599.
- TONG L., S.M. SAW, A. CARKEET, W.Y. CHAN, H.M. WU, D. TAN. 2002. Prevalence rates and epidemiological risk factors for astigmatism in Singapore school children. – *Optometry and Vision Science*, 79(9): 606-613.
- VASAN R.S., A. BEISER, S. SESHADRI, M.G. LARSON, W.B. KANNEL, R.B. D'AGOSTINO, D. LEVY. 2002. Residual lifetime risk for developing hypertension in middle-aged women and men: the Framingham Heart Study. – *JAMA*, 287(10): 1000-1010.
- VITALE C., M.E. MENDELSON, G. ROSANO. 2009. Gender differences in the cardiovascular effect of sex hormones. – *Nature Reviews Cardiology*, 6(8): 532-542.
- WEITZEL K.W., J.M. STRICKLAND, K.M. SMITH, J.R. GOODE. 2001. Gender-specific issues in the treatment of migraine. – *Journal of Gender-specific Medicine*, 4: 64-74.

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