International Journal of Research in Medical Sciences
Wahyudi D et al. Int J Res Med Sci. 2020 Nov;8(11):3870-3875
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20204873

Original Research Article

Relationship between levels of serum 25- hydroxyvitamin D with gender and visual acuity students of junior high school

Didik Wahyudi[1]*, Winarto Reki[2], Hardhono[3], Suhartono Damas[4]

[1]Medical/Health Science of Diponegoro University Semarang, Indonesia
[2]Departement of Microbiology faculty of Medicine Diponegoro University Semarang, Indonesia
[3]Departement of Pathology and anatomy, faculty of Medicine, Diponegoro University Semarang, Indonesia
[4]Department of Public Health, Faculty of Public Health, Diponegoro University Semarang, Indonesia

Received: 19 August 2020
Revised: 30 September 2020
Accepted: 01 October 2020

***Correspondence:**
Dr. Didik Wahyudi,
E-mail: didikwahyudidamarmenur812@gmail.com

ABSTRACT

Background: Visual disturbance can be caused by external factors, that is, the lack of outdoor activities and a positive correlation between the length of outdoor activities and vitamin D levels. The aim of this research was to examine the correlation between serum 25-hydroxyvitamin D level, sex and visual acuity.
Methods: This research uses cross-sectional approach, conducted in junior high school 16,18 of Semarang. Purposive sampling method, the analysis is done the chi square test.
Results: There is a correlation between sex and serum 25-hydroxyvitamin D at junior high school 16 (p=0.001, c=13.42) and junior high school 18 (p=0.001, c=13.42). There is a correlation between serum 25-hydroxyvitamin D and visual acuity at junior high school 16 (p=0.302, c=4.868). There is no correlation between serum 25-hydroxyvitamin D and visual acuity at Junior High School 18 (p=0.302, c=4.868).
Conclusion: Serum 25-hydroxyvitamin D is related to sex, 25-hydroxyvitamin D is correlated with a decrease in vision acuity. Serum 25-hydroxyvitamin D is not correlated with a decrease in vision acuity.

Keywords: 25-hydroxyvitamin D, Sex, Visual acuity

INTRODUCTION

Adolescent at the age of 11-18 years are included in high-risk group for vitamin D deficiency due to significant weight gain, accelerated skeletal growth, bone turnover and modelling. The risk of vitamin D deficiency during a critical developmental period, and generally adverse health outcomes, can be exacerbated by sedentary behavior, time indoors, and dietary habits. All risk factors for vitamin D deficiency designate adolescents as targets of special attention to increase the recommended daily intake of vitamin D as much as 800-2,000 IU, depending on body weight and season of the year.[1-3]

Visual impairment can be caused by various factors. Influencing factors can come from the internal and external environment. Internal factors, as major influence, can cause visual impairment are genetic, age, gender. Meanwhile, the external factors that can cause visual impairment are lack of outdoors activities and sports activities, working by looking at objects closely, unhealthy diet, and radiation.[4-6] This study aims to determine the correlation between serum 25-hydroxyvitamin D level and visual acuity.

METHODS

This research was conducted in Semarang, Central Java.

The method used is cross-sectional design, applied to the sixth and seventh grade students at junior high school 16 and 18 of Semarang in September to October 2019. The study population was all junior high school students. The sample was adolescents at the age of 13-15 years who experience impaired vision, selected using purposive sampling to choose students who met the inclusion and exclusion criteria. The number of samples was 83 students from both schools. The variable collected was visual acuity data using visual examination with a snellen optotype within 6 meters. Data on serum 25-hydroxyvitamin D level was taken from examination of blood samples. Serum concentration of 25-hydroxyvitamin D was measured by liquid chromatography-tandem mass spectrometry.[7] Data was then processed and analyzed descriptively, while statistical analysis was done by using SPSS 16 univariate, bivariate with chi square test. This study was declared to have passed the ethical review by the medical and health research ethics.

RESULTS

Characteristics of respondents based on sex

Table 1: Characteristics of respondents based on sex.

	Junior high school 16		Junior high school 18	
Sex	**Total**	**Percentage (%)**	**Total**	**Percentage (%)**
Male	12	14.5	10	23.3
Female	28	33.7	33	76.7
Total	40	100	43	100

Characteristics of respondents based on serum 25-hydroxyvitamin D level

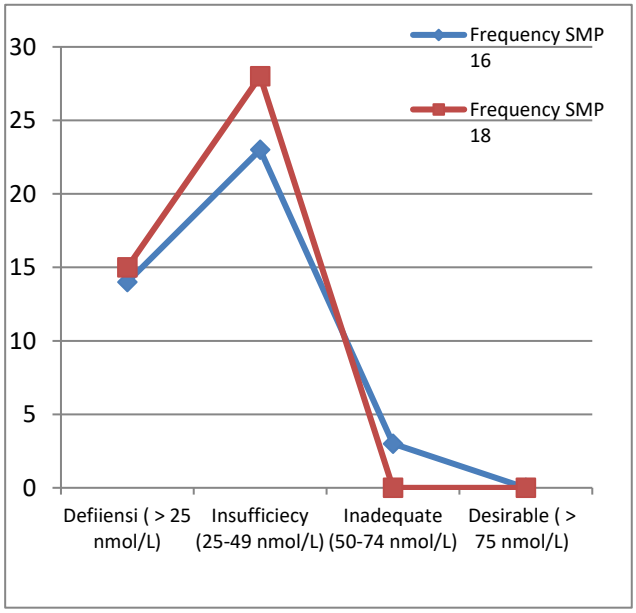

Figure 1: Distribution of frequency of respondents based on serum 25-hydroxyvitamin D level.

Characteristics of respondents based on visual acuity

Table 2: Characteristics of respondents based on visual acuity at junior high school 16.

Variables	OD		OS	
Visual acuity	**Frequency**	**%**	**Frequency**	**%**
Severe low vision	2	2.5	2	2.5
Medium low vision	12	14.8	6	7.4
Almost-normal vision	26	32.1	32	39.5
Total	40	100	43	100

Table 3: Characteristics of respondents based on visual acuity at junior high school 18.

Variables	OD		OS	
Visual Acuity	**Frequency**	**%**	**Frequency**	**%**
Severe low vision	2	4.7	5	11.6
Medium low vision	16	37.2	10	23.3
Almost-normal vision	25	58.1	28	65.1
Total	43	100	43	100

Correlation between serum 25-hydroxyvitamin D level and sex

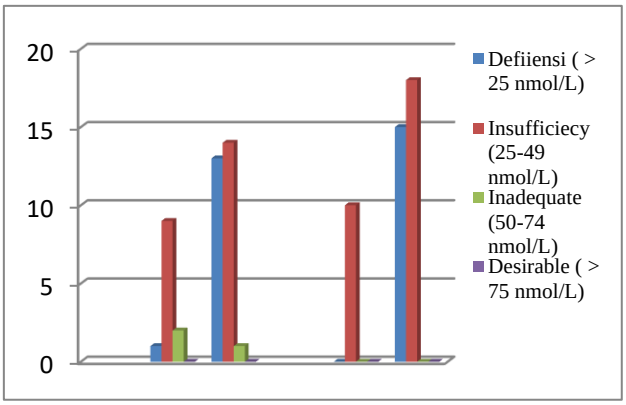

Figure 2: Cross table of correlation between serum 25-hydroxyvitamin D and sex.

Based on figure 2, it can be seen that the number of female students in junior high school 16 with vitamin D deficiency is 13 students (32.5%), vitamin D insufficiency is 14 students (35%), and inadequate intake of vitamin D is 1 student (2.5%). The number of male students with vitamin D deficiency is 1 student (2.5%), vitamin D insufficiency is 9 students (22.5%), and inadequate intake of vitamin D is 2 students (5%). Based on the results of statistical tests using chi square, p value=0.042 where $p<\alpha$ (0.042<0.05) then H1 is accepted and H0 is rejected, which means there is a correlation

between sex and serum 25-hydroxyvitamin D level, where the value of c=6.31.

Based on figure 2, it is seen that the number of female respondents at junior high school 18 with vitamin D deficiency is 15 students (34.8%), vitamin insufficiency is 18 students (41.8%), and inadequate and desirable intake of vitamin D is none. Male respondents are only included in the insufficiency level, that is, 10 students (23.2%). Based on the results of statistical tests using chi square, p value=0.008 where p<α (0.008<0.05) then H1 is accepted and H0 is rejected, which means there is a correlation of sex and serum 25-hydroxyvitamin D, where the value of c=6.98.

Correlation of serum 25-hydroxyvitamin D and visual acuity

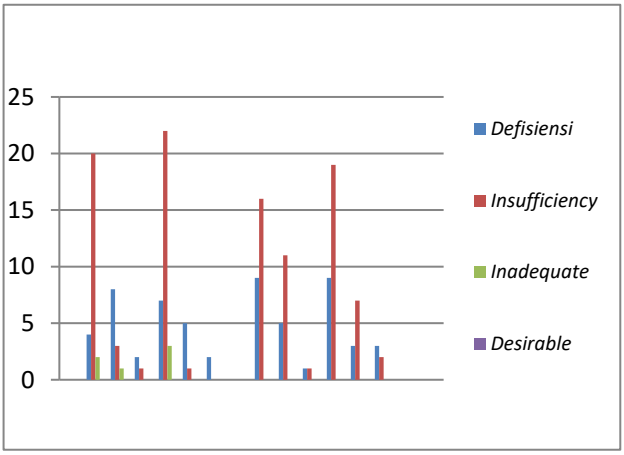

Figure 3: Cross table of correlation of serum 25-hydroxyvitamin D and visual acuity.

Based on figure 3, in junior high school 16, it is seen that the number of students that is in deficiency with severe low vision on the OD is 2 students (5%), with moderate low vision is 8 students (20%), almost-normal vision is 4 (10%). The number of respondents that experiences insufficiency with severe low vision is 1 student (2.5%), with moderate low vision is 3 students (7.5%), and almost-normal vision is 20 students (50%). The number of respondents that is in inadequate with severe low vision is 0, with moderate low vision is 1 student (2.5%), and with almost-normal vision is 2 students (5%). Based on the results of statistical tests using chi square, p value=0.008 where p>α (0.008>0.05) then H1 is accepted and H0 is rejected, which means there is a correlation between serum 25-hydroxyvitamin D and visual acuity on the OD, where the value of c=13.93.

Based on figure 3, in junior high school 16, it is seen that the number of students that is in deficiency level with severe low vision on the left eye is 2 students (5%), with moderate low vision is 5 students (12.5%), and with almost-normal vision is 7 (17.5%). The number of respondents that is insufficiency level with severe low vision is 0, with moderate low vision is 1 student (2.5%), and with almost-normal vision is 22 students (55%). The number of respondents that is in inadequate level with severe low vision and low vision is 0 and with almost-normal vision is 3 students (7.5%). Based on the results of statistical tests using chi square, p value=0.015 where p>α (0.015>0.05) then H1 is accepted and H0 is rejected, which means there is a correlation between serum 25-hydroxyvitamin D serum and visual acuity for the left eye, where the value of c=12.33.

Based on figure 3, at junior high school 18, it is seen that the number of students that is in deficiency level with severe low vision on the right eye is 1 student (2.3%), with moderate low vision is 5 students (11.6%), and almost-normal vision is 9 (20.9%). The number of respondents that is in insufficiency level with severe low vision is 1 student (2.3%), with moderate low vision is 11 students (25.5%), and almost-normal vision is 16 students (37.2%). Based on the results of statistical tests using chi square, p value=0.857 where p>α (0.857>0.05) then H1 is rejected and H0 is accepted, which means there is no correlation between serum 25-hydroxyvitamin D and visual acuity on the right eye vision, where the value of c=0.308.

Based on figure 3, at junior high school 18, it is seen that the number of students that is in deficiency level with severe low vision on the left eye is 3 students (6.9%), with moderate low vision is 3 students (6.9%), and with almost-normal vision is 9 (20.9%). The number of respondents that is in insufficiency level with severe low vision is 2 students (4.6%), with moderate low vision is 7 students (16.2%), and with almost-normal vision is 19 students (44.1%). Based on the results of statistical tests using chi square, p value=0.425 where p> α (0.857>0.05) then H1 is rejected and H0 is accepted, which means there is no correlation between serum 25-hydroxyvitamin D and visual acuity of right eye, where the value of c=1.586.

DISCUSSION

Based on the results of research conducted on the sixth and seventh grade students at junior high school 16 and junior high school 18, more female respondents experience visual impairment than male respondents. These results of the research are in line with a research conducted by Yamamah et al. The results show that there are statistically significant differences in the prevalence of visual impairment between male and female students, the prevalence of visual impairment is significantly higher in female students (p<0.05).[8]

The visual acuity of male respondents is higher than that of female respondents.[9] A research conducted by Abramov et al states that visual acuity of males exceeds the visual acuity of females, both for static stimulation and temporal modulation. Likewise, it has been reported in studies with greater samples and measured by static

and moving stimuli that males have significantly better visual acuity under all conditions, and no studies show the opposite.[10]

The results of serum 25-hydroxyvitamin D level of the sixth and seventh grade students at junior high school 16 and 18, the students are mostly in insufficiency level, followed by deficiency, inadequate and desirable level. There is no student at junior high school 18 who is inadequate and desirable level. These results are in accordance with the previous studies by Ernawati et al who state that the condition of vitamin D status in school-age children needs attention because the average vitamin D level of children at the age of 2.0-12.9 years is 52.6±0.7 nmol/L. The prevalence of vitamin D deficiency is less than 25 nmol/L is 0%, insufficiency is 25-49 nmol/L is 45.1%, inadequate is 50-74 nmol/L is 49.3%, and desirable level is greater than 75 nmol/L, that is 5.6%.[11]

The results of the visual acuity of the sixth and seventh grade students at junior high school 16 and 18 are mostly in almost-normal level, followed by medium low vision and then severe low vision. These results are consistent with previous research by Hidayani et al stating that most respondents have almost-normal visual acuity, which is 50 respondents (46%) and a small portion of respondents experience severe low vision, which is 6 respondents (5%). The research design used in this study is a correlational study using a cross-sectional study design and total sampling with a sample size of 110 respondents.[12]

Correlation between serum 25-Hydroxyvitamin D and sex

Based on the results of research conducted on the sixth and seventh grade students at junior high school 16 of Semarang, the statistical test results p value=0.042 which means there is a correlation between the serum 25-hydroxyvitamin D level and sex, r=6.317. The results of research conducted the sixth and seventh grade students at junior high school 18 of Semarang from the statistical test results p value=0.008 which means there is a correlation between the serum 25-hydroxyvitamin D level and sex, r=6.981.

These results are in line with previous studies by Ernawati et al who state that vitamin D level is higher in males (54.7±0.9 nmol/L) compared to females (49.9±1.0 nmol/L). Prevalence of vitamin D deficiency has increased worldwide.[13,14] Data from KNHANES also show that vitamin D deficiency is very prevalent in Korean adolescents, which can be seen in the reduction of sun exposure caused by the pressure of higher education and decreasing intake of foods rich in vitamin D.[15, 16]

This study is in line with research conducted by Joh who states that male students have significantly higher serum 25 (OH) D level than female students. The research used cross-sectional method based on health examination data of 3,450 healthy male and female students at the age of 18-29 years in Seoul between April and May 2013. The serum 25-hydroxyvitamin D [25 (OH) D] level was determined by using chemiluminescent immunoassay. Anthropometric data was measured, while lifestyle, dietary, and sociodemographic factors were obtained through self-administered questionnaires. Linear regression is commonly used to assess the correlation of 25 (OH) D serum levels. The average of serum 25 (OH) D level was 11.1 ng/mL, and the prevalence of 25 (OH) D level was less than 10 ng/mL was 44.7% (39.5% in men, 50.2% in woman).[17] The results of the above study are in line with previous results. Sex differences in vitamin D status may be caused by a higher percentage of women's body fat, differences in the amount of time outdoors, or sun-protective behavior like the use of sunscreen.[18,19]

Correlation between serum 25-Hydroxyvitamin D and visual acuity

Based on the results of research conducted on the sixth and seventh grade students at junior high school 16, the statistical test results p value=0.008 which means there is a correlation between the serum 25-hydroxyvitamin D level and the visual acuity of OD vision, with a value of r=13.93. The results of research conducted on the sixth and seventh grade students for the left eye show that the statistical test results p value=0.015 which means there is a correlation between the serum 25-hydroxyvitamin D level and visual acuity, with a value of r=12.33. This means that the strength of correlation is weak and the direction of correlation is positive. In other words, the correlation between the two variables is unidirectional. Thus, it can be interpreted that the lower the level of serum 25-hydroxyvitamin D, the lower the level of visual acuity. The correlation between serum 25-hydroxyvitamin D level and visual acuity can be seen from specific data, where all respondents at 25-hydroxyvitamin D serum levels are spread at all levels, which are deficient, insufficient, inadequate and desirable. This can be one of the causes of decreased visual acuity.

This study is in line with a research conducted by Choi et al which show a statistically significant correlation between 25 (OH) D concentration and refractive error. The research involved 2,038 adolescents from South Korea consisting of participants that had -0.5 D of myopia (80.1%) or higher and had high myopia (8.9%). The age-adjusted equivalent spherical distribution with serum 25 (OH) D showed a positive correlation (r=0.067, p=0.012). The myopia group had a significant positive correlation between equivalent spheris and serum 25 (OH) D concentration (p=0.020), while the non-myopia group did not have a significant relationship (p=0.599). In multiple linear regression analysis, equivalent spheris was significantly associated with low serum 25 (OH) D concentration by taking into account the area of

residence, parental income, total energy intake, calcium intake, milk consumption, and smoking experience (p=0.047). The high prevalence of myopia is significantly related to the low serum 25 (OH) D concentration after adjustment for confounding factors (p=0.017).[20]

Based on the results of research conducted on the sixth and seventh grade students at junior high school 18 of Semarang, the statistical test results p value=0.857 which means there is no correlation between the serum 25-hydroxyvitamin D level and the visual acuity of OD, with a value of r=0.308. The results of research conducted on the sixth and seventh grade students at junior high school 16 on the OS show the statistical test results p value=0.452 which means there is no correlation between the serum 25-hydroxyvitamin D level and visual acuity, with a value of r=1.586. This means that the strength of correlation is weak and the direction of correlation is positive. In other words, the correlation between the two variables is unidirectional. Thus, it can be interpreted that the lower the serum 25-hydroxyvitamin D level, the lower the visual acuity. There is no correlation between the serum 25-hydroxyvitamin D level and visual acuity of the ODS in the students of junior high school 18. It can be seen from the special data, in which all respondents at the serum 25-hydroxyvitamin D level are deficient and insufficient just, and there is no respondent included in adequate and desirable level. Thus, it can be one of the causes that makes the correlation does not occur. A study of Norton et al measured UVR using dosimeter, and it found different exposures among people who experienced myopia with emmetropia. The myopia of people who experienced myopia with sun exposure was more stable, and had recovered the myopia. Proposed mediating mechanisms is activation of dopaminergic retinal amacrine cells, stimulated by light.[21]

CONCLUSION

There is a correlation between sex and the ODS visual acuity with serum 25-hydroxyvitamin D level at junior high school 16. There is a correlation between sex and serum 25-hydroxyvitamin D level, no correlation between serum 25-hydroxyvitamin D level and visual acuity at Junior High School 18.

Recommendations

It is necessary to conduct further research to determine the consistency of the correlation between serum 25-hydroxyvitamin D level and the decrease in visual acuity.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Smith TJ, Tripkovic L, Damsgaard CT, Mølgaard C, Ritz C, Wilson-Barnes SL et al. Estimation of the dietary requirement for vitamin D in adolescents aged 14-18 y: a dose-response, double-blind, randomized placebo-controlled trial. Am J Clin Nutr.2016;104(5):1301-9.
2. Choi JA, Han K, Park YM, La TY. Low Serum 25-Hydroxyvitamin D Is Associated with Myopia in Korean Adolescents. Investigative Ophthalmol Visual Sci. 2014;55:2041-7.
3. McCaskill ML, Ogunsakin O, Hottor T, Harville EW, Jarres RK. Serum 25-Hydroxyvitamin D and Diet Mediates Vaso-Occlusive Related Hospitalizations in Sickle-Cell Disease Patients. Nutrients. 2018;10(10):1384.
4. Li SM, Li SY, Kang MT, Zhou Y, Liu LR, Li H et al. Near Work Related Parameter and Myopia in Chinese Children: the Anyang Childhood Eye Study. Plos ONE. 2015;10(8):1-13.
5. Goldschimdt E, Jacobsen N. Genetic and Enviromental Effects on Myopia Development and Progression. Camberidge Opthalmol Symposium. 2014;28:126-33.
6. Larik RSA, Larik F. Adverse Effects of Cell Phone Radiation on Human Health. Int J Scie Engg Res. 2016;7(10):480-5.
7. Bennett SE, Mc Peake J, McCance DR, Manderson JG, Johnston P, McGalliard R et al. Maternal vitamin D status in type 1 diabetic pregnancy: impact on neonatal vitamin D status and association with maternal glycaemic control. PLoS One. 2013;8(9):e74068.
8. Yamamah GAN, Alim AATA, Mostafa YS, Ahmed RAAS, Mahmoud AM. Prevalence of Visual Impairment and Refractive Errors in Children of South Sinai, Egypt. J Ophthalmic Epidemiol. 2015;22(4):246-54.
9. Shaqiri A, Roinishvili M, Grzeczkowski L, Chkonia E, Pilz K, Mohr C et al. Sex-related differences in vision are heterogeneous. Sci Rep. 2018;8:7521.
10. Abramov I, Gordon J, Feldman O, Chavarga A. Sex and vision I: Spatio-temporal resolution. Biol Sex Differ. 2012;4;3(1):20.
11. Fitrah Ernawati, Basuki Budiman. Statuus Vitamin D Terkini Anak Indonesia Usia 2,0 – 12,9 tahun.Gizi Indon 2015;38(1)73-80.
12. Hidayani NP, Tat F, Herliana MA. Djogo. Hubungan antara Lama Penggunaan Jarak Pandang dan Posisi Tubuh Saat Menggunakan Gadget dengan Ketajaman Penglihatan pada Anak Kelas 5 dan 6 di SDK Citra Bangsa Kupang. CHM-K. Applied Scie J. 2020;3:27-34.
13. Braegger C, Campoy C, Colomb V, Decsi T, Domellof M, Fewtrell M et al. Vitamin D in the healthy European paediatric population. J Pediatr Gastroenterol Nutr .2013;56:692-701.

14. Muller DN, Kleinewietfeld M, Kvakan H. Vitamin D review. J Renin Angiotensin Aldosterone Syst. 2011;12:125-8.
15. Choi HS, Oh HJ, Choi H, Choi WH, Kim JG, Kim KM et al. Vitamin D insufficiency in Korea-a greater threat to younger generation: the Korea National Health and Nutrition Examination Survey (KNHANES) 2008. J Clin Endocrinol Metab. 2011;96:643-51.
16. Lee YA, Kim HY, Hong H, Kim JY, Kwon HJ, Shin CH et al. Risk factors for low vitamin D status in Korean adolescents: the Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2009. Public Health Nutr. 2014;17:764-71.
17. Joh HK, Lim CS, Cho BL. Lifestyle and Dietary Factors Associated with Serum 25-Hydroxyvitamin D Levels in Korean Young Adults. J Korean Med Sci. 2015;30(8):1110-20.
18. Lee YA, Kim HY, Hong H, Kim JY, Kwon HJ, Shin CH et al. Risk factors for low vitamin D status in Korean adolescents: the Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2009. Public Health Nutr. 2014;17:764-71.
19. Kühn T, Kaaks R, Teucher B, Hirche F, Dierkes J, Weikert C et al. Dietary, lifestyle, and genetic determinants of vitamin D status: a cross-sectional analysis from the European Perspective Investigation into Cancer and Nutrition (EPIC)-Germany study. Eur J Nutr. 2014;53:731-41.
20. Choi JA, Han K, Park YM, La TY. Low serum 25-hydroxyvitamin D is associated with myopia in Korean adolescents. Invest Ophthalmol Vis Sci. 2014;55:2041-47.
21. Norton TT, Siegwart JT Jr. Light levels, refractive development, and myopia: a speculative review. Exp Eye Res. 2013;114:48-57.

Cite this article as: Wahyudi D, Reki W, Hardhono, Damas S. Relationship between levels of serum 25-hydroxivitamin D with gender and visual acuity students of junior high school. Int J Res Med Sci 2020;8:3870-5.