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REGIONAL DISTRIBUTION OF OPHTHALMOLOGISTS IN THE REPUBLIC OF KAZAKHSTAN

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Abstract

Introduction. It is estimated, that 36 million people are blind worldwide and about one-fifth of the world's population experience vision loss. The majority of vision loss (90%) is preventable or treatable. Thus, access to the eye care is critical in improving eye health status of the whole population. The study of ophthalmologist density allows in general to judge the availability of eye care to the population. Along with this, the staffing level of specialists has a significant impact on the quality of medical care.

Aim: to analyze the ratio of ophthalmologists per 1 million population across the regions of Kazakhstan in the period of 2015-2020 years, as well as a separately study the staffing rate of pediatric ophthalmologists

Materials and methods. A comparative retrospective descriptive analysis of the ratio of ophthalmologists per 1 million population across the regions of Kazakhstan for the period of 2015-2020 was carried out according to the data from the statistical collections "Health of the population of Kazakhstan and the activities of healthcare organizations". A descriptive analysis of the staffing of pediatric ophthalmologists was performed according to the information system "Resource Management System" on the date of October 1st, 2020.

Results. In 2015, the ratio of ophthalmologists was 81.5 ophthalmologists per 1 million population. The ratio of ophthalmologists increased in 2016 to 89.9 per 1 million population. Then it showed downward trend during the study period. However, there was a significant variation among the regions of our country, as well as between urban and rural population. During the study period the highest ophthalmologist density was observed in Almaty city, the lowest in Almaty region. In 2020, the average national provision of ophthalmologists for urban population was 114.5 per 1 million population, while for rural population it was 19.2. In 2015, the ratio of pediatric ophthalmologists was 10.6 per 1 million pediatric population. The staffing rate of pediatric ophthalmologists varied significantly by region from 0% (Atyrau region) to 100% (Zhambyl and Turkestan regions).

Conclusion. There is high regional disparity in distribution of ophthalmologists in the Republic of Kazakhstan, with significantly more specialists concentrated in urban areas. The staffing rate of pediatric ophthalmologists is also unequal between the regions.

Key words: *ophthalmologist, health workforce, urban population, rural population.*

Резюме

КАДРОВАЯ ОБЕСПЕЧЕННОСТЬ ОФТАЛЬМОЛОГИЧЕСКОЙ СЛУЖБЫ В РАЗРЕЗЕ РЕГИОНОВ РЕСПУБЛИКИ КАЗАХСТАН

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Введение. По расчетам, в мире 36 миллионов человек слепы и около одной пятой населения планеты страдает от нарушения зрения. Большую часть состояний, приводящих к потере зрения (90%), можно предотвратить или вылечить. Таким образом, доступ к офтальмологической помощи имеет решающее значение для улучшения состояния здоровья глаз всего населения. Изучение обеспеченности населения офтальмологами позволяет в целом судить о доступности офтальмологической помощи населению. Наряду с этим существенное влияние на качество медицинской помощи оказывает укомплектованность специалистами.

Цель исследования: проанализировать обеспеченность врачами-офтальмологами на 1 миллион населения по регионам Республики Казахстан в период 2015-2020 гг., а также отдельно изучить укомплектованность детскими офтальмологами в разрезе регионов.

Материалы и методы исследования. Проведен сравнительный ретроспективный описательный анализ обеспеченности врачами-офтальмологами на 1 миллион населения по регионам Республики Казахстан за период 2015-2020 гг. по данным статистических сборников «Здоровье населения Казахстана и деятельность организаций здравоохранения». Проведен описательный анализ укомплектованности детскими офтальмологами по данным информационной системы «Система управления ресурсами» на 01.10.2020.

Результаты. В 2015 году обеспеченность всего населения врачами-офтальмологами составила 81,5 на 1 миллион населения. Данный показатель увеличился в 2016 году до 89,9 на 1 миллион населения. Затем он показал тенденцию к снижению в течение периода исследования. Однако существовала значительная вариация между регионами нашей страны, а также между городским и сельским населением. За исследуемый период самая высокая плотность врачей-офтальмологов наблюдалась в г. Алматы, самая низкая – в Алматинской области. В 2020 г. среднереспубликанский показатель обеспеченности врачами-офтальмологами городского населения составил 114,5 на 1 миллион населения, сельского – 19,2. В 2015 г. обеспеченность детскими офтальмологами составила 10,6 на 1 миллион детского населения. Укомплектованность детскими офтальмологами значительно варьировала по регионам от 0% (Атырауская область) до 100% (Жамбылская и Туркестанская области).

Заключение. В Республике Казахстан существует большая региональная диспропорция в распределении врачей-офтальмологов, при этом значительно больше специалистов сосредоточено в городах. Укомплектованность детскими офтальмологами также неодинакова между регионами.

***Ключевые слова**: офтальмологи, кадры здравоохранения, городское население, сельское население*

Түйіндеме

ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ АЙМАҚТАР БОЙЫНША ОФТАЛЬМОЛОГИЯ ҚЫЗМЕТІНІҢ ДӘРІГЕРЛЕРМЕН ҚАМТАМАСЫЗ ЕТІЛУІ

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Кіріспе: Дүние жүзінде 36 миллион адам соқыр және әлем халқының бестен бір бөлігінің көру қабілеті нашар деп есептеледі. Көру қабілетінің жоғалуына әкелетін көптеген жағдайлардың (90%) алдын алуға немесе емдеуге болады Осылайша, көз күтіміне қолжетімділік бүкіл халықтың көз денсаулығының жағдайын жақсарту үшін маңызды. Халықты офтальмологтармен қамтамасыз етуді зерттеу жалпы халыққа офтальмологиялық көмектің қолжетімділігін бағалауға мүмкіндік береді. Сонымен қатар, мамандардың штаттық көрсеткіші медициналық көмектің сапасына айтарлықтай әсер етеді.

Зерттеу мақсаты: 2015-2020 жылдар кезеңінде Қазақстан Республикасының өңірлері бойынша офтальмологтардың 1 миллион тұрғынға шаққандағы қатынасын талдау, сондай-ақ балалар офтальмологтарының штаттық көрсеткішін жеке зерттеу.

Зерттеудің материалдары мен әдістері: «Қазақстан халқының денсаулығы және денсаулық сақтау ұйымдарының қызметі» статистикалық жинақтарының мәліметтері бойынша 2015-2020 жылдар кезеңінде Қазақстан Республикасының өңірлері бойынша офтальмологтардың 1 миллион халықты қамтамасыз етуді салыстырмалы ретроспективті сипаттамалық талдау жүргізілді. 2020 жылғы 1 қазандағы жағдай бойынша «Ресурстарды басқару жүйесі» ақпараттық жүйесі бойынша балалар офтальмологтарының штаттық кестесіне сипаттамалық талдау жүргізілді.

Нәтижелер: 2015 жылы офтальмологтардың қатынасы 1 миллион халыққа шаққанда 81,5 құрады. Бұл арақатынас зерттеу кезеңінде салыстырмалы түрде тұрақты болып қалды. Тек 2016 жылы ол 1 миллион халыққа шаққанда 89,9-ға дейін өсті. Содан кейін ол зерттеу кезеңінде төмендеу тенденциясын көрсетті. Зерттеу кезеңінде офтальмологтардың ең жоғары тығыздығы Алматы қаласында, ең төмені Алматы облысында байқалды. 2020 жылы қала тұрғындарын офтальмологтармен қамтамасыз етудің орташа республикалық көрсеткіші 1 миллионға шаққанда 114,5 болса, ауыл тұрғындары үшін 1 миллионға шаққанда 19,2 құрады. 2015 жылы балалар офтальмологтарымен қамтамасыз ету 1 миллион балаға 10,6 құрады. Балалар офтальмологтарының штаттық көрсеткіші аймақтар бойынша 0%-тен (Атырау облысы) 100%-ке дейін (Жамбыл және Түркістан облыстары) ауытқиды.

Қорытынды: Қазақстан Республикасында халықты офтальмологтармен қамтамасыз ету көрсеткіші аймақтар бойынша айтарлықтай өзгереді, бұл ретте қалаларда мамандар әлдеқайда көп шоғырланған. Балалар офтальмологтарының штаттық көрсеткіші де аймақтар арасында тең емес.

Түйінді сөздер: *офтальмологтар, денсаулық сақтау қызметкерлері, қала халқы, ауыл халқы*

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Introduction

It is estimated, that 36 million people are blind worldwide and about one-fifth of the world's population experience vision loss [2]. The majority of vision loss (90%) is preventable or treatable [20]. According to the Vision Atlas of the International Agency of Blindness, there were an estimated 2.3 million people of vision loss in the Republic of Kazakhstan (further Kazakhstan) in 2020. Of these, 60 000 people were blind [20].

Globally there are approximately 14 million blind children [12]. Childhood blindness, being although rare, has lifelong implication. It may restrict children's educational opportunities and employment in the future [7]. It was estimated that about a half of the conditions leading to the pediatric blindness is avoidable [4]. Thus, access to the eye care is critical in improving eye health status of whole population, especially in children, due to the fact that the most of conditions leading to the visual impairment and blindness are asymptomatic and children usually do not complain of visual difficulties. Therefore, it is crucial to identify and manage those diseases early on.

The human factor is a key link that ensures the effectiveness of the entire healthcare system. Demographic, political, socio-economic, technological, epidemiological changes intensify the problems of health care institutions associated with the imbalance of human resources [5, 6, 9]. To date, the following problems remain relevant for healthcare organizations in Kazakhstan: the level of training, staffing with qualified specialists, as well as the lack of medical personnel in rural areas [6, 9, 21].

The study of ophthalmologist density allows in general to judge the availability of eye care to the population. Along with this, the staffing level of specialists has a significant impact on the quality of medical care.

The aim of our study was to analyze the ratio of ophthalmologists per 1 million population across the regions of Kazakhstan in the period of 2015-2020 years, as well as a separately study the staffing rate of pediatric ophthalmologists.

Materials and methods. A comparative retrospective descriptive analysis of the ratio of ophthalmologists per 1 million population across the regions of Kazakhstan for the period of 2015-2020 was carried out according to the data from the statistical collections "Health of the population of Kazakhstan and the activities of healthcare organizations". The analysis of the relative annual change of workforce density was performed using Clopper-Pearson method with a 95% confidence interval. A descriptive analysis of the staffing of pediatric ophthalmologists was performed according to the information system "Resource Management System" on the date of October 1st, 2020.

Results

In 2015, the population of Kazakhstan was 17 670 600 people and there were 1441 ophthalmologists [13]. This represents the ratio of 81.5 ophthalmologists per 1 million population. In 2020, there were 1425 ophthalmologists and the population of our country was 18 879 552 people [15]. This ratio of ophthalmologists increased in 2016 to 89.9 per 1 million population. Then it showed downward trend during the study period (Figure 1).

Figure 2 represents the average workforce density across the provinces of Kazakhstan during the study period. The highest average ratio was observed in Almaty city (227.1 per 1 million population), Astana (176.1) and Aktobe region (93.1). The lowest average workforce density was in Almaty region (34.7 per 1 million population), Kostanay (43.5), Turkestan (44.4) and Zhambyl regions (44.5). The actual numbers of ophthalmologist's ratio across the regions of Kazakhstan in different years is presented in Table 1.

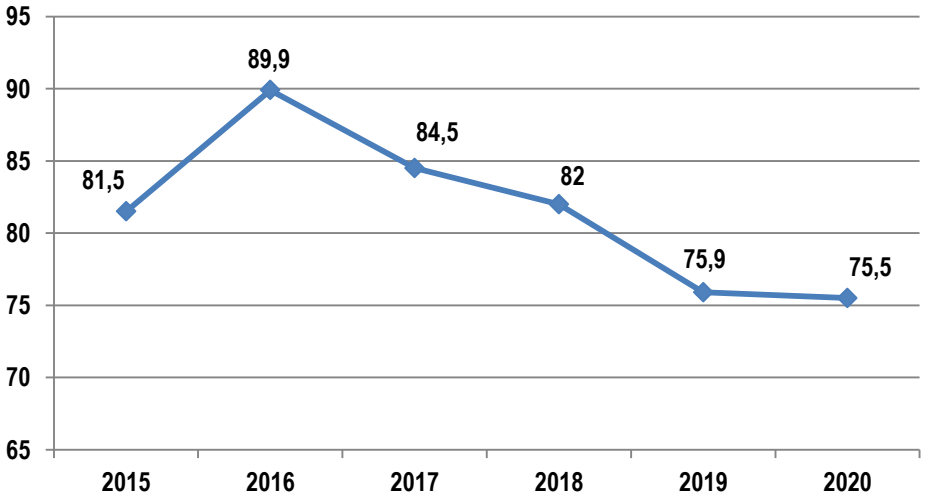

Figure 1. Ophthalmologist density per 1 million population in the Republic of Kazakhstan over study period [13–18].

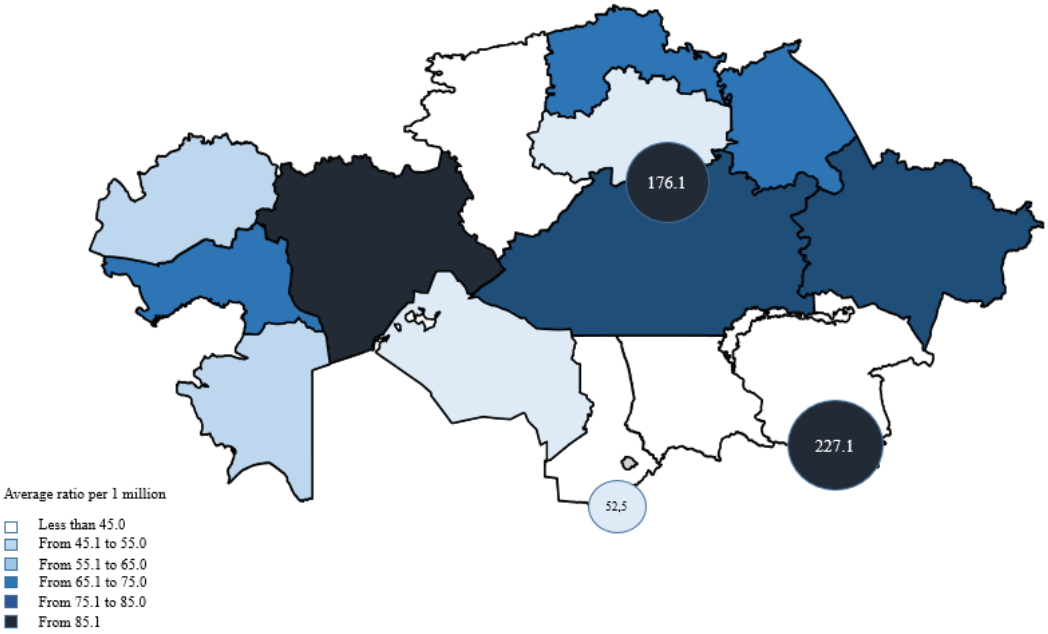

Figure 2. Average workforce density across the provinces of Kazakhstan per 1 million population over study period [13–18]

Table 1 represents the ophthalmologist distribution in relation to the entire population (urban and rural) in the regions of Kazakhstan. During the study period the highest ophthalmologist density was observed in Almaty city, the lowest in Almaty region. The ratio of ophthalmologists was higher than national average level in 5 regions (Almaty city, Astana, East Kazakhstan, Karaganda and Aktobe), remaining 12 regions were below the national average (Akmola, Almaty, Atyrau, West Kazakhstan, Zhambyl, Kostanay, Kyzylorda, Mangystau, Pavlodar, North Kazakhstan, Turkestan and Shymkent city) [13–18].

We separately analyzed the ratio of ophthalmologists to urban and rural population. In 2015, 57% of the population of Kazakhstan lived in cities (10 066 500 people). The number of ophthalmologists in the cities accounted for 1286 people [13]. By 2020, 1277 ophthalmologists provided ophthalmic care for the people living in the cities (11 045 014 population) [15]. Figure 3 represents the provision of urban population with ophthalmologists per 1 million population during 2015-2020 years. A downward trend was noted in the national average. It was found that the maximum ratio during the entire study period was observed in the Almaty city: 237.3 (2015), 298.6 (2016), 254.8 (2017), 220.0 (2018), 178.9 (2019) and 177.0 (2020). There was also a decrease in the ratio in the following regions: Akmola, Atyrau, Kyzylorda, Mangystau, North Kazakhstan, East Kazakhstan regions, as well as in the cities of Astana and Almaty. A relatively stable ratio of ophthalmologists was observed in Karaganda, West Kazakhstan, Pavlodar, Turkestan regions and the city of Shymkent. In 2020 the highest ratio was in Almaty city (177.0) and the lowest in Shymkent city (54.9) followed by Akmola (57.3) and Kyzylorda regions (60.3). Compared with the national average, 4 regions (Almaty city, Astana, Turkestan and Aktobe regions) were above and 9 regions were below the national average (Akmola, Almaty, West Kazakhstan, Zhambyl, Karaganda, Kostanay, Kyzylorda, Pavlodar regions and Shymkent city). The remaining 4 regions were in the line with the national average [13–18].

Table 1.

Provision of whole population with ophthalmologists per 1 million population over study period (Health of the Population of the Republic of Kazakhstan and the Activities of Health Organizations in 2015-2020. Statistical compendium [13–18])

Region	Ratio of ophthalmologists 2015	2016	Relative change (95%CI)	Ratio 2017	Relative change (95%CI)	Ratio 2018	Relative change (95%CI)	Ratio 2019	Relative change (95%CI)	Ratio 2020	Relative change (95%CI)
Akmola	57.8	61.3	6.75% (1.66-16.89)	54.2	-11,58% (-22.38- (-4.79))	46.0	-15.13% (-27.56 – (-6.77))	31.2	-32,17% (-47.66- (-19.07))	38.1	21.50% (8.77 – 39.80)
Aktobe	86.2	80.4	- 6.73% (-14.38- (-2.38))	93.3	16.04% (8.72 – 26.02)	101.2	8.47% (3.61 - 16.21)	106.6	5.34% (1.76 – 11.86)	90.6	-15.01% (-23.23 – (-8.83))
Almaty	32.3	32.3	-	36.2	12.07% (3.02 – 28.86)	38.7	6.91% (1.17 – 20.50)	34.1	-11.89% (-26.44 – (-3.68))	34.6	1.47% (0.00 – 12.90)
Atyrau	69.0	65.8	- 4.64% (-12.75- (-0.97))	67.7	2.89 (0.21 – 10.80)	69.4	2.51% (0.18 – 9.83)	63.5	-8.50% (-17.91 – (-3.02))	68.5	7.87% (2.61 – 17.43)
West Kazakhstan	72.2	67.0	- 7.2% (-15.9 - (-2.38))	64.9	-3.13% (-10.70- (-0.38))	59.8	-7.86% (-17.83- (-2.60))	60.9	1.84% (0.05 – 9.39)	62.0	1.81% (0.05 – 9.23)
Zhambyl	44.1	50.2	13.83% (5.25 – 27.63)	39.4	-21.51% (-35.52- (-11.07))	47.1	19.54% (8.56 – 35.39)	44.2	-2.34% (-11.79 – (-0.06))	42.1	-4.75% (-15.88 – (-0.58))
Karaganda	81.6	83.2	2.33% (0.17 – 8.79)	83.3	0.12% (-0.84 – 5.49)	90.7	8.88% (3.65 – 17.32)	85.0	-6.28% (-13.50 – (-2.22))	85.8	0.94% (0.00 – 6.39)
Kostanay	43.0	42.1	-2,09% (-12.88 – 0.00)	38.8	-7.84% (-20.74 – (-1.65))	43.5	12.11% (3.75 – 26.79)	46.1	5.98% (1.01 – 17.73)	47.4	2.82% (0.07 – 13.09)
Kyzylorda	41.8	47.9	14,59% (5.55 – 29.03)	49.8	3.97% (0.29 – 14.58)	50.4	1.20% (0.00 – 9.57)	53.5	5.56% (0.94 – 16.21)	47.9	-10.47% (-21.97 – (-3.73))
Mangystau	52.7	59.1	12,14% (4.60 – 24.33)	62.1	5.08% (1.06 – 14.13)	72.3	16.43% (8.17 – 28.08)	51.5	-28.77% (-40.66 – (-18.67))	52.8	2.52% (0.06 – 11.79)
Pavlodar	72.5	68.7	- 5.24% (-13.37- (-1.28))	66.3	-3.49% (-11.39- (-0.43))	61.0	-7.99% (-17.49 – (-2.65))	66.5	9.02% (3.20 – 19.15)	66.6	0.15% (-1.03 – 6.78)
North Kazakhstan	68.5	69.2	1.02% (0.00 – 7.46)	68.1	-1.59% (-8.16- (-0.04))	68.5	0.59% (-0.86 – 7.31)	63.8	-6.86% (-15.77 – (-2.10))	66.2	3.76% (0.46 – 12.22)
East Kazakhstan	85.3	87.1	2.11% (0.15 – 8.14)	83.1	-4.59% (-11.34- (-1.27))	86.3	3,85% (0,80 – 10,67)	81.0	-6.14% (-13.61 – (-2.03))	77.0	-4.94% (-12.16 – (-1.36))
Astana	193.7	202.5	4.54% (2.04 – 8.56)	178.2	-12.00% (-17.32- (-7.84))	163.2	-8.42% (-13.50- (-4.79))	160.2	-1.84% (-5.28 – (-0.38))	158.7	-0.94% (-3.94 – (-0.07))
Almaty city	233.1	298.6	28,10% (22.43 – 34.34)	254.8	-17.19% (-22.41- (-12.76))	220.0	-13.66% (-18.51- (-9.68))	178.9	-18,68% (-24,48 – (-13,75))	177.0	-1.06% (-4.09 – (-0.08))
South Kazakhstan (Turkestan since 2018)	46.5	46.9	0.86% (-1.18 – 10.45)	47.1	0.43% (0.00 – 8.98)	41.8	-11.25% (-24.09- (-3.77))	41.7	-0.24% (-9,24 – 0.01)	42.1	0.96% (-1.29 – 11.48)
Shymkent city (since 2018)	-	-		-		49.5	-	53.0	7.07% (1.74 – 18.08)	54.9	3.58% (0.26 – 13.26)
Republic of Kazakhstan	**81.5**	**89.9**	**10.31% (4.56 – 19.18)**	**84.5**	**-6.01% (-13.28- (-1.98)**	**82.0**	**-2,96% (-9.17- (-0.50))**	**75.9**	**-7.44% (-15.45 – (-2,78))**	**75.5**	**-0.53% (-6.60 – 0.78)**

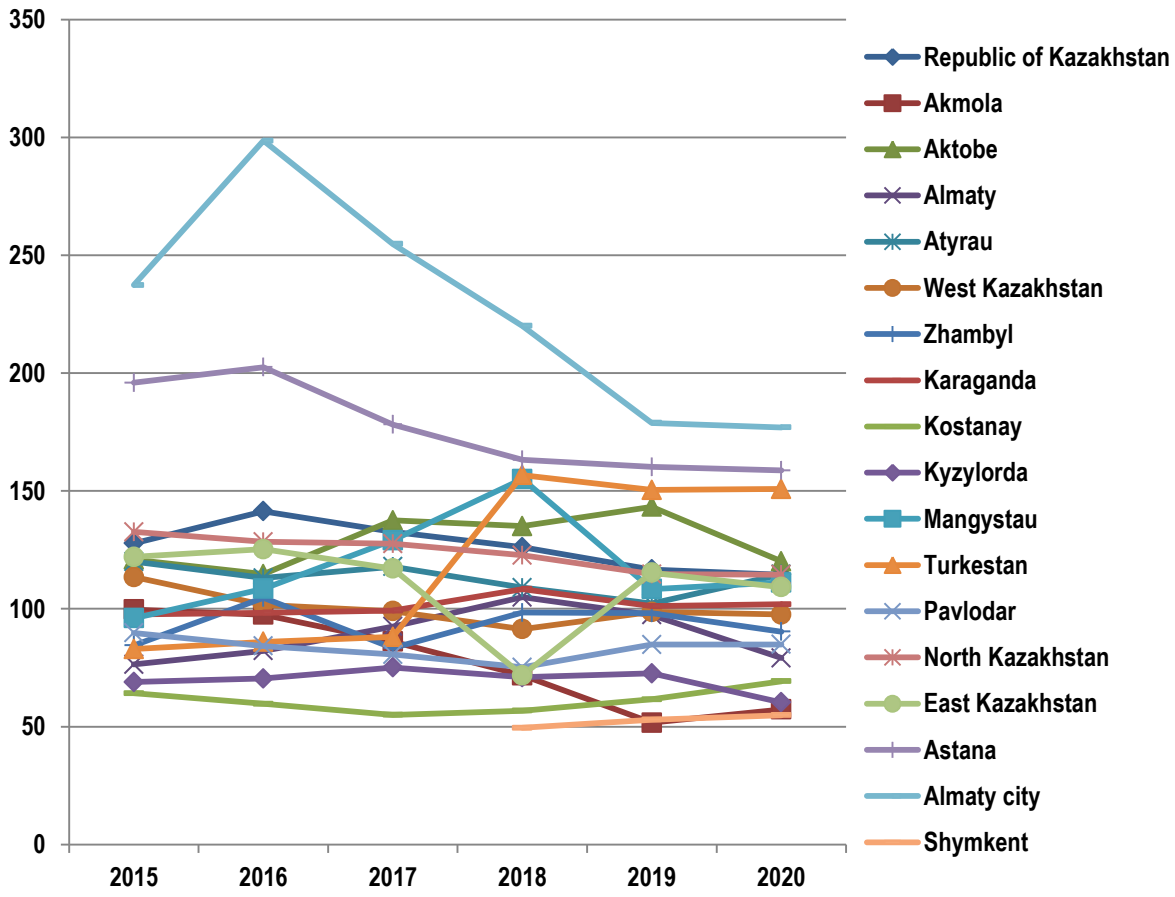

Figure 3. Provision of urban population with ophthalmologists per 1 million population over study period (Health of the Population of the Republic of Kazakhstan and the Activities of Health Organizations in 2015-2020. Statistical compendium [13–18]).

In 2015, 155 ophthalmologists provided care to the rural population of Kazakhstan (7 576 500 people) [13]. By 2020, the number of ophthalmologists accounted for 148 (rural population 7 728 176 people) [15]. Figure 4 represents the provision of rural population with ophthalmologists per 1 million population during the study period. Although the national average remained relatively stable, there were fluctuations of the ratio of ophthalmologists within the regions. A downward trend was noted in the western regions of Kazakhstan (Atyrau, West Kazakhstan regions) and an upward trend was noted in the Kyzylord region. Ratio of ophthalmologists showed an upward trend in East Kazakhstan region until 2019 (the highest rate of 44.2 per 1 million population) with a sharp drop in 2020 (23.4). In other regions, the indicator of provision with ophthalmologists remained relatively stable. Low rates of provision with ophthalmologists of the rural population for the entire period of the study were noted in the Zhambyl and Turkestan regions (12.1 and 14.3 per 1 million population, respectively). In 2020, the ratio of ophthalmologists was the highest in Kyzylorda region. Six regions were below the national average (Aktobe, Atyrau, Zhambul, Kostanay, Mangystau and Turkestan regions). The remaining 7 regions were just above with the national average [13–18].

Next, we analyzed the staffing of pediatric ophthalmologists across the regions of our country. According to the information system "Resource Management System", the number of pediatric ophthalmologists in Kazakhstan on the date of October 1st, 2020 was 67. In 2020, the number of children 0-17 year old was 6 295 590 [15]. This gives the ratio 10.6 pediatric ophthalmologist per 1 million pediatric population. The national average staffing rate of pediatric ophthalmologists was 73% (table 2). The staffing rate of pediatric ophthalmologists varied significantly by region. The highest rate was noted in the Zhambyl and Turkestan regions (100%). In Atyrau region, this indicator was the lowest (0%). Compared with the national average, 8 regions were above (Aktobe, Almaty, Zhambul, Karaganda, Pavlodar, East Kazakhstan, Turkestan regions and Almaty city) and 8 regions were below (Akmola, Atyrau, West Kazakhstan, Kostanay, Kyzylorda, Mangystau, North Kazakhstan regions and Astana).

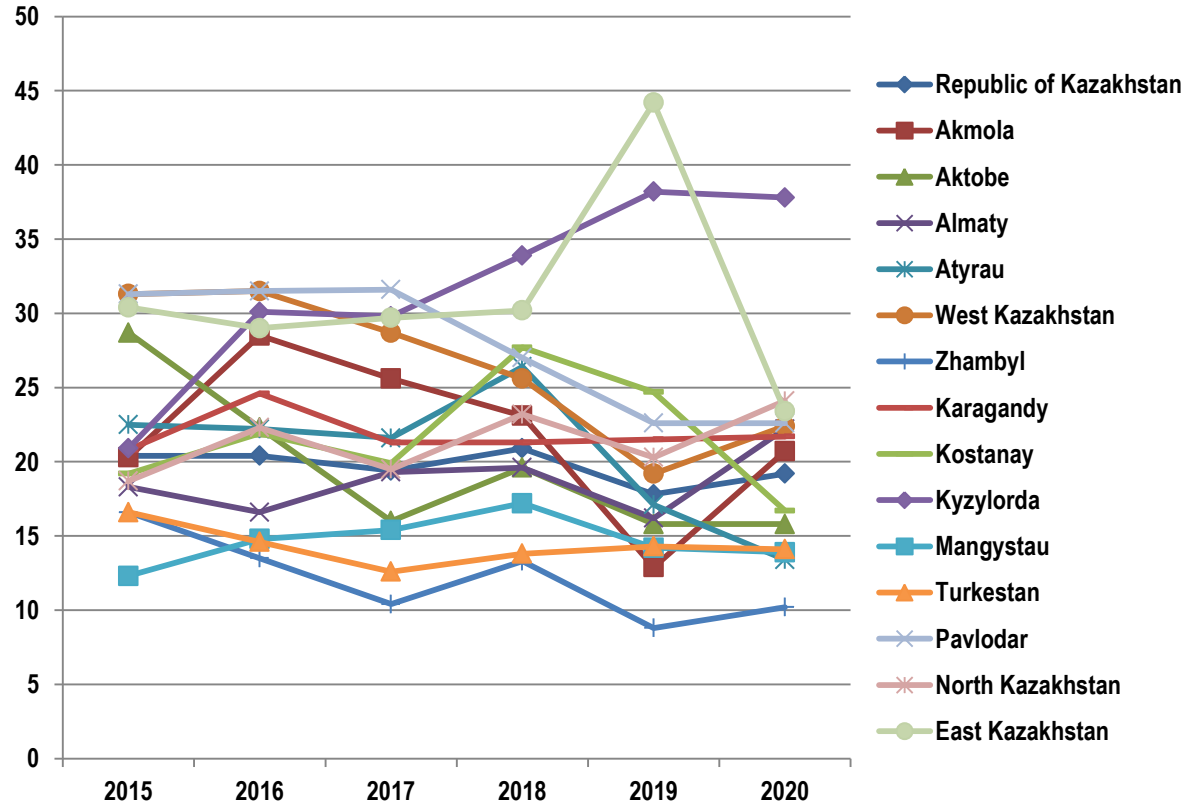

Figure 4. Provision of urban population with ophthalmologists per 1 million population over time (Health of the Population of the Republic of Kazakhstan and the Activities of Health Organizations in 2015-2020. Statistical compendium[13–18]).

Table 2.

Information regarding the number of pediatric ophthalmologists and the staffing level of pediatric ophthalmologists on the date of October 1st, 2020.

Region	Established staff positions	Occupied staff positions	Individuals (number)	Staffing rate of pediatric ophthalmologists (%)
Akmola	2.50	0.50	0	20%
Aktobe	6.25	4.75	5	76%
Almaty	4.00	3.75	2	94%
Atyrau	0.50	0.00	0	0%
West Kazakhstan	4.75	3.25	2	68%
Zhambyl	3.00	3.00	2	100%
Karaganda	13.75	10.75	8	78%
Kostanay	4.00	1.25	1	31%
Kyzylorda	7.00	3.50	3	50%
Mangystau	6.50	3.75	4	58%
Pavlodar	10.75	8.00	8	74%
North Kazakhstan	0.75	0.50	0	67%
East Kazakhstan	12.75	10.50	7	82%
Turkestan	10.50	10.50	10	100%
Astana	13.50	8.50	6	63%
Almaty city	23.00	18.25	9	79%
Republic of Kazakhstan	**123.50**	**90.75**	**67**	**73%**

Discussion

The Republic of Kazakhstan is the ninth-largest country in the world with one of the lowest population densities (less than 6.93 people per square kilometer) [6]. On June 19, 2018, by decree of the President of Kazakhstan, the South Kazakhstan region was renamed Turkestan, and its administrative center was transferred from Shymkent to Turkestan; Shymkent was withdrawn from the South Kazakhstan region, having received the status of a city of republican significance [19]. In our study we found that in 2020 the ratio of ophthalmologists in Kazakhstan was 75.5 per 1 million population or 1 ophthalmologist per 13 245

populaiton. The World Health Organization recommended target ratios of 1 per 50 000 population for Asia [22]. Although our finding exceeds this indicator, we observe a significant variation among the regions of our country. The ratio of ophthalmologist was higher than the national average level in 5 regions, which have large medical universities. Similarly, L. Bellan et al. found that despite the stable levels of national estimates of distribution of ophthalmologists in Canada, there were significant regional disparity [1].

In 2015, the International Council of Ophthalmology (ICO) carried out a survey study to gather the data about global distribution of ophthalmologists and analyze their relationship to income of the countries, prevalence rates of blindness and visual impairment and gross domestic product (GDP) per capita [11]. It was found that there were 232 866 ophthalmologists in 194 countries. Ophthalmologist density was positively associated with income of the countries, inversely correlated to the prevalence rates of blindness and visual impairment and positively correlated with GDP per capita. The ratio of ophthalmologists was estimated per million population. In 2015, the population of Kazakhstan was 17 670 600 people and there were 1441 ophthalmologists. This gives an ophthalmologist density of 81.5 per million population in 2015 in Kazakhstan. According to the ICO survey, this ratio is comparable with ophthalmologist density in high income countries, like Finland (81.8 per million population), Israel (80.6 per million), Norway (81.0 per million), Saudi Arabia (80.7 per million) [11].

According to the Order of the Minister of Healthcare of the Republic of Kazakhstan "On approval of the minimum standards for the provision of regions with medical workers" No. KR DSM -205/2020 dated November 25, 2020, the standard for the provision of cities of republican, regional significance with ophthalmologists is 0.4 per 10,000 or 40 per 1 million population, and cities of regional significance, towns and villages - 0.2 - 0.3 per 10,000 or 20-30 per 1 million population. At the same time, the index specified in this order is representing the minimum value. We found that the national average for urban population was much above the recommended minimum ratio (114,5 per 1 million population in 2020), while the ratio of ophthalmologists in rural areas was six time lower – 19.2 per 1 million in 2020. However, there were large regional variations. The ophthalmologist density in rural areas in our study was much lower than in urban areas. Likewise, P. W. Feng et al. reported that in the United States of America (USA) rural counties had a lower mean ophthalmologist density (5.8 per 1 million individuals) compared with nonmetropolitan (21.9 per 1 million population) and metropolitan counties (62.9 per 1 million) in 2017 [3]. H. Hong et al. found that on average, there were 52 ophthalmologists per 1 million population in Latin America with high inequality in distribution of ophthalmologists between and within countries. More ophthalmologists were concentrated in more developed, socially advantaged areas [8]. The study of national trends of eye care workforce in USA reported that possible explanations of rural/urban disparity are less sufficient healthcare infrastructure in rural areas and the fact that most residencies are located in cities and specialists may prefer to settle in urban location for lifestyle reasons [3].

The staffing rate of pediatric ophthalmologists in our study was variable depending on the region. In some regions, for instance, Akmola and Kostanay regions the staffing rate was low, Atyrau region had no pediatric ophthalmologist. In southern regions (Zhambyl and Turkestan) the staffing rate was 100%. Overall, the pediatric ophthalmologist's ratio was 10.6 per million pediatric population. This ratio is close to the median ratio of pediatric ophthalmologists across the states of USA (11.7), according to the recent study by K.E. Lee at al. [10]. Also they found that many states face a shortage of pediatric ophthalmologists due to the several reasons: insurance issues, rising numbers of retirement among specialists, declining interest of residents in pediatric ophthalmology [10].

Conclusion

The results of the study showed that during the study period, despite the relatively stable average national indicator of the provision of the entire population (urban, rural) with ophthalmic care, there were significant fluctuations in this indicator by region. It should also be noted that the provision of the rural population with ophthalmologists remains lower than the urban one. The staffing of pediatric ophthalmologists also varies significantly by region (from 0 to 100%). The average national value of this indicator on the date of October 1st, 2020 was 73%.

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