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Forecasting the Dynamics of Morbidity/Disability of Young People in Ukraine

Drozdova Irina Vladimirovna[*], Khramtsova Victoriia Victorovna, Honchar Yuliia Alexandrovna

Psycho-neurology, Psychotherapy & Medical Psychology Group of the Department, State Institution "Ukrainian State Institute of Medical and Social Problems of Disability Ministry of Public Health of Ukraine", Dnipro City, Ukraine

Email address:

drozdova@ua.fm (D. I. Vladimirovna), xvv2004@gmail.com (K. V. Victorovna), gonchar.yulia@gmail.com (H. Y. Alexandrovna)
[*]Corresponding author

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Abstract: In the current period of health care system reform in Ukraine the study of youth morbidity is particularly important due to the unfavorable demographic conditions in the country: increasing mortality and reducing fertility. In the light of this problem, approaches to the analysis and prediction of morbidity and disability of young people in Ukraine have been developed. The analysis of morbidity dynamics is done with our own design, using software that is the part of the Information technology of disability dynamics analysis. The results of analysis of the monitoring functioning of child morbidity in Ukraine, let the forecast be carried out in a short time series. The prevalence of all diseases In Ukraine for 2008 – 2016 years among adolescents 15–18 years increased by 38,87% (from 17037,06 to 23659,1), morbidity – by 32,32% (from 9444,78 to 12497,6 for 10 thousand population). During this period it took place the reduction of primary disability of people over 18 years among adult and working population. The highest among persons aged 18 years are the numbers of newly recognized disabilities in classes: mental and behavioral disorders (1431), congenital malformations, deformations and chromosomal disorders (1196), nervous system diseases (836 cases).

Keywords: Morbidity, Disability, Prediction, Epidemiology

1. Introduction

In the current period of health care system reform in Ukraine, a complex socio-economic situation of the population, there is a need in deeper study of children and adolescent morbidity, as of the future of the nation and the most important society resource [3, 4]. The study of youth morbidity is particularly important due to the unfavorable demographic conditions in the country: increasing mortality and reducing fertility [1, 10, 11]. In the research works of the next authors [1, 2, 10] had been shown an importance of child health quality under conditions of low birth rate that is largely dependent on parents' health, the nature of mother's pregnancy and birthing, quality and accessibility of health services for children and mothers.

European Regional Committee of the World Health Organization (WHO) has developed a European strategy "Health and development of children and adolescents" to attract the attention to the health care of children. Ukraine was chosen by WHO European Regional Committee as a pilot region for the implementation of that Strategy [4, 13]. The strategy identifies major problems in health care system for children and adolescents as well as their solutions, based on the experience of WHO over the past decades [4, 13, 14]. One of its tasks is the development of information technologies for collecting, analyzing, storing and predicting the dynamics of fertility, morbidity, disability and mortality among child population and adapting them to the requirements and standards of the European Union. One of the solutions of this problem may be the development of new approaches to the analysis and forecasting of child, adolescent and individual over 18 morbidity in Ukraine.

2. Objective

To develop approaches to the analysis and prediction of adolescent morbidity and primary disability of people over 18 years in Ukraine.

3. Materials and Methods

Prevalence and morbidity of adolescents (15–17 years) were studied in Ukraine from the statistics data of the Ministry of Health of Ukraine, according to F.12. "Statement of the diseases registered in patients living in the area of a certain health care service institution" in 2004–2008 and 2016, according to the International Classification of Diseases (ICD-10) [12].

Extended statistical information on the disability status of 18 years old people having the status of a "disabled child" in Ukraine contains "Report on the cause of disability, indications for medical, occupational and social rehabilitation" (p. 14). The report data analysis from 2013 has been used by the State Institution "Ukrainian State Institute of Medical and Social Problems of Disability Ministry of Public Health of Ukraine" for publishing the analytical and informative guide "Basic indicators of disability and activity of Ukrainian medical and social expert committees for... year" [9].

The analysis of morbidity dynamics is done with using software that is the part of the Information technology of disability dynamics analysis [5]. One of the elements of the developed Information technology of disability dynamics analysis is the computer technology for forecasting morbidity indicators, which are the time series forms:

$$\left\{ x_t; t = \overline{1, n} \right\} \tag{1}$$

where x_t – is the value of primary disability due to pathology x, registered in t- year; n – the number of years during which the morbidity of adolescents was monitored.

The results of analysis of the monitoring functioning of child morbidity in Ukraine, let the forecast be carried out in a short time series. Taking that into account, the adaptive methods of short-term forecasting became the basis of the developed computer forecasting technology [6, 8]. Adaptive forecasting methods are based on the principle of exponential smoothing, which takes into account the degree of information obsolescence and due to adaptation to changes in the test series it allows to obtain reasonably accurate estimates of future values, but no more than three steps forward [6, 8].

In order to select the most appropriate adaptive prediction model, the preliminary research of morbidity time series was conducted basing on the criteria of randomness and series visual analysis [6, 8]. The analysis of the survey results showed the presence of linear trends in a time series that justified the choice of models of linear growth of Holt, Brown and Box-Jenkins. At the core of these models is the hypothesis that the prognosis may be obtained by the formula:

$$\hat{x}_\tau(t) = \hat{a}_{1,t} + \hat{a}_{2,t}\tau \tag{2}$$

where $\hat{x}_\tau(t)$ – the prognosis for τ steps forward, made in t-th year; $\hat{a}_{1,t}$, $\hat{a}_{2,t}$ – the estimates of adaptive model coefficients.

4. Results and Discussion

Data analysis of disease morbidity and prevalence among adolescents in Ukraine for 2004–2008, developed and used methods of medium and long-term forecasting which have been conducted earlier [7], showed the possibility of all diseases prevalence growth among adolescents (15–17 years); diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (anemia, including iron deficiency anemia); diabetes (insulin–dependent diabetes) and obesity; nervous system diseases (vascular dystonia); diseases of the eye and adnexa (including myopia); diseases of the respiratory system (including acute pharyngitis, tonsillitis, tracheitis, chronic disease of tonsils and adenoids, laryngitis and laryngotracheitis); diseases of the digestive system (including gastritis and duodenitis, functional disorders of the stomach, pancreas diseases); pregnancy, childbirth and the postpartum period; birth defects (malformations), deformations and chromosomal disorders; other diseases of the heart; diseases of the skin and subcutaneous tissue; menstrual disorders.

According to the calculations, it was predicted the increase in adolescents morbidity in Ukraine for all diseases; diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (including anemia, including iron deficiency anemia); nervous system diseases (including vascular dystonia); diseases of the eye and adnexa, ear and mastoid process; diseases of the respiratory system (including strep throat and tonsillitis, allergic rhinitis, chronic laryngitis, laryngotracheitis); diseases of the digestive system (including gastritis, functional disorders of the stomach, pancreas diseases); diseases of the skin and subcutaneous tissue; obesity; essential hypertension and other heart diseases; menstrual disorders, pregnancy, childbirth and the postpartum period.

These statistical reports [12] show that among adolescents between 2008 and 2016 the prevalence of all diseases increased by 38,87% (from 17037,06 to 23659,1 for 10 thousand of population), morbidity – to 32,32% (from 9444,78 to 12497,6 for 10 thousand of population) (table 1).

Table 1. *The prevalence of diseases among adolescents (15–17 years) in Ukraine for 2004–2008, long-term prognosis, for the 2016 and primary disability of 18 year old people with the status of "a disabled child".*

Names of classes and specific diseases	Diseases prevalence among adolescents of 15–17 years			Primary disability of 18 year old people
	Average in 2004-2008 for 10 thousand population	Long-term prognosis	In 2016 to 10 thousand population	In 2016 to 10 thousand population
All diseases	17037,06	23659,10	21 545,3	*
Certain infectious and parasitic diseases	426,58	593,88	434,8	62
Neoplasms	98,92	122,68	155,4	286
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	142,48	289,77	220,0	143
Coagulation defects, purpura and other haemorrhagic conditions	130,24	270,72	205,5	93
Endocrine, nutritional and metabolic diseases	1293,22	1937,71	1 503,7	595
Diffuse goiter of 2–3 degrees	90,00	131,34	78,8	33
Diabetes mellitus	16,18	23,89	21,8	*
Including insulin-dependent diabetes mellitus	14,94	23,86	*	*
Obesity	139,02	285,69	293,9	*
Mental and behavioral disorders	461,06	203,84	350,9	1431
Diseases of the nervous system	1003,82	1307,88	1 177,9	836
Including vegetative dystonia	708,92	957,92	844,2	*
Diseases of the eye and adnexa	1296,60	1864,21	1 696,8	467
Including myopia	538,88	805,30	792,2	*
Diseases of the ear and mastoid process	366,28	368,24	427,3	412
Diseases of the circulatory system	555,64	638,81	779,8	161
including chronic rheumatic heart diseases	20,58	-2,12	4,3	*
Diseases of the respiratory system	5569,18	8249,18	8 223,7	167
Including acute pharyngitis and acute tonsillitis	335,46	580,95	57,1	*
Chronic disease of tonsils and adenoids	452,18	698,58	501,7	*
Chronic bronchitis	42,20	-17,03	20,2	*
Asthma	89,06	60,05	85,7	*
Diseases of the digestive system	1701,84	2477,15	1 919,3	79
In particular gastric and duodenal ulcer	42,98	9,62	29,7	*
Gastritis and duodenitis	564,16	737,17	517,2	*
Functional disorders of stomach	41,92	93,59	185,7	*
The pancreas diseases	28,68	52,09	45,8	*
Diseases of the skin and subcutaneous tissue	813,36	1094,03	977,9	39
Diseases of the musculoskeletal system and connective tissue	1568,02	1403,77	1 628,9	492
In particular rheumatoid arthritis	19,20	17,29	6,4	*
Diseases of the genitourinary system	834,04	2141,82	1 043,6	316
Including chronic glomerulonephritis	120,78	232,83	7,1	*
Kidneys Infections	94,10	167,95	142,4	*
Congenital malformations, deformations and chromosomal abnormalities	180,08	245,99	257,2	1196
Injuries, poisoning and certain other consequences of external causes	520,60	217,54	693,2	332

Notes: * – cases of primary disability (among 18 year old people) and diseases prevalence (among 15–17 years adolescents) from the given nosological unit were absent in 2016 year (on 10 thousand of population).

The prevalence of all diseases of adolescents increased by the growth of certain infectious and parasitic diseases (by 1,92%); neoplasms (57,1%); diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (to 54,41%), including anemia (by 57,59%); endocrine, nutritional and metabolic diseases (by 16,28%), including diabetes (by 34,73%); obesity (by 111,41%); diseases of the nervous system (17,34%), including vegetative-vascular dystonia (to 19,08%); diseases of the eye and adnexa (to 30,87%), including myopia (by 47,01%); diseases of the ear and mastoid process (to 16,66%); diseases of the circulatory system (to 40,34%); diseases of the respiratory system (by 47,66%), including tonsils and adenoids (at 10,95%); diseases of the digestive system (by 12,78%), functional disorders of the stomach (3, 4 times),

diseases of the pancreas (to 59,69%); diseases of the skin and subcutaneous tissue (by 20,32%); diseases of the musculoskeletal system and connective tissue (by 3,88%); diseases of the urinary system (25,13%), including infections of the kidneys (by 51,33%); congenital malformations, deformations and chromosomal disorders (at 42,83%); injury, poisoning and certain other consequences of external causes (to 33,15%). So, the highest growth rates of children diseases prevalence in Ukraine during 2008–2016 years were observed for the functional stomach disorders and obesity.

Only some nosological forms and classes of diseases for this period showed the decrease of morbidity: diffuse goiter 2–3 degrees – by 12,44%, mental and behavioral disorders – by 23,89%, chronic rheumatic heart disease – by 79,11%, acute pharyngitis and acute tonsillitis – by 82,98%, chronic bronchitis

– by 52,13%, asthma – by 3,77%, gastric and duodenal ulcer – at 30,89%, gastritis and duodenitis – in 8,32%, rheumatoid arthritis – at 66,66% and chronic glomerulonephritis – 94,12%. So the highest rates of decline of children diseases prevalence in Ukraine during 2008–2016 years were observed for chronic glomerulonephritis, acute pharyngitis, acute tonsillitis and chronic rheumatic heart disease.

By the classes of diseases, the highest ranks on the prevalence among adolescents in 2016 place respiratory diseases (8223,7), digestive (1919,3) diseases of the eye and adnexa (1696,8), of the musculoskeletal system and connective tissue (1628,9), endocrine, nutritional and metabolic diseases (1503,7), lower – neoplasms (155,4), diseases of the blood–forming organs and certain disorders involving the immune mechanism (220,0), congenital malformations, deformations and chromosomal abnormalities (257,2) and mental and behavioral disorders (350,9 for 10 thousand population).

Dynamics of adolescent morbidity over these years, led to the reduction of primary disability for people over 18 years among adults and working population in 2013 – 3,1 and 4,4, in 2014 – 2,9 and 3,3 in 2015 – 2,7 and 3,8 and in 2016 – 2,6 and 3,6 per 10 thousand population. However, the highest among persons aged 18 in 2016 remain the number of newly recognized disabled in classes: mental and behavioral disorders (1431), congenital malformations, deformations and chromosomal abnormalities (1196), diseases of the nervous system (836); the lowest – diseases of the skin and subcutaneous tissue (39), certain infectious and parasitic diseases (62) and diseases of the digestive system (79 cases).

The proposed approach to the analysis of the dynamics of youth morbidity / disability in Ukraine makes it possible to not only generalize data on morbidity / disability over a long period of time, set the leading trends during this period, assess the risk of increasing morbidity / disability as the result of various pathologies, but model the data on morbidity / disability for a certain period of time. All this is necessary for further improvement of organizational and methodological work of doctors and the development of targeted measures for the youth morbidity / disability prevention and reduction in Ukraine.

The prospects for further research of public health issues are to develop the youth morbidity / disability monitoring model in Ukraine with a list of indicators, monitored sources and its frequency, levels of surveillance, software for informational support of health care system functioning. For the study of multivariate dependent trends of morbidity / disability of population in Ukraine, it is necessary to use the methods of mathematical statistics, taking into account the ambiguity of the socio-economic, demographic, industrial, political and other features of the regions development.

5. Conclusions

The prevalence of all diseases in Ukraine for 2008 – 2016 years among adolescents 15 –18 years increased by 38,87% (from 17037,06 to 23659,1), morbidity – by 32,32% (from

9444,78 to 12497,6 for 10 thousand population). The prevalence of all diseases among adolescents increased due to the growth of neoplasms – 57,1%, diseases of blood and blood-forming organs and certain disorders involving the immune mechanism – by 54,41%, anemia – by 57,59%, obesity – by 111,41%, functional disorders of the stomach – by 3,4 times, diseases of the pancreas – by 59,69%, infections of the kidneys – by 51,33%, congenital malformations, deformations and chromosomal disorders – by 42,83%.

During this period it took place the reduction of primary disability of people over 18 years among adult and working population from 3,1 and 4,4 in 2013 to 2,6 and 3,6 per 10 thousand population in 2016. However, the highest among persons aged 18 years are the numbers of newly recognized disabilities in classes: mental and behavioral disorders (1431), congenital malformations, deformations and chromosomal disorders (1196), nervous system diseases (836 cases).

The development of information technologies of health dynamics analysis for young people enables not only generalizing data on morbidity / disability over a long period of time, establishing their leading trends during this period, assessing the risk of increasing morbidity / disability as a result of various pathologies, but also modeling the data of morbidity / disability for a certain period of time. All this is necessary for further improvement of the organizational and methodological work of doctors and development of targeted measures for the prevention and reduction of youth morbidity disability in Ukraine.

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