

ANALYSIS OF DIRECT COSTS OF HYPERTENSION TREATMENT AMONG ADOLESCENTS IN POLAND

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Abstract: In adolescents, arterial hypertension (AH) is diagnosed much more frequently than previously thought – it affects 3.2% of the population aged 11–18. In Poland, at present, there are no cost analyses of treatment arterial hypertension among adolescents. The aim of the conducted studies was to analyze direct medical and non-medical costs in the time horizon of one calendar year (2010) of AH treatment in adolescents in Poland. A retrospective study from the societal perspective was based on data from 480 patients medical history cards obtained from the archives of the hospital. From this group, according to the criteria for inclusion in the study, a research group was selected consisting of 36 patients aged 16–18 years, with a diagnosed and treated hypertension. Analysis covered direct medical costs (costs of pharmacotherapy, doctors' visits and laboratory tests, hospitalization) and direct non-medical costs (cost of transport to the outpatient clinic). Average annual cost of hypertension treatment per patient was 89.96 €. The largest part of the structure of total costs related with hypertension treatment in adolescents in Poland were the costs of medical consultation with lab tests and diagnostic examinations – 35.04% and pharmacotherapy costs – 32.95%, with hospital stays rating somewhat lower with 19.12%, and the smallest part were the costs of the patient's transportation to the hypertension outpatient clinic – 12.89%. Early identification of risk factors of such cardiovascular diseases as hypertension as early as in the developmental age, and their subsequent elimination, should be considered a good investment in the reduction of costs associated with hypertension treatment in adulthood.

Keywords: adolescents, arterial hypertension, disease cost analysis

Arterial hypertension is the most important and the most dangerous risk factor of cardiovascular incidents. It is estimated that incidence of AH in children and teenagers in the total population is around 1–3%. In children aged below 10 it is usually secondary. Incidence of primary hypertension increases with age and has become the main cause of arterial hypertension in teenagers. In adolescents, AH is diagnosed much more frequently than previously thought – it affects 3.2% of the population aged 11–18 (1).

The main reasons for increased incidence of AH in adolescents include the changes in the diet (increased consumption of high-calorie foods) and life style (little exercise) taking place over the last few decades. These changes have led to a global obesity epidemics in the younger generation (2). Apart from obesity, the main factors predisposing to development of AH in adolescents include: exces-

sive consumption of salt and comorbid fat and carbohydrate metabolism disorders (3).

AH is not only a major health problem but also a major economic issue both for the health care system and the society as a whole (4, 5). In Poland, at present, there are no cost analyses of undetected, untreated or ineffectively treated hypertension. Due to the major increase in AH incidence in adolescents, there are also no cost analyses of its treatment (6). Only estimation of costs associated with prevention and treatment of AH and its complications throughout the population gives a full representation of the economic burden of AH in Poland.

Analysis of the costs of the disease by estimating the economic burden and establishing the relationship between the individual costs of this disease is an integral part of reasonable functioning of the health care system. Analysis of disease costs allows indication of potential sources of savings in treat-

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ment expenditures. It is an argument in making decisions on implementation of preventive and therapeutic programmes and a reference point to estimate the benefits of the treatment applied (7).

The aim of this studies was to analyze direct medical and non-medical costs of AH treatment in adolescents in Poland.

EXPERIMENTAL

The study was conducted at the Chair and Clinic of Internal Diseases, Metabolic Disorders and Hypertension in Poznań. The study was approved by the bioethics committee.

Study group

A retrospective study from the societal perspective was based on data from 480 patients medical history cards obtained from the archives of the hospital. From this group, taking in account the described below criteria for inclusion in the study, there was selected research group consisting of 36 patients (11 women and 25 men) aged 16–18 years, with a diagnosed and treated primary hypertension (according to the International Statistical Classification of Diseases and Related Health Problems – ICD-10).

Inclusion criteria in the study were:

- age of 16-18;
- primary hypertension diagnosed (code I10 according to ICD-10) and treated at the selected outpatient clinic;
- continuation of hypertension treatment in the analyzed time horizon (provided at least two medical visits).

Research time horizon

Analysis covered treatment costs of patients who continued their treatment for a year at the selected health care facility. Time horizon adopted in the study was one calendar year (1. 01. 2010 to 31. 12. 2010).

Analytical technique

The study was based on data from the patients' medical records, doctors' request cards and data from the hospital organization and settlement department.

Analysis covered direct medical costs (costs of pharmacotherapy, doctors' visits and laboratory tests, hospitalization) and direct non-medical costs (cost of transport to the outpatient clinic). Estimated costs presented in euro, according to the table of average rates of the National Bank of Poland (number 012/A/ of 17. 01. 2013, 1 € = 4.1178 PLN).

Pharmacotherapy costs were calculated in relation to patients whose drug therapies were implemented, on the basis of wholesale drug prices set for quarters 1 to 4 in the study calendar year. Total costs of pharmacotherapy, other than expenses for antihypertensive drugs, in line with the guidelines of the Polish Hypertension Association (8) covered also expenses for hypolipidemic drugs, anti-platelet agents and potassium-containing preparations.

Costs of doctors' visits, lab tests and hospital stays were based on prices for medical services set by the National Health Fund (NFZ) in a contract with the selected health care facility. In the case of contracts with the NFZ, the costs of lab and diagnostic tests were included in the cost of medical consultation. In 2010, in the selected health care facility, the cost of medical consultation with the ordered lab/diagnostic tests based on a contract with the National Health Fund was valued at 9.96 €. The value of hospital stays based on the system of homogeneous patient groups on the basis of a contract with the National Health Fund amounted to 123.86 € per patient. The above-mentioned values were constant regardless of the number of tests ordered. The costs of hospital stays were calculated in relation to patients who required hospitalization for diagnosis and treatment of hypertension.

Costs of the patient's transport to the outpatient clinic were evaluated on the basis of single fare price list for the given calendar year agreed by the City Transportation Board in Poznań (MPK) and single fare price list agreed by Poznań bus company – PKS Poznań.

In the study group, none of the patients was occupationally active because of their age, and thus they did not generate any indirect costs related to productivity lost due to AH.

Analysis of costs of hypertension treatment did not take into account the cost of non-pharmacological treatment as it is not possible to estimate them reliably.

RESULTS

Study characteristics

Baseline characteristics of the participants are given in Table 1. The study group comprised 36 patients (11 women and 25 men) aged 17.2 ± 0.8 years. All patients included in the study were still studying (were not occupationally active) and thus did not generate any indirect costs related to productivity lost due to AH. Average duration of AH was 1.7 ± 0.7 years. Average value of systolic blood pressure for total study population over the analyzed

time horizon was 138 ± 11 mmHg and diastolic blood pressure – 81 ± 10 mmHg.

Analysis of antihypertensive therapy

In the analyzed study group, antihypertensive therapy was chosen by the managing physician. Of the entire study group, 44.4% of the subjects were treated solely non-pharmacologically. Pharmacological treatment was implemented for 55.6% of the subjects, of which 60% had monotherapy and for 40% combined therapy was applied. Supplementary therapy, consisting in the use of drugs containing potassium to maintain correct electrolyte balance, was implemented only for one person receiving combined therapy (2.7% of all subjects). In this case, the total cost of supplementary therapy was 21.3 €/year.

In the group treated pharmacologically, the most commonly used antihypertensive drugs were: β -adrenolytics (45% of subjects), angiotensin convertingase inhibitors (35% of subjects), calcium antagonists (35% of subjects), AT₁ receptor antagonists (10% of subjects), diuretics (10% of subjects) and α -adrenolytics (5% of subjects).

Cost analysis

Total cost of AH pharmacotherapy for adolescents over the study time horizon amounted in total to 1067.09 €. Average annual cost of AH pharmacotherapy per patient was 53.35 €.

The largest part of the structure of total costs related with AH pharmacotherapy were the costs of antihypertensive drugs – 98% (1045.82 €, 52.28 €/patient per year). Potassium-containing agents accounted 2% (21.27 €, 1.07 €/patient per year) of total cost related with AH pharmacotherapy.

Among the costs associated with the use of antihypertensive drugs, the largest part of the total costs structure were the costs of use of the following group of antihypertensive drugs: Angiotensin II receptor antagonists – 24% (254.04 €, 127.03 € per patient), β -blockers – 21% (216.67 €, 24.06 € per patient), calcium channel blockers – 21% (221.93 €, 31.69 € per patient) and angiotensin-converting enzyme – 17% (182.18 €, 26.03 € per patient), combined drugs (combination of two different active substances in one tablet) – 12% (119.84 €, 119.84 € per patient), diuretics – 4% (45.02 €, 22.5 € per patient) and α -blockers – 1% (6.12 €, 6.12 € per patient).

Table 1. General characteristics of adolescents with hypertension (n = 36).

Numbers	Total	36
	Women (%)	
Men (%)		25 (69.4%)
Age	General (M ¹ \pm SD ²)	17.2 \pm 0.8
	Women (M \pm SD)	17.4 \pm 0.8
	Men (M \pm SD)	17.1 \pm 0.8
Education	Primary (%)	36 (100%)
Source of income	Supported by parents (%)	36 (100%)
Place of residence	Poznań City (%)	15 (41.6%)
	Towns up to 50 km away from Poznań (%)	12 (33.3%)
	Towns away from the city of Poznań over 50 km (%)	9 (25.1%)
Duration of hypertension (years)	(M \pm SD)	1.7 \pm 0.7
Systolic blood pressure (mmHg)	(M \pm SD)	138 \pm 11
Diastolic blood pressure (mmHg)	(M \pm SD)	81 \pm 10
Controlled blood pressure (< 95 percentile) (%)	16	(44%)

¹ M = Average, ² SD = Standard deviation

Over the study time horizon in the entire study group with diagnosed AH treated at a selected outpatient clinic, 114 medical consultations have taken place, on average 3.2 ± 0.7 visits/patient.

Tables 2 and 3 show laboratory and diagnostic tests ordered in hypertension treatment in adolescents. During medical consultations, 16 types of laboratory tests were ordered, of which the largest part were measurements of the levels of: fraction of total cholesterol (69% of patients), LDL (69% of patients), HDL (69% of patients), triglycerides (69% of patients), creatinine (50% of patients) and thyroid-stimulating hormone (44% of patients). Furthermore, 3 types of diagnostic tests were ordered, including Holter pressure (22% of patients), Holter electrocardiogram (5% of patients), electrocardiogram (3% of patients). In the study

horizon, none of the patients had laboratory or diagnostic tests ordered more than once.

Total costs of doctor's visits and laboratory/diagnostic tests were estimated at 1135.4 €. Average total cost of medical consultations and test per 1 patient was: 31.5 €.

Of the entire study group, 5 patients required hospital treatment to diagnose secondary forms of AH. Average hospital stay time for these 5 patients was 3.4 ± 0.5 days. Total cost of hospital stays amounted to 619.3 € and average cost of hospital stay per patient was 123.86 €.

Direct non-medical costs comprising the cost of travel to the outpatient clinic from the city of Poznań and beyond its limits amounted in total to 417.35 €, with 11.58 € per patient per year.

Table 2. Laboratory tests ordered in hypertension treatment in adolescents (n = 36).

Type of tests	Percentage of patients with tests ordered n [%]
Morphology	22
Biernacki reaction	14
C-reactive protein	14
Urinalysis	11
Uric acid	19
Urea	19
Electrolytes	25
Creatinine	50
Total cholesterol	69
Low density lipoproteins	69
High density lipoproteins	69
Triglycerides	69
Fasting glucose	25
Glutamic oxaloacetic transaminase	36
Glutamic pyruvic transferase	36
Thyroid-stimulating hormone	44

Table 3. Diagnostic tests ordered in hypertension treatment in adolescents (n = 36).

Type of tests	Percentage of patients with tests ordered n [%]
Electrocardiogram	3
Holter pressure	22
Holter electrocardiogram	5

Table 4. Summary of the total cost of hypertension treatment of among adolescents (n = 36).

Type of costs	Total costs [€]	Average cost per patient \pm SD* [€]
Direct medical costs		
Pharmacotherapy	1067.09	53.35 \pm 35.43
Medical consultation with laboratory/diagnostic tests	1135.2	31.5 \pm 8.71
Hospital stays	619.3	123.86 \pm 0
Indirect medical costs		
Patient's transportation to the health care facility	417.35	11.58 \pm 9.25
Total	3238.94	89.96 \pm 60.13

*- Standard deviation

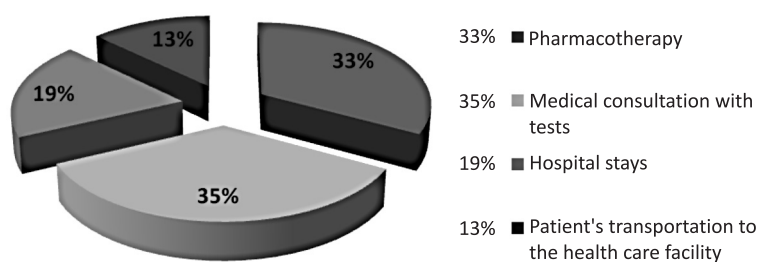


Figure 1. Structure of total costs of hypertension treatment in adolescents

Total cost of AH treatment in the adolescent group of 36 over the study time horizon amounted in total to 3238.9 €. Average total cost of hypertension treatment per patient was 89.96 € (Table 4).

According to the aim of conducted studies, structure of total costs of AH treatment in adolescents in Poland has been analyzed. The largest part of the structure of total costs of AH treatment in adolescents in Poland were the costs of medical consultation with tests – 35.04% and pharmacotherapy costs – 32.95%, with hospital stays rating somewhat lower with 19.12%, and the smallest part were the costs of the patient's transportation to the health care facility – 12.89% (Fig. 1).

DISCUSSION AND CONCLUSION

Early prevention aimed at improved detectability of AH by conducting screening measurements of blood pressure and preventing development of the disease by elimination of environmental factors predisposing to development of AH are an important aspect in the context of issues associated with AH in

children and adolescents (9). In the United States, it was estimated that the cost associated with screening assays for increase blood pressure values in adolescents aged 12–19 as a part of a two-year programme (in the years 2001–2003) of AH prevention amounted to 107 \$ per one subject. This cost included purchase of the necessary medical equipment to measure blood pressure values and fees for the medical staff involved in the program (10).

The knowledge of the economic burden and relationship between the individual components of costs of a disease is an integral part of reasonable management of limited resources of the health care system. Analysis of disease costs allows indication of potential sources of savings in treatment expenditures (11).

Conducted research has shown that the structure of AH treatment costs in adolescents is dominated by direct medical costs (87% of total costs). Average total cost of AH treatment per patient was 89.96 €.

Considering the fact that no papers on similar subjects were found in medical databases, these

results of the evaluation of costs associated with AH treatment in adolescents are the first such data in Poland and worldwide and an important point of reference for further research in this area.

The main reason for the lack of scientific reports on the analysis of costs of AH in adolescents is the strategy of therapeutic procedure. A vast majority of adolescents suffer from AH with the key indirect phenotype being obesity or overweight and secondary metabolic disorders, and thus non-pharmacological treatment is the mainstay of hypertension treatment (12). Non-pharmacological treatment, consisting in the change of lifestyle (increased amount of exercise or appropriate diet) is extremely difficult to estimate and express in monetary values.

Numerous clinical studies have shown that non-pharmacological treatment in antihypertensive therapy yields measurable health and economic effects. It was found that in children and adolescents with AH reduction of the amount of visceral fat and increase of the muscle weight promotes regression of the organ damage by reducing the left ventricular mass and the thickness of the carotid intima media thickness (ITM) (13).

Pharmacological treatment in adolescents with hypertension should be implemented in the case of secondary hypertension, grade II AH and/or the presence of organ damage or if non-pharmacological treatment fails to yield any effect over 3–6 months in adolescents with grade I AH with no organ damage (12).

According to many hypertension specialists, in view of the problem related with the increased incidence of AH in adolescents, it should be a priority to implement effective prevention programme in schools and at primary health care pediatric surgeries to detect hypertension, and, if necessary, strive to normalize blood pressure values to reverse organ damages and prevent cardiovascular incidents in adulthood (14). Such a strategy was adopted for the young population also by the World Health Organization (15).

It should be clearly emphasised that total costs associated with AH treatment comprise expenses on primary prevention, secondary prevention and prevention of complications. Costs incurred at individual stages depend on measures taken and are inter-related. Expenditures for effective prevention of hypertension result in reduced costs of AH treatment, which also minimizes the costs of possible cardiovascular incidents (16). Early identification of risk factors of such cardiovascular diseases as AH as early as in the developmental age, and their subse-

quent elimination, should be considered a good investment in the reduction of costs associated with AH treatment in adulthood (14). In the Framingham Heart Study it was proved that for patients who underwent a long-term antihypertensive therapy the risk of death due to cardiovascular incidents was 13% lower than in patients not treated or treated only occasionally (17).

Results of many pharmacoeconomic analyses confirm that cost-effectiveness of AH treatment depends on many factors, such as: age, sex, baseline blood pressure values and degree of compliance with doctor's recommendations (18, 19).

Evaluation of benefits of antihypertensive therapy based on the risk of cardiovascular events shows that the cost-effectiveness ratio (quality adjusted cost of one life year – QALY) of AH decreases with age as the risk of cardiovascular incidents increases with age (18).

Nevertheless, evaluation of cost-effectiveness of antihypertensive therapy in young people based on the risk of cardiovascular incidents raises many controversies. Therefore, the experts think that evaluation of effects of AH treatment in individual age groups should be based on different criteria. For young people, outcomes of antihypertensive therapy should be defined by evaluating its effect on indirect indicators of the risk of cardiovascular incidents such as hypotensive effect, organ damage regression and normalization of metabolic disorders (1). According to Zanchetti, the cost-effectiveness ratio, where clinical efficacy evaluation is based on long-term observation studies, increases with age, which suggests that early commencement of antihypertensive therapy even brings savings in the longer term (20).

As shown in the present study, the largest part of the structure of total costs related with hypertension treatment in adolescents in Poland were the costs of medical consultation with tests and pharmacotherapy costs. Early identification of risk factors of such cardiovascular diseases as hypertension as early as in the developmental age, and their subsequent elimination, should be considered a good investment in the reduction of costs associated with hypertension treatment in adulthood.

No conflicts of interest were reported.

REFERENCES

1. Litwin M.: Primary hypertension among children and adolescents. Więcek A., Januszewicz A., Szczepańska-Sadowska E., Prejbisz A.

- Eds., Hipertensjologia. The pathogenesis, diagnosis and treatment of hypertension (Polish). p. 377, Medycyna praktyczna, Kraków 2011.
- Fichna P., Skowrońska B.: Family Medicine and Primary Care Review 10, 269 (2008).
 - Pac-Kożuchowska E., Majewski M., Szajner-Milart I., Chrzęstek-Spruch H.: Przegląd Pediatriczny 31, 278 (2001).
 - American Heart Association. Heart and stroke facts: 1994 statistical supplement. American Heart Association, Dallas 1994.
 - Hermanowski T., Jaworski R., Czech M., Pachocki R.: Nadciśnienie tętnicze 5, 83 (2001).
 - Wilimski R., Niewada M.: Nadciśnienie tętnicze 10, 551 (2006).
 - Orlewska E.: Principles of pharmacoeconomics (Polish). p. 47, Unimed, Warszawa 1999.
 - Widecka K., Grodzicki T., Narkiewicz K., Tykarski A., Dziwura J.: Nadciśnienie tętnicze 15, 55 (2011).
 - The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. Pediatrics 114, 555 (2004).
 - Brosnan CH., Swint M., Upchurch S., Meininger J., Johnson G., Lee Y., Nguyen T., Eissa M.: Public Health Nurs. 25, 235 (2008).
 - Kwaśniewska M., Drygas W.: Terapia 8, 65 (2001).
 - Litwin M.: Treatment of primary hypertension in adolescents. in Hipertensjologia. The pathogenesis, diagnosis and treatment of hypertension (Polish), Więcek A., Januszewicz A., Szczepańska-Sadowska E., Prejbisz A. Eds., p. 586, Medycyna praktyczna, Kraków 2011.
 - Litwin M., Niemierska A., Sładowska J. et al.: Pediatr. Nephrol. 25, 2489 (2010).
 - Bryl W.: Nadciśnienie tętnicze 10, 273 (2006).
 - Prevention in childhood and youth of adult cardiovascular disease: time for action. Report of a WHO Expert Committee. World Health Organization, Geneva 1990.
 - Czech M.: Pharmacoeconomics in pharmaceutical care (Polish), p. 37, Farmapress, Warszawa 2008.
 - Sytkowski P.A., D'Agostino R.B., Belanger A.J., Kannel W.B.: Circulation 93, 697 (1996).
 - Mar J., Rodriguez-Artalejo F.: J. Hypertens. 19, 149 (2001).
 - Ambrosioni E., Costa F.V.: J. Hypertens. Suppl. 14, 47 (1996).
 - Zanchetti A.: Am. J. Cardiol. 79, 3 (1997).

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