SHORT THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (PHD)

CHILDHOOD OBESITY AND DESCRIPTION OF PRIMARY CARE IN SOME EUROPEAN COUNTRIES

Anthropometric measurements of children in 6 countries and description of healthcare systems in the former Eastern bloc countries

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INTRODUCTION

Childhood obesity: a global public health issue

Obesity levels have quadrupled in the last 30 years as a result of a general trend worldwide (industrialization, urbanization, a sedentary lifestyle, and a nutritional transition to processed foods). Given current practices, researchers predict that this epidemic will worsen in the future, highlighting the need to adjust policies and measures. Research programme initiatives targeting different countries and groups are good, but there would be a requirement for a more complex, larger-scale strategy that seeks to curb obesity in multiple, simultaneous areas. There is also a need for long-term, clearly structured primary prevention trials with parents and their children as the target groups. Schools are seen as inevitable supporters of obesity prevention, yet face barriers in implementation of this duty. To improve the efficacy of interventions, a multidimensional approach is indispensable. Disproportion between PA and calorie intake is a dominant cause of obesity in children and adolescents. Furthermore, genetic, biological-, socio-environmental factors, as well as family, school, community, socio-economical status and national policies are pieces of a complex puzzle. The complexity of risk factors leads to the difficulty of early detection and efficient treatment of young aged children.

Definition of overweight and obesity: BMI calculation for children

Childhood obesity is one of the most serious and difficult public health issues in both developed and developing countries. Anthropometric measurement is a routine part of children's care, typically conducted by paediatricians, midwives, or other school health service personnel.

Individual growth trend (weight and height) and BMI are two of the most significant health indicators for children that are regularly measured (Body Mass Index). Professionals agree that children two years of age or older with a BMI between the 85^{th} and 94^{th} percentile on age-growth charts are overweight, while children with a BMI greater than the 95^{th} percentile are obese. National databases of children's populations are frequently out of date and do not always providing appropriate representation. In recent decades, there has been a shift in the anthropometric measurements of children due to the acceleration of their growth. This phenomenon is strongly linked to changes in their living conditions, increased nutrition, and other socioeconomic factors. BMI is age and gender

specific in children and teenagers, and is often referred to as BMI-for-age. After calculating BMI for children and adolescents, it is expressed as a percentile using either a graph or a percentile calculator. The BMI-for-age percentile growth charts are the most commonly used indicator for measuring children's and adolescents' size and growth patterns.

Reasons and health consequences of childhood obesity

Sedentary lifestyle indicated by insufficient physical exercise is one of the causes of obesity in childhood. Nowadays, in this digitalized world, social media, video games, internet usage consume most of children's spare time and it has led to an inactive lifestyle in general. There is a greater likelihood for obesity among children in the lower and middle socioeconomic income families. The chance to access healthy food and opportunities for several physical activities are slighter in these particular strata. Healthy eating fixated in early ages of childhood is decisive if talking about prolonged lifelong habits. Primary care providers (PCPs) as family physicians (FPs) could be a helping hand and positive impact by counselling about obesity risk factors and giving guidance to adopt these lifestyle habits. Obesity in childhood is likely to lead to obesity in adulthood, so it should be reduced in childhood, in the early years. Moreover, obesity incurs substantial direct and indirect expenses for individuals, families, and society as a whole.

Connection of obesity and type 2 diabetes mellitus

Diabetes mellitus is a chronic noncommunicable metabolic disorder of glucose homeostasis that occurs when the pancreas no longer produces insulin (β- cell dysfunction) or when the body becomes insulin resistant (insulin resistance). Diabetes type 2 is the most common type, accounting for 90% of all diabetes cases. Together, genetic and environmental factors play an important role in the development of diabetes. Type 2 diabetes mellitus (T2DM) was previously referred to as adult-onset diabetes. However, epidemiologic evidence and clinical reports suggest that type 2 diabetes in youth is becoming more common in recent decades. Prediabetes, which can pave the way for diabetes is a preventable illness characterized by elevated blood sugar levels that are not yet high enough to be diagnosed as fully developed type 2 diabetes. Prediabetes, being devoid of symptoms, frequently remains untreated for an extended period until it progresses into fully manifested diabetes mellitus. It is also noted that the rising prevalence of T2DM is attributed to the failure to accurately identify and address the reversible and avoidable condition of prediabetes, which can prevent its development

into diabetes mellitus. In the past ten years, well-regarded randomized studies have unequivocally verified that interventions targeting lifestyle modifications in those at risk of diabetes can successfully prevent or postpone the onset of diabetes.

Programme initiatives for obese population: adults

In some countries there were different initiatives for adult population of obese and overweighed patients. We have to mention the Counterweight Project which was a meticulously designed general practice project that represented the pioneering effort of practice nurses to address the issue of obesity management in primary care. It stands as the first comprehensive intervention of its kind, aiming to enhance the overall approach to obesity management within this healthcare setting. The Counterweight Programme has been established as a successful approach for addressing obesity in the United Kingdom. The findings indicate that individuals who attended regularly had the most positive outcomes, implying that it would be beneficial to explore strategies aimed at improving attendance and retention in greater depth. In Hungary there was also a primary care project within a limited period, unfortunately with shorter follow-up time.

Programme initiatives for obese population: children - *The Toybox study and the Feel4Diabetes study*

The *ToyBox* intervention was created with the purpose of preventing childhood obesity rates in 4-6 years old kindergarteners. In these pre-schoolers targeted interventions were involved 6 European countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain). This study was the „sibling" of the Feel4Diabetes study *(Families across Europe following a hEalthy Lifestyle FOR Diabetes prevention: Feel4Diabetes).* The *Feel4Diabetes study (F4D)* has been granted funding from the European Union's Horizon 2020 research and innovation initiative. The study focused on the pupils of the primary schools. Similar methods were used and socioeconomic status (SES) were considered as well. There was only a small change in the participated countries, Poland was replaced by Hungary, where population mostly have low socioeconomic status (Low and Low Middle Income Countries - LMIC). Bulgaria and Hungary were involved as LMC, Belgium and Finland as High Income Countries (HIC). Two other HIC countries under austerity measures (Greece-Spain) were also joined to the project. The specified group of children were reached through primary schools. A

two-phased method was implemented. Children underwent anthropometric measurements in school and their parents were asked to fill out the Finnish Diabetes Risk Score (FINDRISC) and the Energy-Balance-Related Behaviour (EBRB) questionnaire. Based on the answers, high-risk families (HR) were identified, and these individuals were invited to the second phase of screening, which included anthropometric measurements as well as fasting plasma glucose and blood pressure measurements. All the parameters were checked again after the 2 years long intervention phase had been completed. Increased amount of physical activity and nutritional counselling were part of the intervention. Interventions took place in the schools with the help of teachers who got special, project-focused education from the F4D staff members.

Prevention and treatment of childhood obesity in primary care settings

Healthcare professionals (HCP) should measure height and weight to calculate BMI at every face to face meeting with the child. The CDC, the WHO BMI charts and online calculators can be used to find out BMI percentile for age and sex as well as the International Obesity Task Force (IOTF) cut-offs. Weight gain that crosses BMI percentiles is especially concerning. Primary care systems have different structure in the respective countries, these options are differently utilized. There are countries where different structure of paediatric care exists. In the Western part of Europe, GPs usually care not only adults, but children as well. In the Eastern part (former socialist countries) children usually are under the supervision of paediatric physicians working in primary care, while care of the adult population belong to the GPs.

The role of primary care

Primary care is the first level of medical care, where patients present their health problems and the majority of the population's curative and preventive health needs can be met. Primary care, in medical terminology, refers to a comprehensive form of medical care that emphasizes the overall well-being of an individual, rather than focusing solely on a particular organ system or health issue. The concept of primary care was initially delineated as one of the tiers of health services in the Dawson Report, a publication from the United Kingdom in 1920. A century ago, two additional categories were established: secondary health centres and teaching hospitals. Physicians who operate in this field are classified as primary physicians, family physicians, or GPs, depending on the country of practice.

Europe has consistently been at the forefront of primary care. The European Union of General Practitioners (UEMO) was founded in 1967 by a group of six countries. The World Organization of Family Doctors (WONCA) was established in 1972 by member organizations from 18 nations. Over the course of several decades, it has evolved into a global professional network and a thriving scientific organization that has significant political power. Subsequently, more continental professional organizations and networks were formed, including the European General Practice Research Network (EGPRN) and the European Forum for Primary Care (EFPC). The WHO began a collective discussion on primary care in 1978, and the definition of its scope was further clarified during the International Conference held in the former Soviet Union. The Declaration of Alma-Ata was promptly ratified in the May 1979 meeting of the World Health Assembly and had a significant global influence. The Alma-Ata Declaration was a significant milestone in the advancement of primary care, establishing the fundamental objectives and the anticipated outcomes for the community. Primary care development in Eastern and Western Europe was not symmetrical.

Family medicine and primary care in the Eastern bloc countries

Family medicine and primary healthcare have made significant progress since the Alma-Ata Declaration. The initial perception of structuring healthcare based on community-level needs, in order to provide effective, safe, and timely healthcare, proved to be a crucial factor. Subsequently, the WHO examined the progress made in the preceding three decades and officially acknowledged PHC as an essential element of health systems in its 2008 World Health Report. Until approximately 1990, the countries of Central and Eastern Europe were under the economic and political control of the Soviet Union. There existed a prevalent economic and industrial cooperation known as Council of the mutual Economic Cooperation (former organization of the 'Soviet-bloc' countries) - COMECON, together with a tightly-knit military alliance structure called The Warsaw Treaty Pact. Healthcare was universally seen as a public obligation in all nations. The state or local municipality authorities were responsible for organizing, managing, and delivering care. The financing and administration processes were characterized by bureaucratic practices and a high degree of centralization. PHC was administered by inexperienced recent graduates or specialists from hospitals who lacked sufficient clinical specialization in family medicine. Almost every citizen had the right to free access to the healthcare system. The state funded healthcare through general taxation. There

was no mechanism in place to restrict access; patients had unrestricted or even unlimited access to most outpatient clinical specialists, and often to inpatient treatments as well. Healthcare providers, including doctors and nurses, received inadequate compensation, resulting in a prevalence of informal payments, such as tipping or under the table payment (parasolvence), in order to secure improved access to or higher-quality services. In the preceding century, the progress of primary healthcare services exhibited significant variations among different nations. Western nations have acknowledged the significance of primary care at an earlier stage and have consequently implemented modifications to their healthcare systems. The healthcare systems of the former Eastern bloc countries required further modifications. The process of transitioning between regimes, which involves democratic elections and the establishment of new governments, often falls short of meeting the necessary political criteria. Prior to adopting suitable PHC provisions, it was necessary to make both structural and budgetary modifications. Following the dissolution of the Soviet Union, Estonia, Latvia, and Lithuania, which were previously part of the union, gained independence. Slovenia and Croatia seceded from the former Yugoslavia in the early 1990s, preceding the violent 'Balkan war'. In 1993, Czechoslovakia dissolved, resulting in the formation of the Czech Republic and Slovakia. These two countries thereafter pursued their own distinct historical and economic trajectories. Bulgaria, Hungary, Poland, and Romania spearheaded democratic transformations in their societies and embarked on comprehensive reforms of their economies and healthcare systems.

RESEARCH AIMS

In this thesis there were two research aims:

1) To describe and analyze the anthropometric measurements of children in the six participating F4D countries (Belgium, Bulgaria, Finland, Greece, Hungary, and Spain): body weight, body height and BMI during the two years long school-based intervention.

2) To prioritize our attention on the Eastern part of Europe, namely the region that was once separated by the 'Iron Curtain'. The growth of primary healthcare in this area was distinct during the period of socialism. The purpose of our work was to offer a concise examination of the social and economic conditions of healthcare systems, with a specific focus on primary care. We aim to analyze the structural and financial modifications in primary healthcare provision and establish connections between the primary healthcare structure, economic progress, epidemiological shifts, and

government health policies in different countries, especially in Bulgaria and Hungary, as these countries were mentioned as low socioeconomic status regions in the F4D study.

Population research

The Feel4Diabetes study was a community-based research project in Europe that consisted of an intervention element at the family, school, and community levels. Enrollment was based on a standardized, multi-stage survey method and was carried out in selected provinces of the participating countries, focusing on vulnerable populations at high risk of developing T2DM. In LMICs, Bulgaria (BG), and Hungary (HU), all municipalities within the collaborating regions were eligible for recruitment, whereas in HICs, families in low SES municipalities were selected. Low SES municipalities in Greece (GR) and Spain (ES) were defined as those with the lowest educational level and/or the highest unemployment rates, as determined by official resources and local authorities in each country. Measurements were taken at the project's baseline, at the start of the academic year, in the first three grades of compulsory (primary level) education, with intervention and follow-up over the next two years. Every participating country used the same method and selection procedures.

Model of the Feel4Diabetes study

All procedures were carried out in accordance with the Declaration of Helsinki (1964) and the conventions of the Council of Europe on human rights and biomedicine. All participating countries obtained ethics approval from the relevant national ethical committees and local authorities prior to launching the intervention. Written informed consent was collected from the parents both for themselves as participants and for their children. The intervention consisted of multiple components, encompassing school, community, and family levels. At the school level, teachers underwent training facilitated by healthcare professionals to foster a conductive educational environment. The school activities were enhanced by the provision of easily comprehensible newsletters, which served as a means to actively involve families. Each participated country had the potential to modify the materials to suit their specific country characteristics. At the community level, the local municipal officials endeavoured to create a conductive climate. During the initial year of the intervention, specifically from 2016 to 2017, a total of seven monthly lifestyle counselling informative sessions were conducted for the families associated with the human resources department.

Data collection: FINDRISC-, EBRB questionnaire

At baseline, follow-up 1 (FU1), and follow-up 2 (FU2), all families, including HR families, underwent evaluations of various measurements such as children's weight, height, and the EBRB questionnaire. The EBRB questionnaire specifically determines socio-demographic factors, children's energy balance related behaviors, and associated determinants. FINDRISC questionnaire was employed to identify high-risk families. The FINDRISC was created as part of the Finnish National T2DM Prevention Programme with the aim of aiding in the detection of individuals who have a higher likelihood of developing T2DM. At least one (step) parent was required to complete this questionnaire. The assessment comprises eight components that encompass the established risk factors associated with diabetes mellitus type 2 (DM2): age, BMI, waist circumference, daily PA, daily intake of fruits and vegetables, utilization of antihypertensive medication, history of raised blood glucose levels, and family history of T2DM.

Measurements used in the F4D study

Children's anthropometric indices were measured by skilled experts using standardized protocols and calibrated equipment before the measurements began (in each time period). During the measurements, participants were asked to remove heavy footwear and clothing and stand still in an erect position. Portable equipment (digital scales for weight - SECA 813 and SECA 877, telescopic stadiometers - SECA 213, SECA 214, SECA 217, and SECA 225 for height, and a non-elastic waist tape for waist circumference - SECA 201) was used (all manufactured by SECA Co.). The weight and height of children were measured at school by a proficient research team. Data were collected by experts who were teached adequately before the measurement procedures started and these researchers from every participating country gathered required data three times during the program, at the baseline, first, and second year (2016-2018) to evaluate the socio-demographic aspects and body weight insights of children participating in the study. In parents, anthropometric measures were acquired via the EBRB questionnaire in the ‘all families’ and measured by researchers in HR-families. The classification of the measures was determined using the cut-off points provided by the WHO. After calculating the BMI, the 85th percentile was considered overweight, while anything above the 95th percentile was considered obese.

Statistics used to analyze anthropometric measurements

Descriptive statistics were run on the merged data of 20,832 measurements conducted between 2016 and 2018, with a focus on children aged 6-9.99 years. We calculated proportions and 95% confidence intervals (CI). When the 95% CI did not overlap, the cases were considered significant. The aim of our work was to analyze the data generated in the Feel4Diabetes study and compare the results between the participated countries based on these datasets only. The data was not weighted statically; it would be very complex and multi-factored task to receive valid and representative data of the population groups in each age category on a national level. That is the reason why our intention was to analyze these data specifically generated in the study. Our main aim was to merely describe the different countries' parameters with confidence intervals to present the observed data. The median and interquartile-range of data was also calculated. In order to reduce the rate of family-wise error, Dunn test and Bonferroni correction was used. The cases where the p-value was less than 0.05 (typically ≤ 0.05) were considered significant.

Method used for the primary care research

The macroeconomic data on healthcare expenses and financing methods of the respective countries were researched. In order to compare epidemiological data and reports on the structure of the healthcare system, databases from national and international organizations were utilized. The Primary Health Care Activity Monitor for Europe (PHAMEU) study conducted systematic literature searches to investigate the recognition and standing of primary care in different nations which was also useful. A self-structured questionnaire was distributed to the leaders of national primary care associations/societies affiliated with the WONCA and the national representatives within the EGPRN.

RESULTS

Anthropometric measurements in 6 European countries

BOYS. *Weight.* Hungarian boys had the highest body weight at age 6, but Greek boys had the highest body weight from ages 7 to 9. Belgian boys had significantly lower body weights in each cohort. *Height*. Belgian boys had the shortest body heights when they were 6 years old. The Hungarian boys were much shorter than boys from other nations in the 8-year age group than were boys from Greece

and Finland, this difference was significant. The tallest boys in the 9-year-old age group were Finns, who were also noticeably taller than Hungarians.

BMI. Boys from Bulgaria had the lowest value in the 6 year age group, followed by boys from Belgium, with no discernible differences. Belgian boys consistently had the lowest BMI in the older age groups (7-9y), while Greek boys frequently had the highest.

The median values of Belgian boys' body weight there was a significant difference compared to all the countries in each age groups except the 9-9.99y where only the Finnish and Hungarian boys' values showed such a difference. In the age group of 6y another significant difference was found between the Greek and Spanish boys' body weight median values. In the following age categories (7-7.99y and 8-8.99y) a mentionable difference was found between the Finnish and Greek boys and the Greek boys' median values significantly differ from the Hungarian, Bulgarian and Spanish boys' weight. 9-9.99 year-old Finnish boys weight significantly differ from the Bulgarian and Spanish boys's median values.

In the age group of 6-6.99, there were two significant differences in height: the first was between Belgian and Bulgarian boys, and the second was between Bulgarian and Spanish boys. At the age of eight years, there was one significant difference between Finnish and Hungarian boys. Finnish boys differ significantly from every other country in the age group of 9-9.99 years. Belgian boys' BMI differed significantly from Greek, Hungarian, and Spanish boys in the age category of 6-6.99 years old boys, with another difference between Greek and Bulgarians.

Belgian boys' BMI differs significantly from every other country between the ages of 7-7.99 and 8-8.99 years. Returning to the age group of 7-7.99 and 8-8.99 years, Greek boys differ significantly from Finnish, Hungarian, Bulgarian, and Spanish boys. Belgian boys' BMI differs significantly from Finnish, Greek, and Hungarian boys at the age of nine.

GIRLS. *Weight*. The Belgian girls had the lowest body weight, which was significantly lower than that of their Hungarian counterparts, while the Greek girls had the greatest weight. For all age groups, this was discovered.

Height. The Finnish girls ranked first in all age divisions, they were the highest. The Belgian, Greek, and Spanish girls were much smaller than the Hungarians at age 6, whereas the Finnish and Bulgarian girls were significantly taller at age 7 and age 8, respectively.

BMI. There was no discernible difference between the nations in the 6 year age group. Greek girls consistently exhibited the highest values in the latter age groups, albeit this was only significant at 9

years. The highest BMI values were notably found in Greek girls. Belgian girls had the lowest BMI levels among all other age groups from 7 to 9 years.

Belgian girls' weight differed significantly from girls' weight in other countries in the two youngest age categories (6 and 7 years). Hungarian girls differ significantly from Finnish, Greek, Bulgarian, and Spanish girls in the age group of 7-7.99.

In the 8-8.99 age group, there was a significant difference between Belgian and Greek girls, as well as Greek and Finnish girls. During the analysis, no significant difference was found in the age group of 9-9.99. In the age category of 6-6.99, there was no significant difference between the countries in terms of girls' height. In the age group 7-7.99, Belgian girls' height differs significantly from Finnish, Greek, and Bulgarian girls, while Finnish girls' height differs significantly from Hungarian and Spanish girls. In the age of 8-8.99 there was a significant difference regarding Belgian girls' height which significantly differ from Greek and Hungarian girls' height. In the age of 9-9.99 a significant difference was observed between Finnish and Belgian, Finnish and Greek, Finnish and Spanish girls' height. Belgian girls' BMI differs significantly from all other countries except Finland in the age group 6-6.99. Another significant difference in the same age group was between Greek and Spanish girls. There were three countries (Belgium, Finland, and Greece) where the BMI values differed significantly from every other country separately in the age categories of 7-7.99 and 8-8.99. In the age group 9-9.99, no significant difference was found.

The prevalence of overweight and obese children varied among the six countries. Greek boys had the highest percentage of overweight boys across all age groups (45-53%), followed by Hungarians (34-38%). Spanish boys ranked third with a percentage of 36-37%, Bulgarians ranked fourth with a percentage of 30-36%, and Finnish boys ranked fifth with a percentage of 31-34%. Belgian boys had the lowest proportion above the 85th percentile, with a percentage of 17-19%. The distributions of boys who were obese and above the 95th percentile were identical. The Greeks held the top position on the ranking list with a percentage range of 29-35%, followed by the Hungarians with a range of 25-27%. The Spanish ranked third with a percentage of 21%, while the Bulgarians ranked fourth with a range of 18-20%. The preceding two cohorts consisted of Finnish boys (17–19%) and Belgian boys (7–9%). Regarding the girls population, Greek girls had the highest percentage of being overweight, varying according to the time of measurement. In total, 41-44% of Greek girls were above the 85^{th} percentile. The Spanish girls held the second place with a percentage range of 32-34%, followed by the Bulgarian girls with a range of 31-33%, and the Hungarian girls with a range

of 29-31%. The Finnish girls had a percentage range of 27-28%, and the Belgian girls had a range of 20-21%. The distribution patterns of obese girls above the 95th percentile exhibited a comparable trend. The percentage of Greek girls was 23-25%, followed by Hungarians at 19%, Spanish at 17-18%, and Bulgarians at 16-17%. The prevalence of obesity among Finnish girls was 15%, while among Belgian girls it was 9%.

The main findings of anthropometric measurements

The displayed data above are accurate and up-to-date anthropometric measurements of a sizable group of children from six different European nations. Some of them should be highlighted: In practically all age cohorts, boys from Belgium had the lowest body weight and height, Greek boys had the greatest body weight, and Finnish boys had the highest body height. Greece had the greatest percentage of overweight and obese boys, followed by boys from Hungary, Spain, Bulgaria, and Finland. In both categories, Belgian boys had the lowest ratio. Greek girls had the greatest body mass index, Belgian girls had the lowest and Finnish girls had the highest across all age groups. Greece had the greatest percentage of girls who were overweight, followed by girls from Spain, Bulgaria, and Hungary who were second in the obese category. In both BMI categories, Finnish and Belgian girls had the lowest ratios.

Primary healthcare systems

The following part of the thesis will give a summary about the results of the desk research and literature review (in addition to data collected by PHAMEU) which was used to describe the primary healthcare systems of the targeted countries.

The ensuing tables utilize country abbreviations based on their respective internet domains, such as BG for Bulgaria, CR for Croatia, CZ for Czech Republic, EE for Estonia, HU for Hungary, LV for Latvia, LT for Lithuania, PL for Poland, RO for Romania, SK for Slovakia and SI for Slovenia.

Healthcare expenditures

The Statistical Office of the European Union (EUROSTAT), the Organization for Economic Co-Operation and Development (OECD), and the WHO have established a longstanding collaboration to develop a unified system for gathering statistics on health expenditures. The primary outcomes of

this collaboration include the International Classification for Health Accounts (ICHA), a Joint Questionnaire on Health Expenditure, and the manuals 'A System of Health Accounts (SHA)'. Health spending can be categorized based on healthcare functions, with the exception of capital investment. The Total Current Healthcare Expenditure (CHE) is defined as the aggregate amount spent on various healthcare services, including curative, rehabilitative, and long-term care, ancillary services, medical goods, preventive care, governance and health system administration, financing administration, and other unidentified healthcare services. Health expenditure can also be categorized based on the financing schemes of healthcare, which include government and/or obligatory contributory healthcare financing schemes, voluntary healthcare payment schemes, household out-of-pocket payment, and unknown financing systems. GDP per capita PPP - Purchasing Power Parity (GDP (PPP)) is the gross domestic product based on purchasing power parity. GDP comparisons based on PPP are arguably more useful than using nominal GDP when evaluating a country's internal market, as PPP takes into account the relative costs of local goods and services and a country's inflation rates, rather than international market exchange rates, which can distort real differences in per capita income. This gives a more accurate picture of the living standards of people in each country.

Mortality-based indicators

Life expectancies had substantial enhancements in all nations. Over the past 25 years, Slovenian men experienced the greatest increase in age, with a nine-year difference. On the other hand, Bulgarian and Lithuanian men had the lowest increase, with only three years. The disparities between these countries are expanding. Women in Bulgaria experienced the smallest increase in improvement, which was three years. On the other hand, women in Slovenia had the biggest increase, which was seven years. Women in the Czech Republic and Estonia had the same increase as those in Slovenia.

Organization of the healthcare system, the role of primary care

The number of hospital beds has experienced a substantial drop, particularly in the 'Baltic' states. The number of medical doctors in these countries experienced minimal change. Within the nursing profession, there was a marginal rise in three nations (Czech Republic, Hungary, and Slovenia), whereas Slovakia had a decline. The primary care dimensions were analyzed and categorized into several important characteristics. The data from different countries regarding these indicators were converted into scores, which represent the extent to which healthcare systems prioritize primary care.

These scores range from 1 (indicating a low emphasis on primary care) to 3 (indicating a high emphasis on primary care). There were variations in scores seen in the rows. The proportion of public health and prevention expenses in the overall healthcare budget was highest in Romania and Slovakia (expressed as a percentage).

The framework and proficiency of primary healthcare

Based on the evaluation surveys, around 18-25% of all practicing physicians are employed in primary care. The emigration of healthcare professionals was identified as a common obstacle faced by all nations. The primary focal points include Germany, the Scandinavian countries, and the UK. The average age of practicing FPs is often elevated, ranging from 52 to 58 years, with the exception of Lithuania, where it is 45 years. The number of providers in Romania and Lithuania is generally increasing, whereas it is falling in Hungary. Paediatric care networks are present in nearly all countries, where the issue of doctors' advanced average age has also been raised as a concern. The average size of practices varies, with the lowest number of enrolled patients being 1300 in Lithuania, and the greatest numbers being 1800 in Romania and Croatia. In every country, general practitioners primarily engage into contracts with national health insurance funds as private entrepreneurs, either operating as self-entrepreneurs or owning their own limited liability companies (LLC), or they may operate as employees for public or private employers. Approximately 33% of general practitioners in Croatia are employed as civil servants. Due to variations in contracting and remuneration procedures, accurately determining their actual income is challenging. It ranges from 1100 EUR (in Lithuania) to 4000 EUR per month (in Croatia) after taxes. The prevailing norm is for a single doctor to work alongside one paid nurse. Group practices or professional cooperation between providers are currently in the early stages of implementation in several countries such as Hungary and Romania, but are more prevalent in Lithuania. Several company chains in the Czech Republic are increasingly acquiring additional practices. Certain countries, such as Poland and Croatia, have established collaborative healthcare centres. PHC funding typically relies on capitation, supplemented by fee-for-service components, but does not heavily rely on financing according to quality metrics. Nurse education often adhered to the previous framework. The system does not have any nurse practitioners as nurses did not receive expanded competencies. The gate-keeping duties are exclusively declarative, allowing for more frequent direct access to secondary care.

Postgraduate and continuous medical education

Family medicine is universally acknowledged as a distinct medical specialty, with universities and medical schools having already established dedicated departments for this field. In Croatia and Romania, the duration of vocational training is four years, while in the other countries it lasts for three years. Merely 50% of family physicians in Croatia possess professional certification, although the majority of GPs in other nations have already successfully completed the national board examinations. Universities and professional bodies mostly offer ongoing medical education programs, with Non-Governmental Organizations (NGOs) playing a minimal role. The primary obstacles to continued improvement were identified as a lack of coordination between practices and a lack of interdisciplinary cooperation. Family physicians frequently engage in preventative measures and screening procedures driven by additional funding.

Economic circumstances

The economic positions in these countries had divergent improvements, mostly influenced by their various national policies, traditions, and collaboration. The economic conditions of primary care are primarily influenced by the allocation of overall health expenditure towards primary care and the financial accessibility of care for patients. Cost sharing and co-payment have the potential to undermine fairness in the financial accessibility of healthcare. In these nations, the out-of-pocket payment or co-payment tends to be higher compared to the countries in the 'Western' section of Europe. Primary care professionals can work as salaried or self-employed providers, whether they are contracted or not with the health services or health insurance system. The attractiveness of primary care professions may also be influenced by the employment status and method of compensation. It has the potential to elucidate the disparities in the earnings of general practitioners both within and across these nations. There was no discernible correlation between a country's national income (GDP) and its overall economic state in terms of primary care. This implies that the impact of financial rules and systems is more significant than the availability of financial resources.

There is significant variation in primary care expenditure across different countries. We were unable to obtain accurate statistics regarding the proportion of primary care funding in the overall healthcare budget. Partially, this is due to the services encompassed in the primary care expenses. The lack of a standardized approach for assessing primary care expenditure across nations impedes the comparability of this metric. For instance, several countries restrict coverage to expenses related to

family practice exclusively, whereas in other countries, publicly available specialized care services are encompassed as well. Primary care expenditures may encompass expenses related to community nursing, primary mental healthcare, dental, and emergency care. Even within the context of family practice fundholding, it is possible to incorporate components for laboratory tests and other studies.

Healthcare organization and inter-professional collaboration

Thanks to technological improvement, hospital stays have become shorter or even unnecessary due to the availability of ambulance services and one-day surgeries. As a result, the number of hospital beds has been reduced in all countries. Advanced healthcare services could be delivered inside the local community. The strength of primary care is sometimes linked to the gatekeeping role of GPs; yet, the robustness of primary care is contingent upon various additional attributes. The majority of health issues can be effectively managed within primary care. Alternatively, general practitioners are responsible for assisting the patient in navigating the process of being referred to a medical specialist or hospital. According to the experts surveyed, the gate-keeping system in these countries is typically ineffective or merely symbolic. There were no significant initiatives in the education of nurses and the widening of their capabilities. Additional professional contributors have not yet been engaged in primary care. Collaboration among healthcare professionals who work closely together can lead to more effective treatment of chronic illnesses and multi-morbidity. This collaboration may involve redistributing jobs among the team members. An integrated primary care level plays a significant role, particularly in connection to community and occupational services. Primary care in these countries primarily comprises general practitioners operating in solo practices. The text only refers to programs specifically aimed at group practices, not including partnerships in the UK or other similar arrangements. In France, where the practice of single-handed healthcare is traditional, a national initiative has effectively boosted the establishment of group practices and multifunctional healthcare centers, known as maisons de santé, in primary care. These countries did not have any national plans listed, simply a few efforts. Between 2012 and 2016, Hungary implemented a primary care model plan with backing from the Swiss Government. The aim of this programme was to expand the scope of basic healthcare to address public health concerns more effectively, with a particular emphasis on prevention. The Swiss Contribution was implemented in a region of Hungary that was economically and socially disadvantaged. The established screening programmes enhanced the level

of primary healthcare provision in this region. This data exhibits disparities in comparison to prior Hungarian investigations.

DISCUSSION

Similar to the anthropometric statistics of their adult populations *("North-South gradient")*, these minor discrepancies between nations could be explained by the genetic, environmental and perhaps lifestyle variances between these countries. Native populations predominate in these six nations, with Belgium and Spain having the highest proportions of immigrants without any documented genetic impacts. Numerous researches have used children's anthropometric measurements. The *IDEFICS Study (Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS)* collected nearly all comparable anthropometric data from eight distinct European nations. Higher results in the *COSI studies* (European Childhood Obesity Surveillance Initiative) indicated greater support for a nutritious school environment. Hungary, Bulgaria, and Greece were among the nations with low scores. Children aged 7-9 years old in the subsequent COSI studies' anthropometric data revealed regional disparities. Compared to our findings, the leading countries were the same; differences could be considered for the different cohorts examined. Considering the normal growth of children, differences in body parameters between genders were smaller than in the later age among adolescents. The *European Childhood Obesity Project* (CHOP) had a 5 year long follow-up period. Its main finding was that higher physical activity and lower sedentary behaviour were the most effective tools for obesity prevention. The methodology of these studies differed from the Feel4Diabetes Study, although there was wide agreement on the appropriate tools for obesity prevention and the importance of the topic. Childhood obesity is an important public health concern, and long-term, high-quality primary prevention trials aimed at parents of young children are needed.

Strengths and limitations of the anthropometric measurements

The strengths of our anthropometric study included a large sample size of measured children and a standardized method of measurement (conducted by trained researchers, not based on parents' reports). This presentation of data had many limitations: There were differences in the number of children measured at different age groups in different countries. In some of them, certain age groups were underrepresented. Due to the nature of the collected and presented data, comparisons between

different strata should be handled with special caution because, when several comparisons were made, the probability of the family-wise error could increase, which could lead to the production of false discoveries, therefore distorting the understanding of the results. The populations examined could not be considered representative at a national level. The main findings of the F4D study support the importance of early obesity prevention. While other published outcomes of this 2-year long project are not presented here, it became clear that lifelong interventions for the entire population and more political-economical supports are needed, in addition to appropriate education on healthy lifestyles in schools, within the family and in the mass media as well. The key of obesity prevention is in the hands of primary care.

Primary care in Eastern Europe

Traditional healthcare systems, which are typically geared to handle short-term instances of a specific sickness, require a more comprehensive approach to delivering services both within healthcare institutions and in the community. Enhancing cooperation is necessary, and professional organizations such as EFPC, EGPRN, WONCA provide an excellent platform for achieving this goal. Out of the former Eastern bloc countries, only Slovenia was recognized for having a comparatively robust primary care system. The presence of primary care is crucial for the functionality and long-term viability of healthcare systems. The effectiveness of a country's healthcare system hinges on the sufficiency of its primary care system. Even after 40 years, this statement from the Alma Ata Declaration remains still pertinent. Significant enhancements in population health and the overall state of the national economy were observed universally. These improvements were accompanied by notable transformations in healthcare infrastructure, with a greater emphasis placed on primary care. The former 'Soviet bloc' countries exhibited higher life expectancies, characterized by significant diversity between countries. However, it is not definitively shown that these differences may be attributed to the growth of healthcare systems. The provision of PHC was enhanced, although there was little implementation of structural changes, typically solely as part of specific projects or model initiatives. Workforce migrations pose a significant and actual threat.

Limitations of the healthcare systems analysis

We lacked access to dependable data on primary healthcare expenditures in the nations under investigation. The correlation between GDP, healthcare expenditures, and life expectancies is

ambiguous, as it may also be influenced by other socioeconomic or environmental factors. The metrics employed, such as the number of hospital beds, doctors, and nurses, do not accurately represent the individual national healthcare systems. There is a lack of quantifiable data regarding the efficacy of the PHC system management by the respective governments. Since our evaluation was made, the serious impacts of the Covid-19 pandemic modified many indicators of economy and healthcare systems; therefore recent data could not be reliable.

Relation between primary care performance and obesity prevalence

Bulgaria and Hungary were listed under the category of low- and middle-income countries in the F4D study, and the prevalence of obesity among children was similar as well. There are disparities between the European countries, impacted by the health politics and objectives of the authorities, by national norms, resources at their disposal, the patients' demands and the position of primary care. The function of primary care differs across different countries. A practical primary care guideline is necessary. The study employed analyzed the relationships between childhood obesity, socio-demographic factors within families, and the obesity status of parents. Children residing in low-income countries and countries experiencing economic crisis have a higher likelihood of being overweight or obese compared to those in high-income countries. Furthermore, children with one or both obese parents are at an increased risk of being overweight or obese. In the face of mounting evidence on the long-term consequences of childhood obesity, family physicians must use their network of support and massive influence as representatives to endorse for both local and nationwide policies that can affect the obesogenic scenery. Overweight and obesity in young age can be considered as a major concern and it will affect adult health. We need to assume that, despite significant public health initiatives, obesity prevalence remain consistently high and evidence-based prevention methods are still not quite effective. Future initiatives aimed at preventing childhood obesity should focus on the entire family, while also considering the socioeconomic background and weight status of parents.

SUMMARY

This Thesis presents two different research topics: 1.anthropometric measurement of an international population of children and 2. describing the status of primary care in the framework of the health

system in the "post-socialist" countries. Our aims were 1. to describe and compare the anthropometric measurements (body weight, body height and BMI) of children in six participating countries (Belgium, Bulgaria, Finland, Greece, Hungary and Spain) during the interventions of the Feel4Diabetes study and 2. to focus on the former Eastern bloc countries describing the structure and function of their primary healthcare system. Comparisons were made between epidemiological statistics, healthcare structure and financing systems.

Our results: 1. The Belgian boys had the lowest body weight and height, while Greek boys had highest body weight, and the Finnish boys showed the highest body height. Greece had the highest percentage of overweight and obese boys, followed by the Hungarian, Spanish, Bulgarian and Finnish boys. The Belgian boys showed the lowest ratio in both categories. Among girls, the Greek had the highest; the Belgian had the lowest body weight and the Finnish were the highest across all age groups. The ratio in overweight range was the highest in Greece, followed by the Spanish, Bulgarian and Hungarian girls, who were the second in the obese category. Finnish girls had lower and Belgians had the lowest ratio in both BMI categories.

2. Visible improvements in population health, in the national economic condition, structural changes in healthcare, more focus to primary care were experienced in these countries. Higher life expectancies with high inter-country variation were observed in the former "Soviet bloc" countries, although it could not be clearly linked to the development of healthcare system. Bulgaria and Hungary as being low- and middle-income countries and other Eastern bloc countries have similar socio-economic features, similar primary care system and high incidence of childhood obesity. Primary healthcare provision improved, while lack of coordination between singlehanded practices and interdisciplinary cooperation were recognized as the main barriers for further improvement in the structure and more effective performance in prevention. More research is required about the possibilities of primary care in the obesity prevention.

There is a need for appropriate national policies, implementing effective public health initiatives, focusing to the entire family, considering the socioeconomic background and weight status of parents as well, involving other stakeholders on community level at the same time.

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List of publications related to the dissertation

1. **Semánová, C.**, Szőllősi, G. J., Ilyés, I., Cardon, G., Latomme, J., Iotova, V., Bazdarska, Y., Lindström, J., Wikström, K., Herrmann, S., Schwarz, P., Karaglani, E., Manios, Y., Makrilakis, K., Moreno, L., González-Gil, E., Rurik, I., Feel4Diabetes-Study Group: Differences in Anthropometric Parameters of Children in Six European Countries.
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