

DISSERTATION 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*

by Csilla SEMÁNOVÁ, MSc

UNIVERSITY OF DEBRECEN
DOCTORAL SCHOOL OF HEALTH SCIENCES

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1. LIST OF ABBREVIATION

BMI: Body Mass Index

CDC: Centers for Disease Control and Prevention

CI: Confidence Intervals

CHE: Current Healthcare Expenditure

CHOP: European Childhood Obesity Project

COMECON: Council of the mutual Economic Cooperation (former organization of the 'Soviet-bloc' countries)

COSI study: European Childhood Obesity Surveillance Initiative

CSDH: Commission on Social Determinants of Health

DM2: Diabetes Mellitus Type 2

EBRB: Energy Balance-Related Behaviour

EFPC: European Forum for Primary Care

EGPRN: European General Practice Research Network

EUROSTAT: The Statistical Office of the European Union

FINDRISC: Finnish Diabetes Risk Score

Feel4Diabetes study: Families across Europe following a hEalthy Lifestyle FOR Diabetes prevention

F4D: Feel4Diabetes study

FP: Family Physician

GDP: Gross Domestic Product

GDP (PPP): GDP per capita PPP - Purchasing Power Parity

GP: General Practitioner

HAPA: Health Action Process Approach

HCP: Healthcare Professional

HIC: High Income Countries

HR families: High-risk families

ICHA: International Classification for Health Accounts

IDEFICS study: Identification and prevention of Dietary- and lifestyle-induced health Effects In Children and infantS

IOTF: International Obesity Task Force

LLC: Limited Liability Company

LMIC: Low and Low Middle Income Countries
NCDs: Non-communicable diseases
NGO: Non-Governmental Organization
OECD: Organization for Economic Co-Operation and Development
PA: Physical activity
PCPs: Primary care providers
PHAMEU: Primary Health Care Activity Monitor for Europe
PHC: Primary Health Care
SES: Socioeconomic Status
SD: Standard Deviation
SDH: Social Determinant of Health
SHA: System of Health Accounts
SMART: Specific, Measurable, Achievable, Relevant and Time-bound
T2DM: Type 2 Diabetes Mellitus
UEMO: European Union of General Practitioners
WC: Waist Circumference
WHO: World Health Organization
WONCA: World Organization of Family Doctors

2. INTRODUCTION

2.1. 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 [1].

Childhood obesity and overweight incidents are also on the rise, it is one of the major public health concerns and its appearance during adolescence is associated with various medical outcomes, such as diabetes, hypertension, cardiovascular disease, obstructive sleep apnoea, dyslipidaemia, fatty liver disease, reproductive complications, alterations in puberty, musculoskeletal complications, and cancers. Depression, being stigmatised or bullied, and being discriminated against are all psychological chronic conditions and concerns that lead to a lower quality of life (*Figure 1*). Childhood obesity and cardiovascular risk factors follow a strong upward trend into adulthood [2]. That is the reason why childhood obesity prevention must be prioritized.

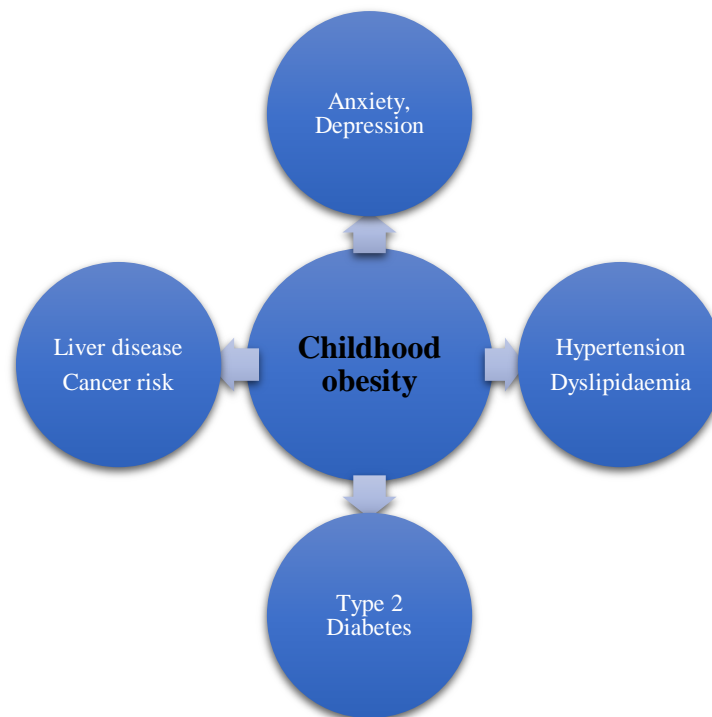


Figure 1. Health consequences that may arise from childhood obesity [figure created by the author]

The evaluation of obesity is a complex process and prevention itself is an explicit task. Common reasons which lead to obesity such as insufficient dietary habits, lack of physical activity (PA) are adaptable lifestyle behaviours, which can be improved. Realizing main risk factors beside the above mentioned ones and be aware of their correlation is a critical point if we want to achieve effective prevention in the early years of childhood. According to the evidence at our disposal the answer would be the multiplex approach, which will target different areas at the same time. Interventions that have focused only on the individual (promoting healthy diet, increasing PA), did not bring breakthrough success and did not stop the increasing number the prevalence of obesity. Therefore, community based, environmental aligned interventions are needed.

A good starting point would be to increase daily physical activity not only in school, but also in kindergarten, to ban unhealthy food advertisements for children, to promote healthy food choices by taxing unhealthy foods and to implement mandatory meal standards in kindergarten and schools globally, not just on a regional or country level. These elements would help to outweigh the effects of obesogenic environment.

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. In addition, the school component is important in this question because a supportive environment at school and at home should be the key. It is not enough to focus only on children; parents' education and influence must also be considered. Schools are seen as inevitable supporters of obesity prevention, yet face barriers in implementation of this duty [3,4]. During the decision making in terms of comprehensive interventions design we should not forget the following components: parents' influence, controlling children's diet, energy-balance, daily physical activity, average media usage, sleep.

Family based childhood obesity prevention programmes should be designed to point out the gaps in the knowledge regarding this topic. 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 [5]. All together have a huge impact on evolution of obesity. The complexity of risk factors leads to the difficulty of early detection and efficient

treatment of young aged children. Numerous interventions focusing on this matter have been proven unsuccessful.

Physical-, health-, nutrition education, teacher's awareness, school nutrition is the main path, however it is not enough without involvement of other stakeholders, such as parents, community, policy makers.

The food environment has a strong impact on dietary choices, and initiatives aimed at changing the food environment could help prevent childhood obesity. Many school-based interventions have been implemented, but their success in attempting to address childhood obesity remains unknown. Changes in the school food culture may optimize appropriate eating behaviour and Body Mass Index (BMI), but policy actions to improve the surrounding school food environments are required to maintain healthy dietary intake and BMI [6].

2.2. 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. Its metabolic and health consequences in this age group and later in adulthood are well understood. The home environment is critical, especially for young children, and it can be managed to improve by educating and empowering families, in conjunction with school- and community-based interventions. Anthropometric measurement is a routine part of children's care, typically conducted by paediatricians, midwives, or other school health service personnel. Registered data assists providers in determining whether a child is growing normally and can indicate when the child's health and well-being are jeopardized. To evaluate an individual, registered data is compared to (national) databases derived from larger national (wide) survey results and measurements from the same cohorts in terms of gender and age. This information is typically presented in the form of tables or age-growth charts [7,8].

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). It is a simple weight-for-height index that provides the most beneficial population-level indicator of overweight and obesity globally because it applies to both sexes and all ages, including children. Professionals agree that children two years of age or older with a BMI between the 85th and 94th percentile on age-growth charts are overweight, while children with a BMI greater than the 95th percentile are obese. The BMI z-score is a quantitative measure

of a specific BMI percentile's deviation from the population mean. A positive z-score indicates that a child is heavier than the mean, whereas a negative z-score indicates that a child is lighter than the mean. A z-score compares a child's BMI to the BMI distribution for a population of children of the same age and gender. National databases of children's populations are frequently out of date and do not always providing appropriate representation [9,10].

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. A database, which incorporates data from six distinct countries, has been extensively utilized and was published two decades ago [10].

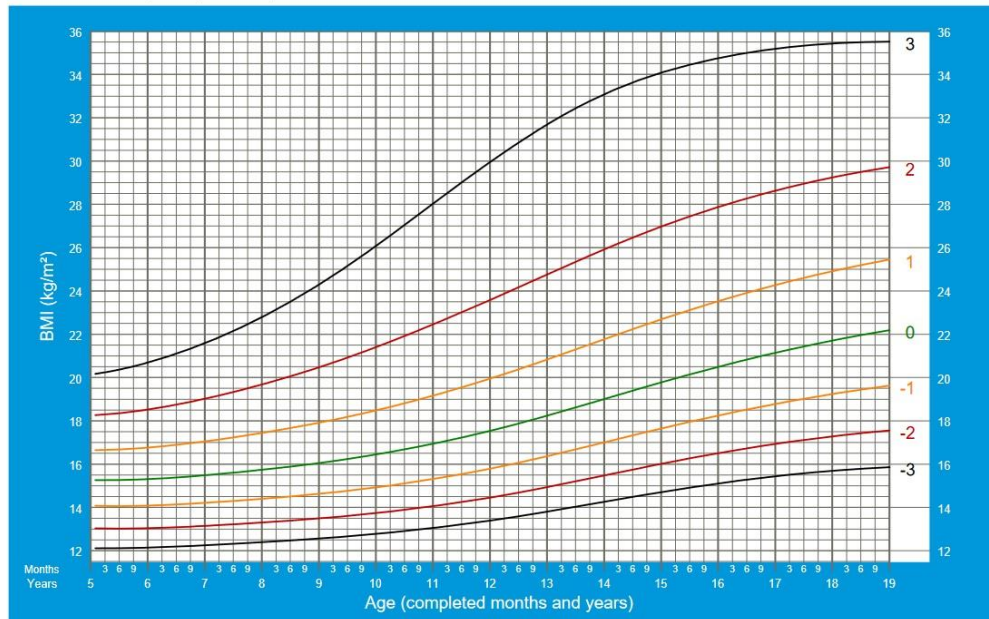
Body mass index is calculated by dividing a person's weight in kilograms by their height in meters squared. It is a low-cost and simple method of screening for weight categories that may lead to health problems. BMI is age and gender specific in children and teenagers, and is often referred to as BMI-for-age. After calculating BMI for children and adolescents, it is expressed as a percentile using either a graph or a percentile calculator [11,12,13].

The BMI-for-age percentile growth charts are the most commonly used indicator for measuring children's and adolescents' size and growth patterns.

The following figures (*Figure 2, Figure 3*) show the BMI-for-age weight status categories and corresponding percentiles based on expert committee recommendations [14,15].

BMI-for-age BOYS

5 to 19 years (z-scores)

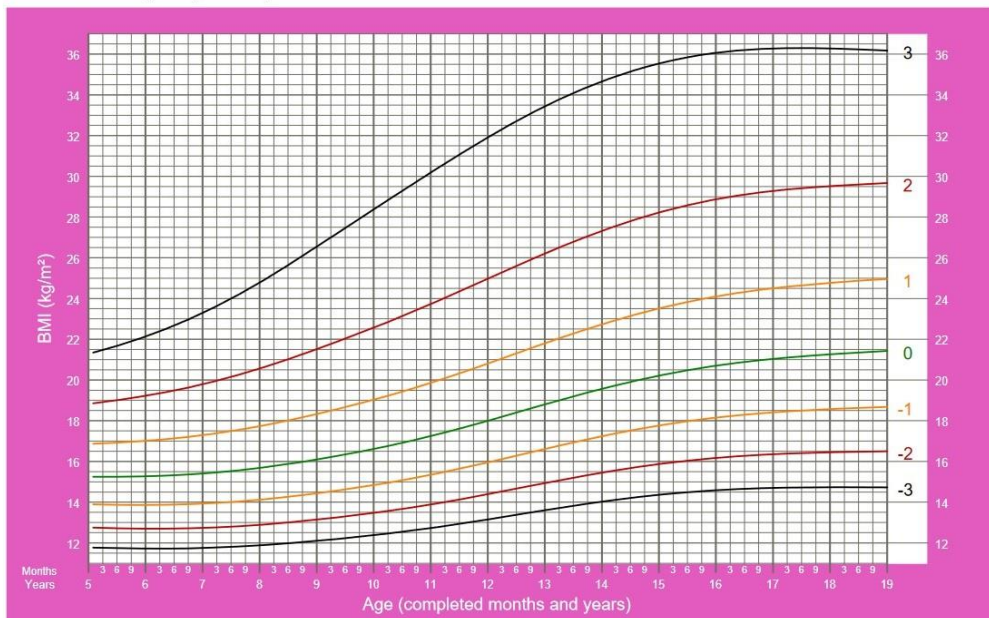


2007 WHO Reference

Figure 2. BMI for Boys (5 to 19 years) [15]

BMI-for-age GIRLS

5 to 19 years (z-scores)



2007 WHO Reference

Figure 3. BMI for Girls (5 to 19 years) [15]

Based on the reports of the Centers for Disease Control and Prevention (CDC), overweight among children of the same age and sex are defined with body mass indexes

from the 85th to the 95th percentile. BMIs exceeding the 95th percentile, can be considered as obese (*Table 1*) [12].

Table 1. Weight status categories and the corresponding percentiles regarding children's BMI [12]

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy Weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obesity	Equal to or greater than the 95th percentile

2.3. 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 [16].

There is a greater likelihood for obesity among children in the lower and middle socioeconomic income families [17]. The chance to access healthy food and opportunities for several physical activities are slighter in these particular strata.

The result of increasing the cost of unhealthy food could be the decreasing number of their intake. At the same time, lowering the price of healthy food could be the key and we could see increasing number of their consumption. Promotion of policies permitting taxation for food materials on a national and state level would be a great method concerning prevention of obesity and overweight in children [18,19].

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. Simple lifestyle changes should be implemented, such as eating breakfast every day, increasing the amount of fruits and vegetables consumed per week, increasing water consumption, reducing fast food consumption,

limiting eating out, 60 minutes of physical activity per day, 2 hours of maximum screen time per day, and getting at least 8 hours of sleep per day [20].

The prevalence of childhood obesity significantly affects the overall well-being of children, encompassing both their physical and mental health. It can deteriorate the overall quality of life. This is due to the various morbidities associated with obesity, including gastrointestinal, musculoskeletal, cardiovascular, metabolic, and orthopaedic complications. Additionally, obesity contributes to the development of mental disorders such as anxiety, eating disorders, depression, and social difficulties, leading to stigmatization. Obesity in childhood is likely to lead to obesity in adulthood, so it should be reduced in childhood, in the early years [21,22].

Moreover, obesity incurs substantial direct and indirect expenses for individuals, families, and society as a whole [23].

2.4. Connection of obesity and type 2 diabetes mellitus

Obesity and overweight co-occur and lead to chronic-, non-communicable diseases (NCDs). 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 [24,25]. 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. Multiple impediments exist in accurately diagnosing prediabetes. An obstacle in accurately detecting diabetes and prediabetes is the lack of consistency in the criteria used for diagnosis. Glucose assessments, specifically through fasting and oral glucose tolerance

tests (OGTT), as well as Hemoglobin A1C (HbA1c) assays, are diagnostic methods used to identify individuals who are at risk [26,27].

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. The published research also highlighted the significance of behaviour modification interventions, namely group-based sessions, in achieving weight loss and enhancing physical activity [28].

2.5. Programme initiatives for obese population: adults

In some countries there were different initiatives for adult population of obese and overweighted 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. This model has been rigorously studied over a period of five years, from 2000 to 2005, and has consistently shown positive outcomes in terms of both clinical effectiveness and cost efficiency [29]. The Scottish Government initiated three rounds of Counterweight implementation between 2006 and 2008 [30].

This study provides novel upcoming proof of a successful weight management paradigm for primary care, marking the first of its kind. Among the practices that decided to implement *Counterweight*, a significant proportion of 86% demonstrated active engagement. Furthermore, the observed weight change data exhibited a favourable comparison to the outcomes attained in specialized research settings. Despite the absence of additional money for practice, over two-thirds of practices successfully registered new patients for a period beyond 12 months, thereby reallocating time that was previously utilized in a rather disorganized manner for controlling obesity. Approximately 50% of the total patient population participated in the 12-month follow-up. 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 [31].

In Hungary there was also a primary care project within a limited period, unfortunately with shorter follow-up time. The objective of our study was to evaluate overweight and obese individuals in primary care settings, engage them in an intervention program, and assess the anticipated alterations in laboratory and anthropometric measurements. Between April 2004 and 2006, a total of 2,489 overweight or obese patients were selected from 29 primary care practices. The questionnaire was utilized to investigate the attributes pertaining to living conditions, lifestyle choices, dietary patterns, and PA habits. The researchers recorded and compared the regular energy consumption with the estimated energy needs. The researchers conducted measurements of metabolic and anthropometric factors. The team consisted of a diverse group of professionals with expertise in multiple disciplines, including internists, FPs, dieticians, skilled nurses, and physical instructors. The interventions implemented in the study included dietary modifications; specifically the suggestion of a low-calorie diet, as well as the promotion of increased PA. After the passage of one year, there was a notable decrease in the body mass index, with an average reduction of 0.56 kg/m². This decrease was sustained until the conclusion of the second year, where the body mass index remained rather stable. There was a marginal reduction observed in waist circumference. On average, there was a considerable decrease of 5.9 mmHg in rest systolic blood pressure by the conclusion of the initial year. However, the decrease in rest diastolic blood pressure was comparatively smaller. With the exception of HDL-cholesterol, all metabolic parameters exhibited a significant drop. The efficacy of primary care intervention has been demonstrated. Enhanced outcomes may be anticipated if there were increased resources, greater backing from health authorities or heightened media attention as these days it is also an important factor [32].

2.6. 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). The main goal was to modify behavioural aspects (drinking, eating and snacking, physical activity and sedentary behaviour) during 24 weeks from October 2012 to April

2013 [33]. 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 [34].

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 a special, project-focused education from the F4D staff members. Within the whole study population, other groups were formed without any intervention [35,36,37].

2.7. Prevention and treatment of childhood obesity in primary care settings

Prevention and treatment of childhood overweight and obesity in the primary care setting focuses on altering behaviours that lead to immoderate energy intake and inadequate energy expenditure. Healthcare professionals (HCP) should measure height and weight to calculate BMI at every face to face meeting with the child [56]. The CDC (www.cdc.gov), 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 [2,39,40].

FPs maintain ongoing relationships with families through regular interactions and patient visits across all stages of life, including preconception, prenatal, postnatal, early

childhood, and beyond. These personal contacts present excellent possibilities for educating parents about obesity prevention. During regular check-ups, the healthcare provider can assess weight and height, and calculate the BMI. By analyzing these measurements, they can identify families at high risk and provide appropriate guidance, as well as establish goals for them. [41,42].

Family physicians are considered as trusted source of information for families. As healthcare professionals they are authentic and it is better if families and children receive instructions from them (regarding lifestyle and weight status/obesity) than from a complete stranger [43,44].

In schools routine monitoring of BMI percentiles, weight and height status should be integrated with feedback and follow-up. Family physicians should receive these results and it could be checked when they meet the child on the next visit in doctor's office. Parents often do not realize their child is overweight and this can lead to serious problems in the long run. Children do not have power over their food choices, purchase, food preparation, daily schedule and environment they live in. That's why it makes no sense trying to educate and influence children without involving their parents and teachers in these programmes. They are the role models for children in these significant years [45,46,47].

In primary care, the prevention and treatment of childhood overweight and obesity puts emphasis on changing behaviours that result in increased energy intake and inadequate energy expenditure. Obesity has been linked to lower educational attainment and socioeconomic status. Because primary care systems have different structure in the respective countries, these options are differently utilized [48,49,50]. 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 [51].

2.8. Possible opportunities for prevention and management

In some countries the providers (family physicians / general practitioners GPs) offer services for adult and for children population as well, while in others these age periods are

separated. In Hungary and in Bulgaria there are 2 different system for adults and for children [52,53].

Since the Alma-Ata Declaration, family medicine and primary healthcare (PHC) have made significant advances. What appeared to be a sound principle at first - structuring healthcare from the community level in response to the requirements of individuals and populations - proved to be a determining factor of efficient, safe, and timely healthcare. Later, the World Health Organization (WHO) examined the previous three decades of development, and in the World Health Report of 2008, the WHO recognized PHC as a critical component of health systems. Primary care could be an important place not for curative care only, but for all levels of prevention [53,54,55].

The Conceptual Framework for Action, Commission on Social Determinants of Health (CSDH) paradigm diverges from prior models by viewing the health system as a social determinant of health (SDH). The significance of the health system is particularly evident in relation to the matter of access, encompassing variations in exposure and susceptibility, as well as intersectoral activity initiated from within the health sector. The healthcare system assumes a crucial role in mitigating the varying impacts of sickness on individuals' lives (*Figure 4*) [56].

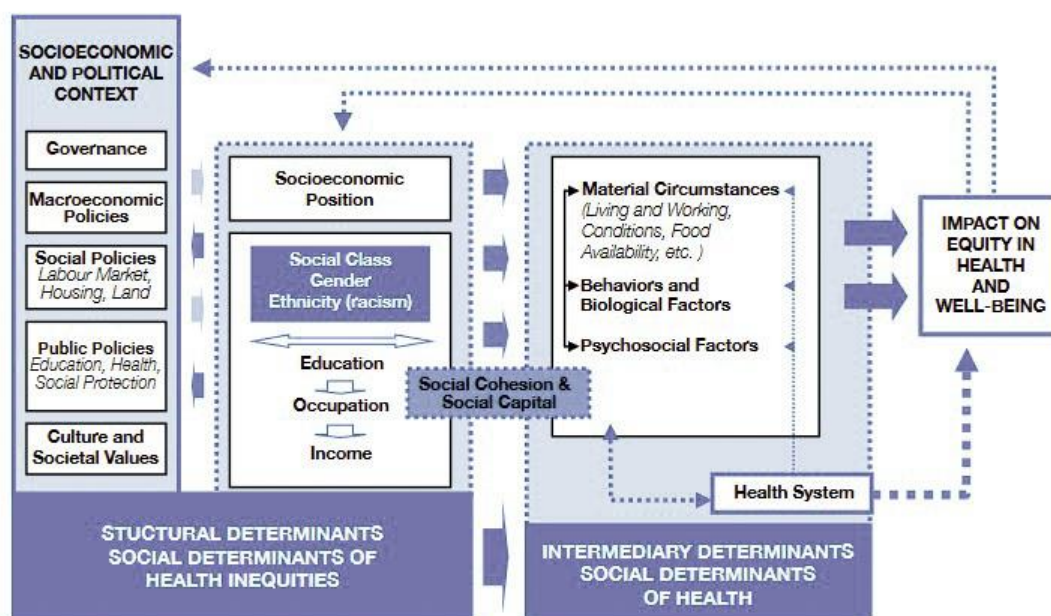


Figure 4. A CSDH conceptual framework [56]

2.8.1. 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 should be available close to people's homes and without any barriers to access [57,58]. Primary care should be conveniently located and easily accessible, ensuring that individuals may receive medical services without any hindrances. 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 [59,60]. 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 [61]. 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 [62]. 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) [63,64]. 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 [65].

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. Commencing the analysis during the 40th anniversary presents a favourable occasion. Primary care development in Eastern and Western Europe was not symmetrical [55].

2.8.2. 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 [66]. 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. This profession was held in low esteem by other medical specialists [67].

Almost every citizen had the right to free access to the healthcare system. The state funded healthcare through general taxation. Patients were assigned to local physicians based on their residential location. 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 [68,69]. Patients made minimal or negligible contributions to healthcare budgets, with the exception of pharmaceuticals. The range of services provided was inadequately defined. Prioritizing healthcare provision did not always align with the requirements of patients or the local population.

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 [53,68].

3. 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.

4. METHODOLOGY

The current thesis proposal is structured in two chapters.

- 1) The main goal was to present the data on anthropometric parameters of children in the six participating countries over a two-year period and compare national trends based on the school intervention study.
- 2) Desk research and literature review was used to describe the primary healthcare systems of the following countries: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Comparisons were made between epidemiological statistics, healthcare costs and structure, and financing systems. A systematic literature search was conducted.

4.1. 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 [70].

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 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 [37,71].

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 [36].

4.2. Ethics approval and consent to participate

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 (*in Hungary, by the National Committee for Scientific Research in Medicine; the approval number is 20095-1/2016/EKU (469/15)*). Written informed consent was collected from the parents both for themselves as participants and for their children. The clinicaltrials.gov registration number for the *Feel4Diabetes* study is NCT02393872 [36,72].

4.3. Model of the Feel4Diabetes study

The intervention was based on theoretical frameworks, particularly the PRECEDE-PROCEED model, which is used to develop, implement, and evaluate the *Feel4Diabetes* intervention. Furthermore, the Health Action Process Approach (HAPA) is utilized to translate information gathered from systematic literature reviews, focus groups, the European Diabetes survey, and other relevant expertise from prior projects into practical advice. By integrating the intervention into existing local initiatives, it was guaranteed that its relevance would encompass practical situations. This enabled the creation of a feasible application and a conceptually sound, potentially long-lasting intervention [73,74].

The intervention consisted of multiple components, encompassing school, community, and family levels. All families belonging to the intervention group were provided with the intervention components that were based in both the school and community settings. Families deemed to be at a heightened risk of developing type 2 diabetes, hence referred to as high-risk (HR) families, as determined by the FINDRISC screening valuation, were provided with an additional component of intervention that focused on the family unit. This intervention was designed to address the need for additional support in implementing the recommendations for a healthy lifestyle within the context of the family unit (*Figure 5*) [75,76,77].

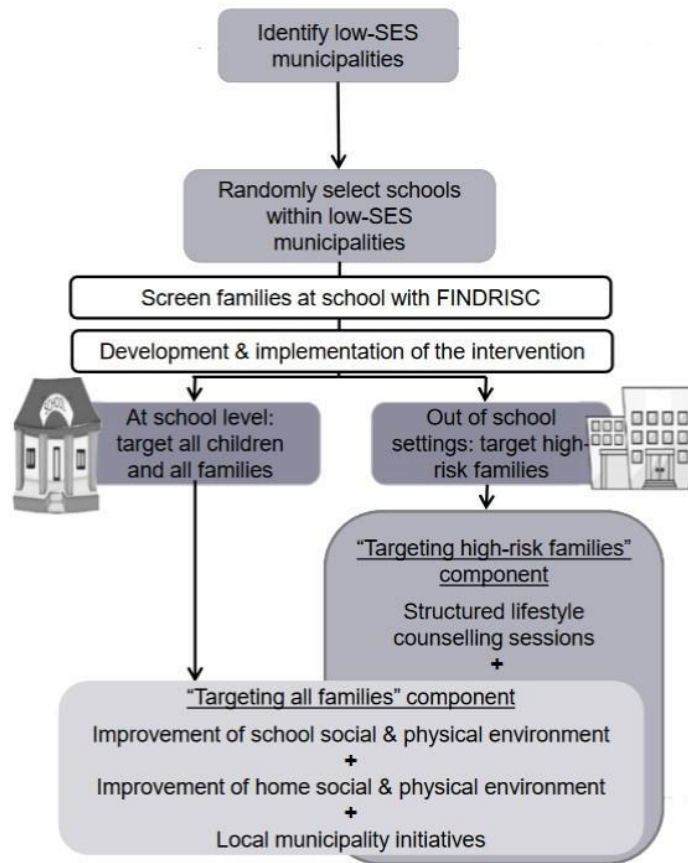


Figure 5. Overview of the F4D-study model [77]

4.3.1. School component

At the school level, teachers underwent training facilitated by healthcare professionals to foster a conducive educational environment that promotes physical activity, encourages the consumption of nutritious food and drinks, and discourages sedentary behaviour. 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 [78].

4.3.2. Community component

At the community level, the local municipal officials endeavoured to create a conducive climate. In addition to offering games and guidance on healthy behaviours, the

study group also supplied various activities. Intervention components were implemented at both the school and municipality levels during both the initial and subsequent years of intervention. Within communities under control, educational institutions were requested to maintain adherence to the established curriculum [75,78].

4.3.3. Family component

The family intervention was exclusively arranged for families with a higher susceptibility to developing T2DM, so qualifying as a secondary preventative intervention. HR-families were actively engaged not only in educational institutions and their local community, but also received targeted interventions from qualified healthcare practitioners with the objective of enhancing the familial environment. 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. Following the dissemination of pre-test data to the participating families, encompassing variables such as BMI, laboratory tests of parents, and daily step counts, an initial meeting was conducted to provide a comprehensive explanation of the experiment. The subsequent session entailed an individualized session aimed at establishing SMART (*Specific, Measurable, Achievable, Relevant and Time-Bound*) goals in order to enhance self-regulation, bolster motivation, and promote adherence to the provided recommendations. Subsequently, a series of group sessions were conducted with the aim of fostering a healthy lifestyle, focusing on physical activity, sedentary behaviour and nutritious dietary habits. Thereafter, a recreational session was arranged for the children. The families in the HR program received motivating text messages twice a week regarding the health goals they had previously selected. The counselling sessions and SMS (text) messages were designed to provide suitable feedback through a tailor-made method. HR-families allocated to the control group were presented with a one-hour session offering general guidance on maintaining a healthy and active lifestyle (**Figure 6**) [75,73,36].

4.4. Data collection

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 [78].

4.4.1. FINDRISC questionnaire

The individual provided self-reported information. The 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 [37,79]. Each item is associated with many answer categories that are measured on a scale. The overall score represents an individual's 10-year risk of developing type 2 diabetes and spans from 0 to 26. The score categories were the following: less than 7 (classified as low risk), 7 to 11 (considered slightly increased risk), 12 to 14 (categorized as moderate risk), 15 to 20 (classified as high risk), and greater than 20 (categorized as extremely high risk). Specifically, in this research, a family was classified as high-risk if at least one parent obtained a score of ten or above. Additionally, the parental educational level, which refers to the number of years parents have attended school, was evaluated in this questionnaire. The investigation exclusively utilized data from parents with the greatest level of education [80,81,82].

4.4.2. EBRB questionnaire

The EBRB questionnaire was used to examine socio-demographical characteristics such as the age of the kid and parent, as well as the household income. The assessment of family income was conducted by inquiring about the level of difficulty or ease experienced in meeting financial obligations with the given income. When respondents indicated that they found a task to be challenging or highly challenging, it was categorized as experiencing financial difficulties [75].

4.5. 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, telescopic stadiometers for height, and a non-elastic waist tape for waist circumference) was used (all manufactured by SECA Co.). Children were first measured when they were 6, 7, or 8 years old, at the start of the project [83]. The measurements were repeated every year, and each child's data was considered at the appropriate age. For example, a child entering the project at the age of six was assigned to a group of six-year-old children. One year later, he/she was included in the group of 7-year-old children, along with those who began at that age. The exact age groups were abbreviated in the text, for example, 6-6.99 as 6y [75].

Data were collected by experts who were taught 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 [36,37].

The research used a cluster randomized controlled design, incorporating a pre-test/post-test methodology. The intervention group was provided with both the school and community intervention for all families. In addition, if the children belonged to high-risk households, they also received a family intervention. The control group consisted of HR-families who got standard care, while no interventions were provided to the children in any of the families. The randomization occurred at the level of municipalities. The collection of socio-demographic characteristics was facilitated through the administration of questionnaires, while the researchers objectively evaluated anthropometric data [75].

The schools were chosen randomly and then allocated to either the control or intervention group according to their respective towns. The study group from the nation established contact with schools by telephone communication and continued to enroll participants until the desired recruitment goal was achieved. Schools were considered eligible upon confirmation of their participation by the headmaster. Ultimately, the recruitment of families was accomplished through the targeted engagement of educational institutions. Participation was open to children in the age range of first to third grade.

Among the families that were enlisted, those classified as 'high risk' were determined by the utilization of the FINDRISC to estimate the risk of developing DM2. Further details on this scoring system may be found elsewhere. Eligibility for inclusion in the study was determined based on the enrolment of children in either the first, second, or third grade of primary school at the time of baseline measurements. In addition, the involvement of parents or caregivers in the research was established by the submission of a signed, informed permission form and the completion of the EBRB and FINDRISC questionnaires. The Feel4Diabetes study offered free participation and enrolment to all participants [37,81,82].

4.6. Anthropometric measurements

The weight and height of children were measured at school by a proficient research team. The aforementioned measures were employed in the computation of the Body Mass Index. In parents, anthropometric measures were acquired via the EBRB questionnaire in the 'all families' and measured by researchers in HR-families. These were employed for the computation of parental BMI.

The measurement of height was taken without footwear and recorded to the nearest tenth of a centimeter (0.1 cm) using telescopic stadiometers: SECA 213, SECA 214, SECA 217, and SECA 225 (manufactured by SECA International). Body weight was assessed while wearing lightweight attire and without footwear, and then documented to the nearest 0.1 kg. The equipment included of two electronic weight scales: SECA 813 and SECA 877. The classification of all volunteers based on their body weight was done using the cut-off points of the Body Mass Index. Waist Circumference (WC) measurements were taken using a non-elastic measuring tape (SECA 201) (SECA International) and recorded to the closest tenth of a centimeter (0.1 cm). The classification of the measures was determined using the cut-off points provided by the WHO [83,84,85].

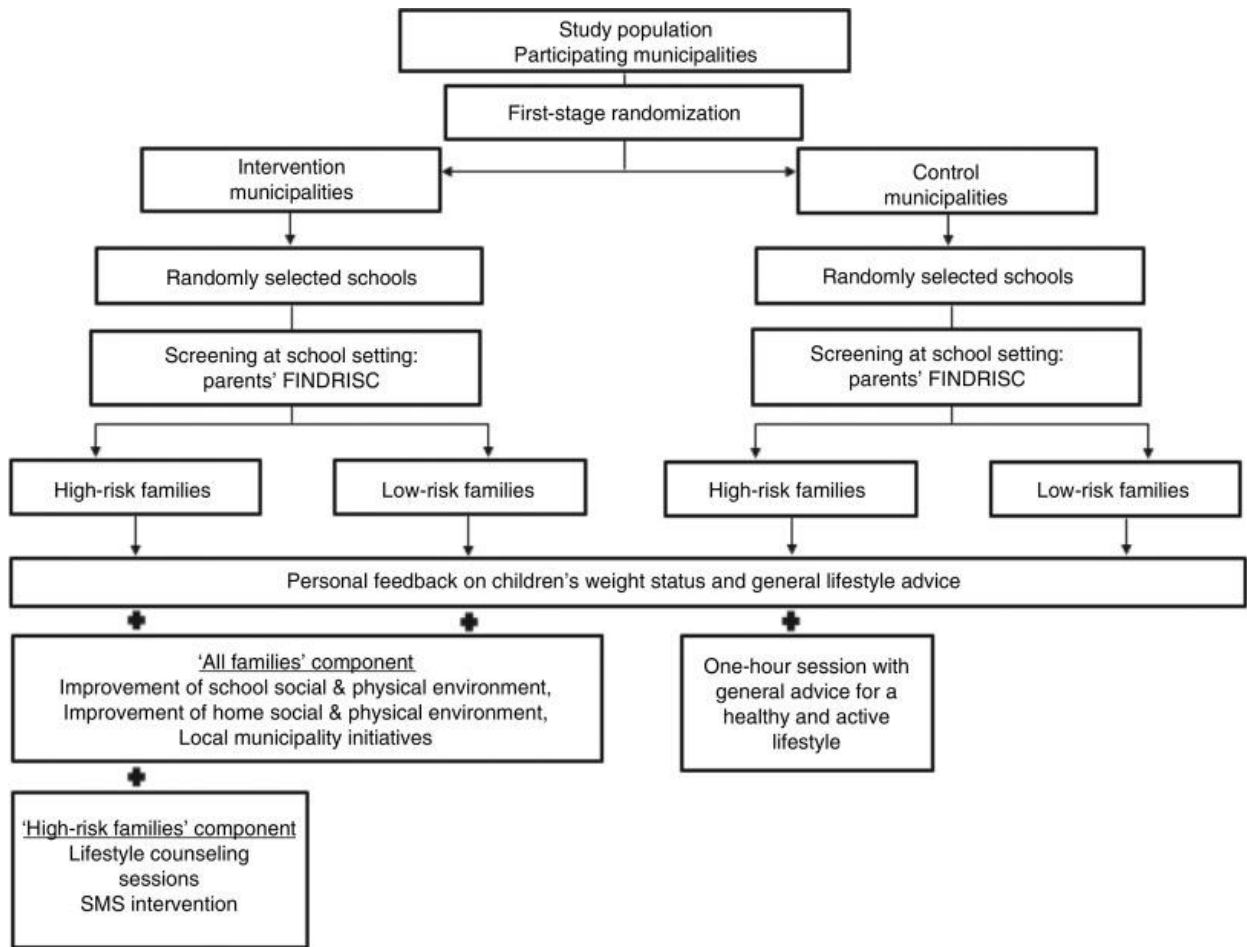


Figure 6. Summary of the F4D-study intervention [36]

4.7. Analytical statistics in the study

Descriptive statistics were applied to provide a comprehensive overview of the participants' characteristics at the Baseline stage. In addition, the study employed independent t-tests and χ^2 tests to examine and quantify the disparities between male and female participants in terms of age, BMI, socioeconomic status, and PA levels in both children and their parents. The findings were reported in the form of percentages or as measures of central tendency, specifically means and standard deviations (SDs). The analyses were conducted using SPSS version 24 [86].

4.7.1. 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. Comparisons between all groups and categories were not always made [87]. WHO norm was used for calculating the BMI, the 85th percentile was considered overweight, while anything above the 95th percentile was considered obese.

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. *Family-wise error* could reduce the precision of the estimation when multiple hypotheses testing is performed, therefore distorting the understanding of the results and the conclusion. However, 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. In addition, controlling for this type of error could involve *Bonferroni*, *Sidak* or *Tukey's* procedure, which would have made the tables relatively complex and even difficult to understand.

4.8. Method used for the primary care research

The macroeconomic data on healthcare expenses and financing methods of the respective countries were researched. Within the outcomes, the data were elucidated. In order to compare epidemiological data and reports on the structure of the healthcare system, databases from national and international organizations were utilized [53]. 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 helpful [58]. A self-structured questionnaire (refer to Appendix) was distributed to the leaders of national primary care associations/societies affiliated with the WONCA and the national representatives within the EGPRN. Each country had a minimum of two respondents. The responses that were presented and debated were of utmost importance and relevance.

5. RESULTS

5.1. Anthropometric measurements in 6 European countries

Four tables and eight figures are used to present the data and their comparisons regarding the children's anthropometric measurements.

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. According to *Table 2*, 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.

Table 2. The means of weight-, height- and BMI values of boys separately in 4 age categories during the project period

Prevalence					
BOYS	Age-Group [Year]	n	Weight [kg]	Height [cm]	BMI [kg/m ²]
BE	6-6.99	139	23.67 [23.04-24.29]	121.83 [120.90-122.76]	15.87 [15.62-16.13]
	7-7.99	378	26.00 [25.56-26.44]	127.32 [126.76-127.88]	15.97 [15.79-16.15]
	8-8.99	610	29.15 [28.73-29.57]	133.09 [132.62-133.56]	16.38 [16.22-16.54]
	9-9.99	578	32.12 [31.63-32.61]	138.04 [137.54-138.54]	16.77 [16.59-16.96]
BG	6-6.99	37	24.51 [23.24-25.78]	124.35 [123.01-125.68]	15.79 [15.15-16.43]
	7-7.99	331	28.18 [27.55-28.81]	128.39 [127.79-129.00]	16.99 [16.70-17.28]
	8-8.99	593	31.33 [30.80-31.86]	133.49 [133.01-133.96]	17.48 [17.25-17.71]
	9-9.99	673	34.93 [34.34-35.52]	138.20 [137.73-138.68]	18.16 [17.92-18.41]
FI	6-6.99	13	25.73 [23.84-27.62]	124.30 [121.80-126.81]	16.60 [15.74-17.47]
	7-7.99	179	27.66 [27.01-28.30]	128.38 [127.66-129.10]	16.72 [16.43-17.01]
	8-8.99	414	30.91 [30.34-31.48]	133.69 [133.13-134.25]	17.20 [16.97-17.44]
	9-9.99	605	34.70 [34.12-35.27]	139.25 [138.75-139.74]	17.76 [17.54-17.98]
GR	6-6.99	237	25.34 [24.73-25.95]	122.33 [121.68-122.98]	16.84 [16.54-17.14]
	7-7.99	544	29.25 [28.73-29.77]	128.11 [127.65-128.57]	17.69 [17.45-17.92]
	8-8.99	875	33.04 [32.56-33.52]	133.57 [133.19-133.94]	18.38 [18.18-18.59]
	9-9.99	719	36.77 [36.17-37.38]	138.49 [138.05-138.93]	19.02 [18.78-19.25]
HU	6-6.99	34	26.24 [23.99-28.48]	124.32 [121.94-126.71]	16.74 [15.82-17.66]
	7-7.99	242	27.72 [26.86-28.58]	127.35 [126.54-128.16]	16.93 [16.54-17.32]
	8-8.99	490	31.18 [30.49-31.87]	132.47 [131.87-133.07]	17.60 [17.31-17.90]
	9-9.99	705	34.91 [34.24-35.58]	137.79 [137.26-138.32]	18.21 [17.94-18.47]
ES	6-6.99	164	24.74 [24.08-25.40]	121.85 [121.07-122.63]	16.54 [16.25-16.84]
	7-7.99	383	27.63 [27.09-28.18]	127.37 [126.83-127.91]	16.92 [16.68-17.17]
	8-8.99	626	30.98 [30.47-31.48]	133.01 [132.56-133.47]	17.39 [17.18-17.61]
	9-9.99	580	34.03 [33.42-34.63]	137.69 [137.19-138.20]	17.82 [17.58-18.06]

Anthropometric data of boys in each age group of 6 European countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary, ES = Spain)

Table 3. The *median* weight-, height- and BMI values and *interquartile range* of boys separately in 4 age categories during the project period

Median value								
Age group [year]	BOYS	n	Weight [kg]	p-value	Height [cm]	p-value	BMI [kg/m ²]	p-value
6-6.99	BE	139	23.1 (21.0 - 25.6)	0.0001	121.7 (117.8 - 125.4)	0.0183	15.6 (15.0 - 16.6)	0.0001
	BG	37	24.4 (21.9 - 25.6)		124.5 (122.5 - 127.0)		15.6 (14.7 - 16.4)	
	FI	13	25.8 (23.2 - 26.5)		124.2 (122.4 - 126.8)		15.9 (15.6 - 17.3)	
	GR	237	24.5 (21.9 - 27.8)		122.4 (119.1 - 125.5)		16.3 (15.3 - 17.8)	
	HU	34	24.6 (20.7 - 30.4)		123.9 (118.9 - 129.6)		15.9 (14.7 - 17.8)	
	ES	164	24.0 (21.7 - 26.6)		122.0 (118.4 - 124.6)		16.2 (15.3 - 17.5)	
7-7.99	BE	378	25.1 (23.1 - 27.7)	0.0001	127.3 (123.5 - 131.0)	0.0255	15.6 (14.9 - 16.6)	0.0001
	BG	331	26.7 (24.3 - 30.2)		128.4 (124.6 - 132.4)		16.3 (15.3 - 17.9)	
	FI	179	26.6 (24.9 - 29.8)		127.8 (125.0 - 131.3)		16.4 (15.4 - 17.2)	
	GR	544	28.0 (24.8 - 32.5)		128.0 (124.6 - 131.7)		17.0 (15.7 - 19.2)	
	HU	242	26.2 (23.2 - 30.3)		127.1 (123.1 - 131.0)		16.1 (15.2 - 17.5)	
	ES	383	26.8 (23.6 - 30.4)		127.0 (123.6 - 130.5)		16.5 (15.1 - 18.1)	
8-8.99	BE	610	28.3 (25.6 - 31.4)	0.0001	132.9 (129.1 - 137.1)	0.0011	15.9 (15.1 - 17.1)	0.0001
	BG	593	29.8 (26.9 - 33.9)		133.3 (129.8 - 137.6)		16.8 (15.5 - 18.7)	
	FI	414	29.7 (26.9 - 33.5)		133.5 (129.7 - 137.8)		16.7 (15.6 - 18.2)	
	GR	875	31.7 (27.8 - 36.7)		133.5 (129.6 - 137.4)		17.7 (16.1 - 20.0)	
	HU	490	29.5 (26.0 - 34.1)		132.1 (128.0 - 136.6)		16.6 (15.4 - 18.9)	
	ES	626	29.7 (26.1 - 34.4)		132.6 (129.2 - 136.4)		16.7 (15.5 - 19.0)	
9-9.99	BE	578	30.8 (28.1 - 34.4)	0.0003	138.0 (133.6 - 142.2)	0.0001	16.3 (15.3 - 17.5)	0.0088
	BG	673	33.3 (29.8 - 38.6)		138.1 (134.1 - 142.1)		17.5 (16.0 - 19.4)	
	FI	605	33.4 (29.7 - 37.7)		139.1 (135.0 - 143.2)		17.1 (16.0 - 18.9)	
	GR	719	35.2 (30.6 - 40.8)		138.4 (134.3 - 142.3)		18.5 (16.6 - 21.0)	
	HU	705	33.0 (28.6 - 38.1)		137.7 (133.0 - 142.6)		17.2 (15.8 - 19.8)	
	ES	580	32.9 (28.5 - 37.9)		137.7 (133.4 - 141.4)		17.1 (15.7 - 19.3)	

Anthropometric data regarding boys in four age groups of 6 European countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary, ES = Spain)

As **Table 3** shows, 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.

Figures 7-9 also show these tendencies and variation.

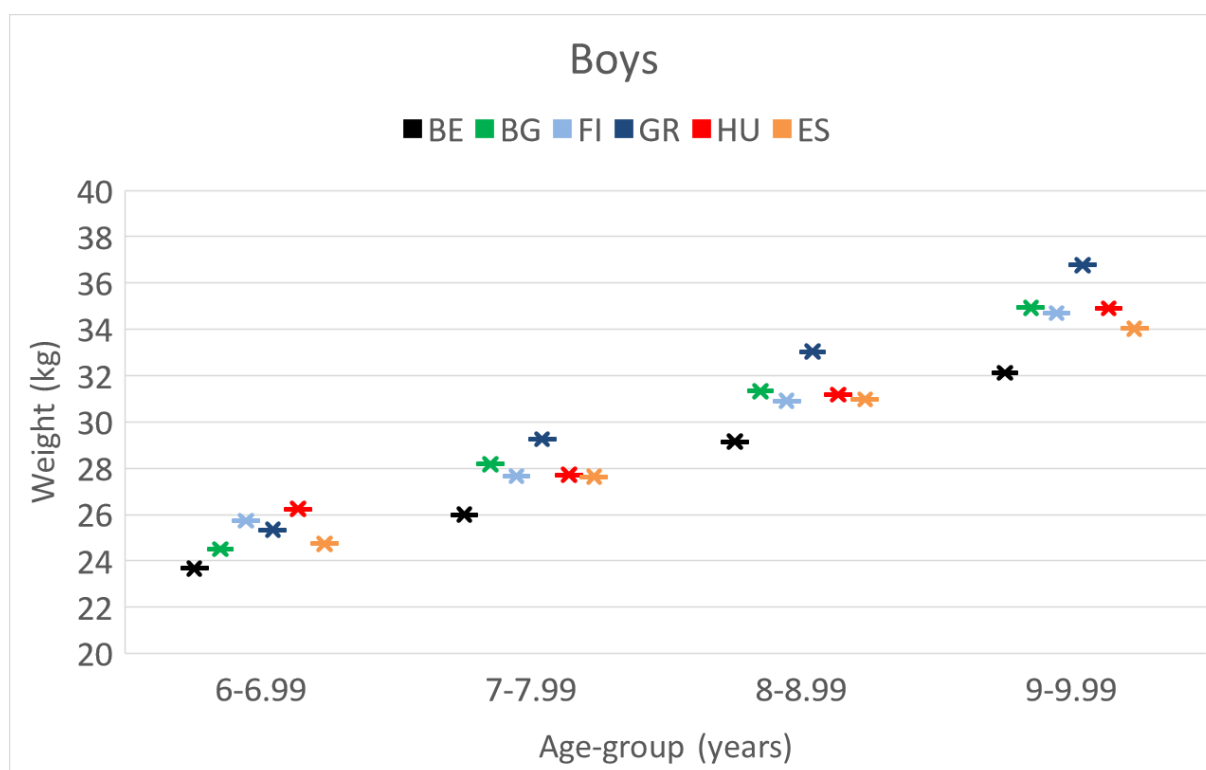


Figure 7. The increase in the **mean** values of weight [kg] and boys by their age [years] in the 6 countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

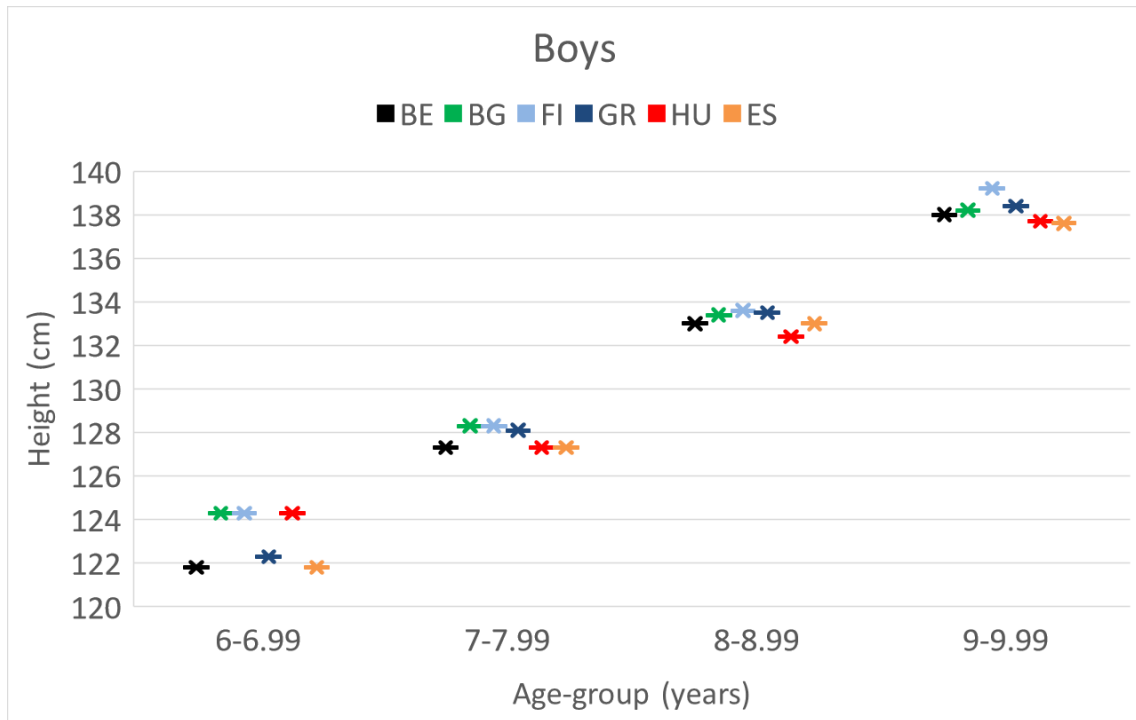


Figure 8. The increase in the *mean* values of the height [cm] of boys by their age [years] in the 6 countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

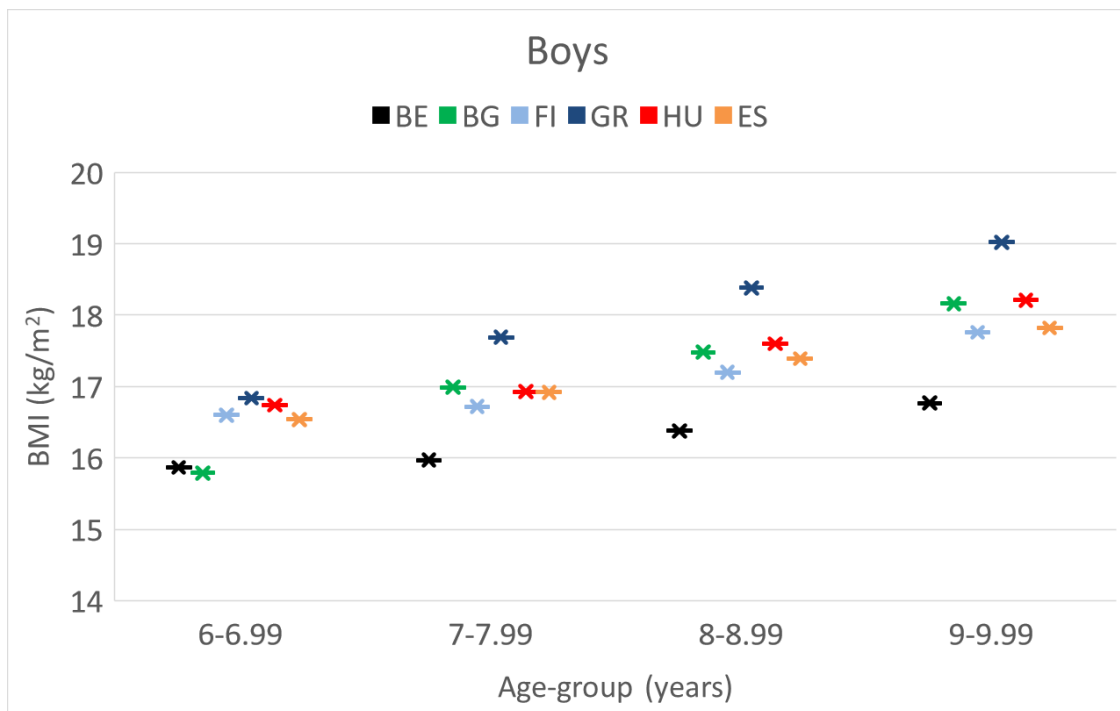


Figure 9. The increase in the *mean* values of BMI [kg/m²] of boys by their age [years] in the 6 countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

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 (see *Table 4*).

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.

Table 4. *The means of weight-, height- and BMI values of girls separately in 4 age categories during the project period*

Prevalence						
GIRLS	Age-Group [year]	<i>n</i>	Weight [kg]	Height [cm]	BMI [kg/m ²]	
BE	6–6.99	129	23.23 [22.70–23.76]	121.03 [120.09–121.97]	15.81 [15.57–16.04]	
	7–7.99	374	25.42 [25.02–25.82]	125.83 [125.26–126.40]	16.00 [15.82–16.18]	
	8–8.99	606	28.99 [28.57–29.41]	132.06 [131.59–132.54]	16.54 [16.36–16.72]	
	9–9.99	580	32.43 [31.88–32.98]	137.21 [136.70–137.72]	17.13 [16.91–17.35]	
BG	6–6.99	41	25.65 [24.30–26.99]	122.10 [120.51–123.70]	17.15 [16.38–17.92]	
	7–7.99	382	27.17 [26.62–27.72]	126.86 [126.31–127.42]	16.78 [16.52–17.04]	
	8–8.99	721	30.79 [30.33–31.25]	132.42 [132.01–132.84]	17.46 [17.25–17.66]	
	9–9.99	783	34.46 [33.94–34.99]	137.77 [137.34–138.20]	18.06 [17.84–18.27]	
FI	6–6.99	8	27.16 [23.41–30.92]	125.66 [124.33–127.00]	17.18 [14.93–19.42]	
	7–7.99	204	27.70 [26.95–28.46]	127.59 [126.85–128.33]	16.87 [16.53–17.22]	
	8–8.99	423	30.17 [29.60–30.74]	132.33 [131.77–132.90]	17.14 [16.89–17.39]	
	9–9.99	612	33.61 [33.07–34.16]	137.97 [137.47–138.46]	17.56 [17.34–17.78]	
GR	6–6.99	232	25.23 [24.57–25.89]	121.41 [120.72–122.09]	17.01 [16.68–17.34]	
	7–7.99	593	28.24 [27.77–28.72]	126.65 [126.19–127.10]	17.48 [17.26–17.70]	
	8–8.99	931	31.76 [31.33–32.20]	132.12 [131.74–132.51]	18.07 [17.88–18.26]	
	9–9.99	783	35.34 [34.80–35.88]	137.45 [137.01–137.90]	18.57 [18.36–18.79]	
HU	6–6.99	34	25.68 [23.97–27.39]	124.33 [122.30–126.36]	16.51 [15.74–17.28]	
	7–7.99	274	27.01 [26.15–27.88]	125.86 [125.07–126.65]	16.88 [16.47–17.28]	
	8–8.99	526	30.70 [29.98–31.41]	131.33 [130.73–131.92]	17.60 [17.30–17.90]	
	9–9.99	778	34.52 [33.83–35.22]	137.42 [136.89–137.94]	18.05 [17.78–18.32]	
ES	6–6.99	160	24.59 [23.92–25.25]	121.20 [120.43–121.98]	16.65 [16.33–16.98]	
	7–7.99	385	27.20 [26.65–27.76]	126.11 [125.55–126.66]	16.99 [16.74–17.24]	
	8–8.99	603	30.63 [30.10–31.16]	131.72 [131.25–132.19]	17.52 [17.30–17.74]	
	9–9.99	521	34.02 [33.33–34.70]	136.85 [136.31–137.40]	18.01 [17.74–18.28]	

Anthropometric data of girls in each age group of 6 European countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

Table 5. The median and interquartile range of weight-, height- and BMI values of girls separately in 4 age categories during the project period

Median value								
Age group [year]	GIRLS	n	Weight [kg]	p-value	Height [cm]	p-value	BMI [kg/m ²]	p-value
6-6.99	BE	129	23.2 (20.8 - 25.5)	0.0001	121.3 (117.3 - 124.9)	0.1232	15.7 (14.9 - 16.4)	0.0001
	BG	41	25.6 (22.5 - 27.9)		121.3 (118.8 - 124.2)		17.0 (15.6 - 18.1)	
	FI	8	24.7 (23.8 - 28.9)		126.0 (124.1 - 127.3)		15.6 (15.2 - 18.1)	
	GR	232	23.9 (21.5 - 28.1)		121.2 (118.3 - 124.7)		16.6 (15.1 - 18.4)	
	HU	34	24.6 (23.1 - 26.7)		124.6 (118.8 - 129.5)		15.9 (15.0 - 17.5)	
	ES	160	24.1 (21.7 - 26.5)		121.6 (118.0 - 124.4)		16.3 (15.2 - 17.8)	
7-7.99	BE	374	24.8 (22.6 - 27.7)	0.0001	125.6 (122.1 - 129.9)	0.0004	15.6 (14.8 - 16.8)	0.0001
	BG	382	25.9 (23.4 - 30.0)		127.0 (123.1 - 130.1)		16.2 (15.1 - 17.9)	
	FI	204	26.5 (24.1 - 30.3)		127.4 (123.7 - 131.3)		16.2 (15.3 - 18.1)	
	GR	593	27.4 (23.7 - 31.8)		126.5 (123.2 - 130.0)		17.0 (15.4 - 19.0)	
	HU	274	25.2 (22.1 - 29.2)		125.7 (120.6 - 130.0)		15.9 (14.8 - 18.1)	
	ES	385	26.1 (23.3 - 29.8)		125.9 (122.3 - 130.4)		16.3 (15.2 - 18.3)	
8-8.99	BE	606	28.0 (25.2 - 31.7)	0.0001	131.9 (128.0 - 136.4)	0.0100	16.1 (15.0 - 17.6)	0.0001
	BG	721	29.3 (26.3 - 34.4)		132.2 (128.5 - 136.1)		16.8 (15.6 - 19.0)	
	FI	423	28.9 (26.0 - 32.9)		132.0 (128.4 - 136.4)		16.4 (15.4 - 18.2)	
	GR	931	30.9 (26.5 - 35.9)		132.0 (128.2 - 135.8)		17.7 (15.8 - 19.8)	
	HU	526	28.4 (25.0 - 34.0)		131.0 (126.9 - 136.2)		16.5 (15.2 - 19.2)	
	ES	603	29.3 (25.7 - 33.9)		131.7 (127.5 - 135.8)		16.9 (15.4 - 19.0)	
9-9.99	BE	580	30.8 (27.7 - 35.8)	0.2792	137.5 (132.9 - 141.4)	0.0009	16.5 (15.3 - 18.3)	0.2650
	BG	783	32.8 (29.5 - 38.4)		137.6 (133.4 - 141.8)		17.3 (16.0 - 19.6)	
	FI	612	32.4 (28.8 - 37.2)		137.9 (133.6 - 142.1)		16.8 (15.7 - 18.9)	
	GR	783	34.4 (29.5 - 40.3)		137.1 (133.1 - 141.5)		18.1 (16.2 - 20.5)	
	HU	778	32.1 (27.8 - 38.6)		137.5 (132.3 - 142.1)		17.0 (15.5 - 19.8)	
	ES	521	32.2 (28.3 - 37.8)		136.6 (132.4 - 141.1)		17.2 (15.7 - 19.6)	

Anthropometric data regarding girls in four age groups of 6 European countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

As **Table 4** represents, 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 (**Table 5**).

There was only one age group in which we could not find a significant difference between the countries in terms of girls' height and that was the age group of 6-6.99.

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 disparities and patterns are more detectable in *Figures 10-12*.

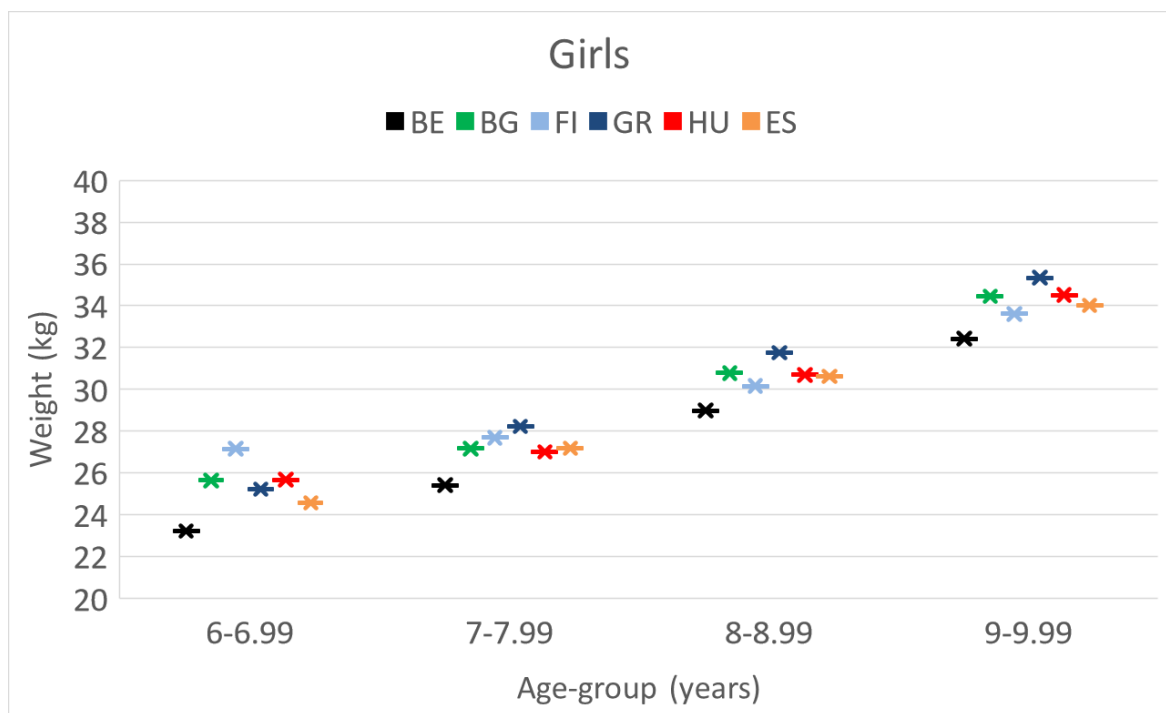


Figure 10. The increase in the *mean* weight [kg] of girls by their age [years] in the 6 countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

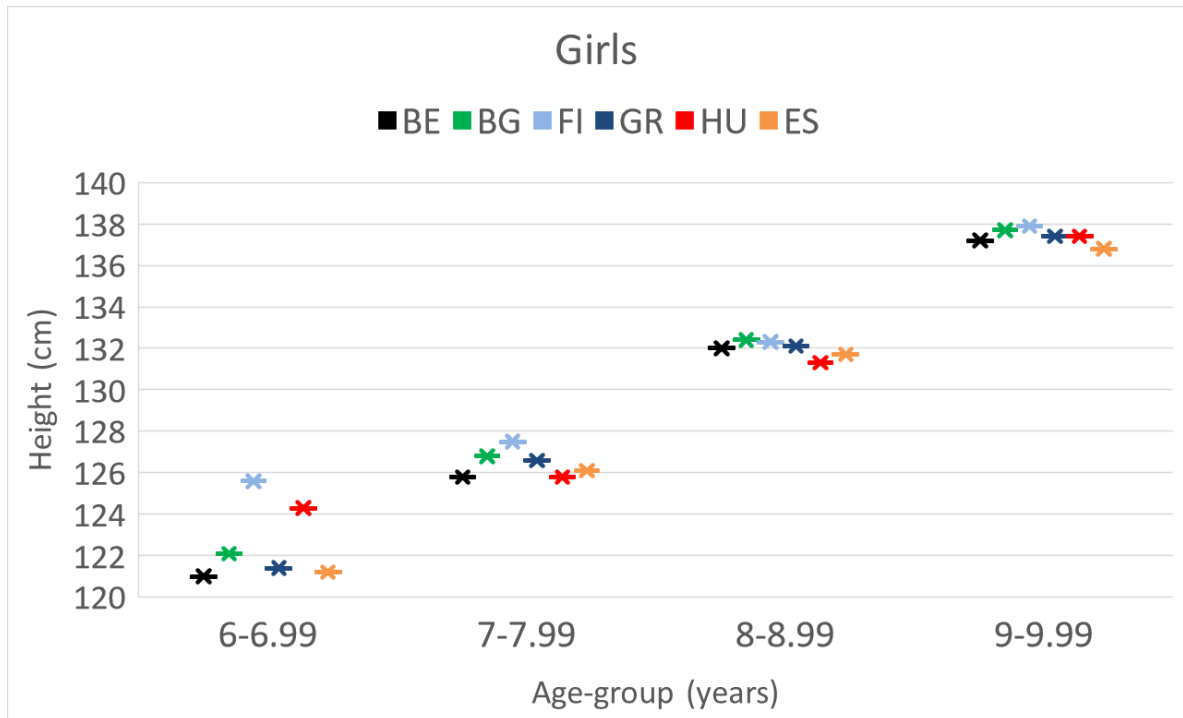


Figure 11. The increase in the **mean** height [cm] of girls by their age [years] in the 6 countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

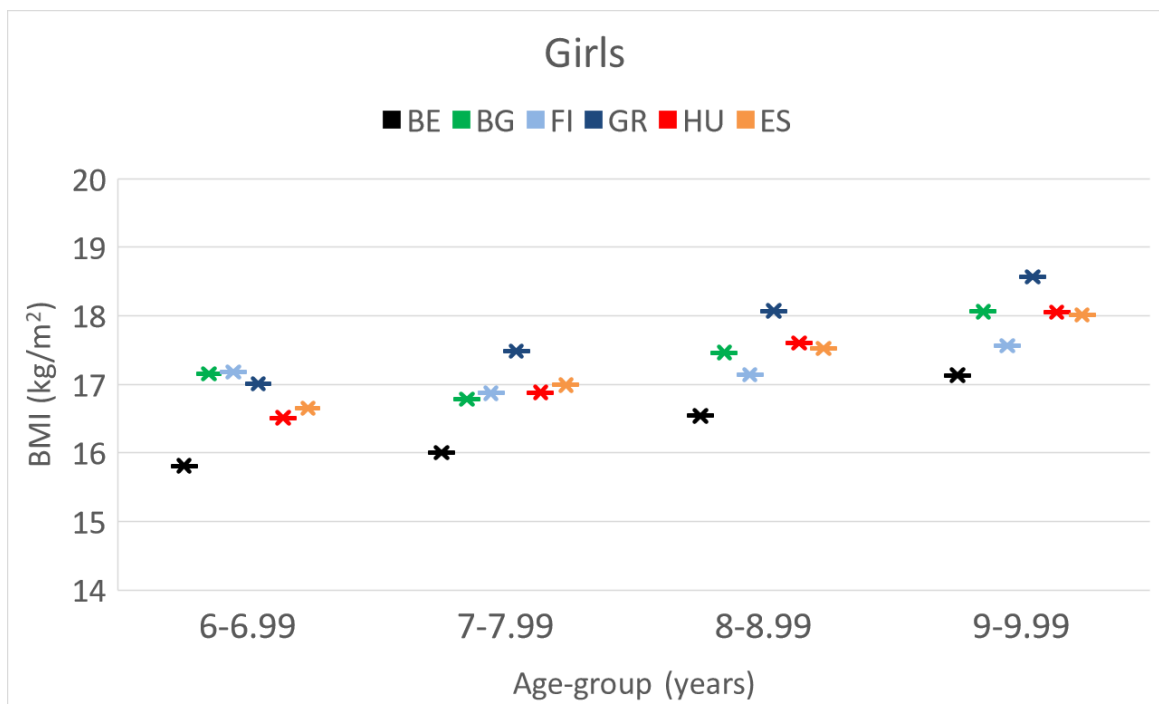


Figure 12. The changes in the **mean** BMI [kg/m²] by age [years] of girls in the 6 countries

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

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%).

Figure 13 displays the graphs.

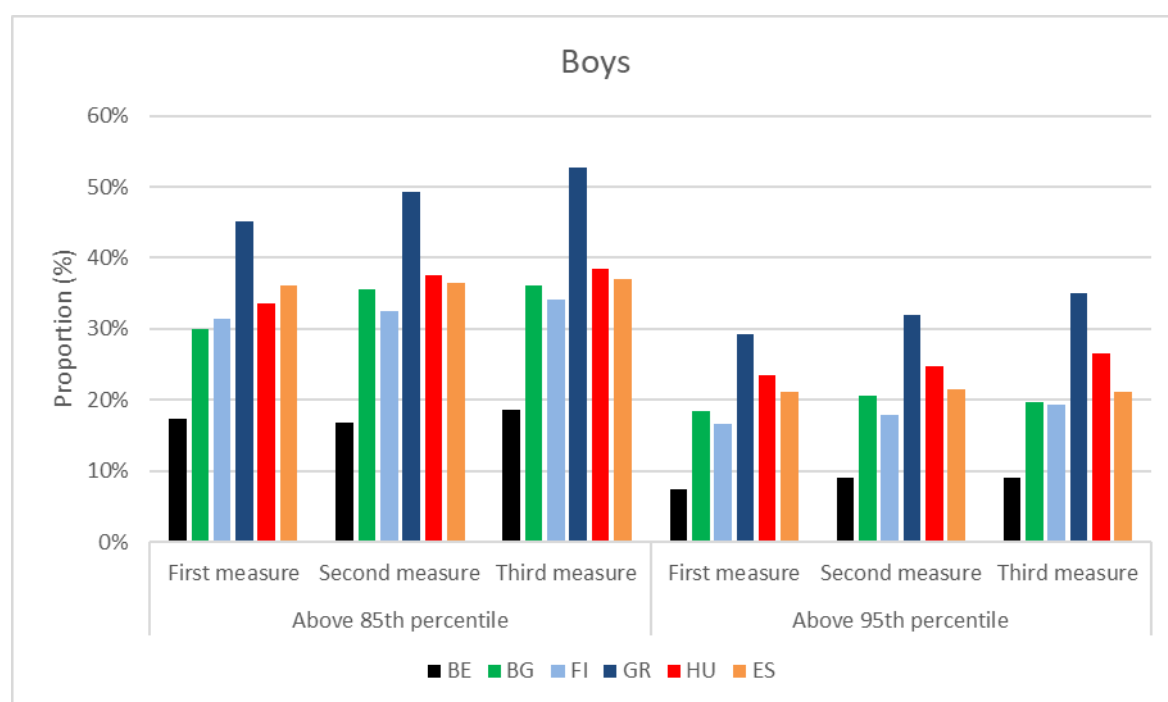


Figure 13. BMI distribution of boys at the time of 3 consecutive anthropometric measurements, performed during the project

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

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 85th 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%. Their distributions are illustrated in *Figure 14*.

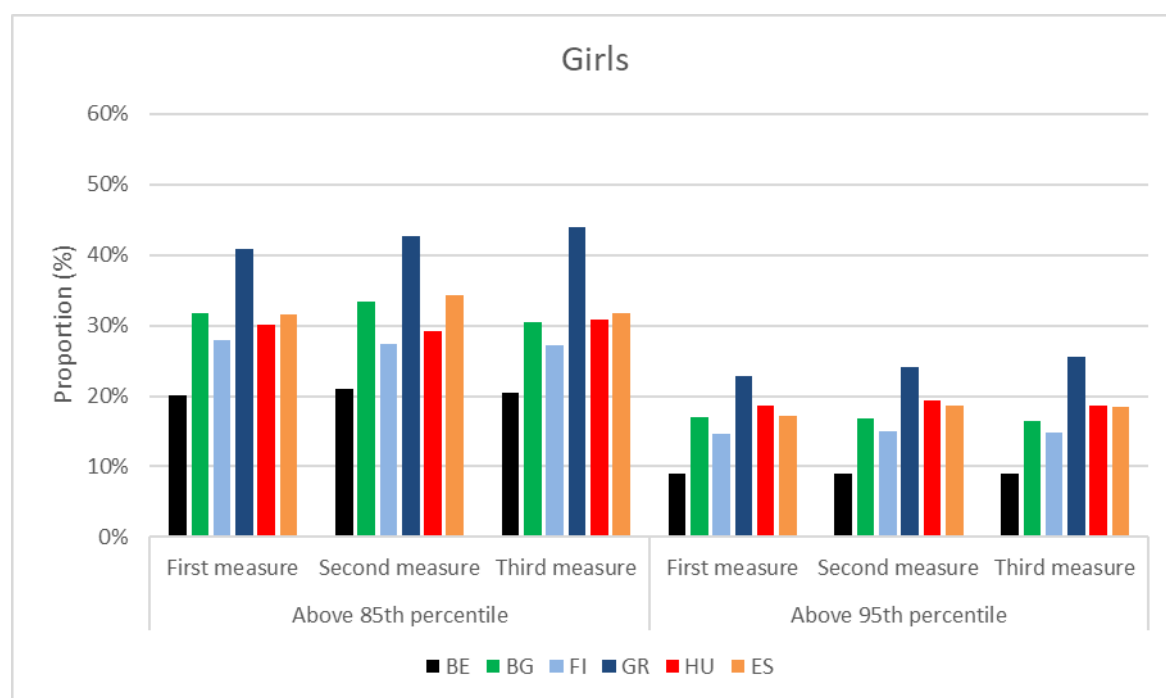


Figure 14. BMI distribution of girls at the time of 3 consecutive anthropometric measurements, performed during the project

(BE = Belgium; BG = Bulgaria; FI = Finland; GR = Greece; HU = Hungary; ES = Spain)

5.1.1. 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.

5.2. 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.

5.2.1. 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.

Table 6. displayed the governmental and compulsory healthcare expenditures alongside the voluntary and household/out-of-pocket contributions. Due to disparities in country rules and reporting systems, various variations may occur.

Table 6. *The percentage of Comprehensive Health Expenditures in relation to the national Gross Domestic Product (GDP) and how they are allocated among different financing schemes.*

	BG	CR	CZ	EE	HU	LV	LT	PL	RO	SK	SI
1990											
GDP (PPP) USD	5,191	*	12,666	*	6,321	*	*	6,179	5,262	*	*
Total healthcare spending - % of GDP	n	*	3.7	*	5.2	*	*	4.3	*	*	*
Gov+comp.	n	*	3.6	*	*	*	*	3.9	*	*	*
Vol+H outofp	n	*	[0.1]	*	*	*	*	[0.4]	*	*	*
2000											
GDP (PPP) USD	6,377	10,753	16,188	9,42	11,876	8,018	8,456	10,651	5,877	11,355	18,048
Total healthcare spending - % of GDP	5.9	7.7	5.7	5.2	6.8	7.9	5.8	5.3	4.2	5.3	5.7
Gov+comp.	3.5	6.6	5.2	4.0	4.7	4.0	4.0	3.7	3.4	4.7	5.7
Vol+H outofp	[2.4]	[1.1]	[0.6]	[1.2]	[2.1]	[3.9]	[2.0]	[1.7]	[0.8]	[0.6]	[2.1]
2010											
GDP (PPP) USD	14,949	19,240	27,694	21,603	21,556	17,576	20,110	21,069	17,027	24,987	27,766
Total healthcare spending - % of GDP	7.1	8.1	6.9	6.3	7.6	8.6	6.8	6.4	5.7	7.8	8.6
Gov+comp.	3.9	6.9	5.8	4.8	5.1	5.2	4.9	4.6	4.6	5.6	6.3
Vol+H outofp	[3.2]	[1.2]	[1.2]	[1.5]	[2.5]	[3.4]	[1.9]	[1.8]	[1.1]	[2.2]	[2.3]
2017											
GDP (PPP) USD	20,329	25,264	36,916	31,638	28,375	27,598	32,093	29,291	25,841	32,110	34,802
Total healthcare spending - % of GDP	n	n	7.1	6.7	7.2	6.3	6.3	6.7	n	7.1	8.3
Gov+comp.	n	n	5.8	5.1	4.8	3.4	4.2	4.6	n	5.7	6.0
Vol+H outofp	n	n	[1.3]	[1.6]	[2.5]	[2.9]	[2.2]	[2.0]	n	[1.4]	[2.3]

(Government + compulsory and household/out of pocket)

Gov+comp. = Government + compulsory healthcare | **Vol+H outofp** = Voluntary schemes healthcare spending + household out of the pocket; **n** = not yet available

* There is a shortage of data in cases where there are no reputable or conflicting sources, as well as in countries that are still in the process of gaining independence.

Bulgaria, Croatia, and Romania are absent from the OECD data bank due to their non-membership status.

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 [88]. This gives a more accurate picture of the living standards of people in each country.

5.2.2. 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.

The data pertaining to these countries is displayed in *Table 7*.

Table 7. Alterations in life expectancies at birth, in relation to both males and females.

Life expectancy at birth [years]	BG	CR	CZ	EE	HU	LV	LT	PL	RO	SK	SI
<i>1990</i>											
Male	68	69	68	65	65	64	66	67	67	67	69
Female	75	76	75	75	74	75	76	76	73	75	77
<i>1995</i>											
Male	67	68	70	61	65	60	63	68	66	68	70
Female	75	77	77	74	75	73	75	76	73	76	78
<i>2000</i>											
Male	68	69	72	65	67	65	67	70	68	69	72
Female	75	77	78	73	76	76	78	78	75	77	79
<i>2005</i>											
Male	69	72	73	67	69	66	65	71	68	70	74
Female	76	79	79	78	77	77	77	79	76	78	81
<i>2010</i>											
Male	70	74	74	71	71	69	68	72	70	72	76
Female	77	80	81	81	78	78	79	81	77	79	83
<i>2015</i>											
Male	71	74	76	73	72	70	69	74	72	73	78
Female	78	80	82	82	79	80	80	82	79	80	84

5.2.3. Organization and personnel of the healthcare system

The number of hospital beds has experienced a substantial drop, particularly in the 'Baltic' states, as shown in *Table 8*. 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.

Table 8. The number of hospital beds and active medical personnel (doctors and nurses) per 1000 inhabitants.

	BG	CR	CZ	EE	HU	LV	LT	PL	RO	SK	SI
<i>Numbers</i>											
Total, per 1 000 inhabitants											
<i>1990</i>											
Hospital beds	9.8	7.4	9.9	11.6	10,1	13.4	12.5	n	8.9	n	6.0
Doctors	3.2	2.1	2.7	3.5	2.9	3.5	n	2.1	1.8	n	n
Nurses	n	n	7.3	8.1	5.2	5.7	n	5.5	n	n	n
<i>1995</i>											
Hospital beds	10.4	5.8	8.5	8.3	9,2	11.2	10.9	n	7.6	n	5.7
Doctors	3.5	2.0	3.0	3.2	3.0	2.8	3.7	2.3	1.8	n	n
Nurses	n	n	7.4	6.4	5.3	4.9	8.9	5.5	n	n	n
<i>2000</i>											
Hospital beds	7.4	6.2	7.8	7.0	8.2	8.8	8.8	n	7.4	7.9	5.4
Doctors	3.4	2.4	3.4	3.1	2.7	2.9	3.6	2.2	1.9	3.4	2.1
Nurses	n	n	7.6	5.8	5.3	4.6	7.6	5.0	n	7.4	6.8
<i>2005</i>											
Hospital beds	6.4	5.5	7.6	5.4	7.9	7.9	7.3	6.5	6.6	6.8	4.8
Doctors	n	2.5	3.6	3.1	2.8	3.0	3.7	2.1	n	3.0	2.4
Nurses	n	n	8.1	6.3	6.0	5.0	7.3	5.1	n	6.0	7.5
<i>2010</i>											
Hospital beds	6.5	5.6	7.0	5.3	7.2	5.7	7.2	6.6	6.3	6.5	4.6
Doctors	3.8	2.9	3.6	3.2	2.9	3.1	4.0	2.2	2.5	3.4	2.4
Nurses	n	n	8.1	6.1	6.2	5.0	7.4	5.3	n	6.1	8.2
<i>2015</i>											
Hospital beds	n	n	6.5	5.0	7.0	5.7	7.0	6.6	n	5.8	4.5
Doctors	n	n	n	3.4	3.1	3.2	4.3	2.3	n	3.5	2.8
Nurses	n	n	8.0	6.0	6.5	4.7	7.7	5.2	n	5.7	8.8

n: data are lacking where no reliable or discrepant sources were available

5.2.4. The significance and role of primary care

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) and can be found in **Table 9**.

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).

Table 9. *The dimensions of primary care were assessed based on its strength and position.*

Dimensions	Scores by countries										
	BG	CZ	CR*	EE	HU	LV	LT	PL	RO	SK	SI
Total governance of primary care	2.46	2.37		2.5	2.2	2.44	2.48	2.32	2.52	2.3	2.51
Total economic conditions of primary care	1.88	2.03		2.06	2.1	2.08	2.08	2.06	2.18	2.1	2.2
Total primary care workforce development	1.95	1.9		2.2	2.1	1.8	2.14	1.92	2.07	1.8	2.23
Total access to primary care scores by country	2.15	2.4		2.2	2.4	2.3	2.16	2.4	2.25	2.25	2.45
Total continuity of primary care scores by country	2.35	2.44		2.45	2.4	2.3	2.42	2.4	2.3	2.4	2.3
Total coordination of primary care score by country	1.4	1.65		1.7	1.45	1.95	1.65	1.85	1.55	1.35	1.8
Total comprehensiveness of primary care score by country	2.55	2.3		2.4	2.3	2.4	2.6	2.3	2.2	1.95	2.4
Level of gate keeping	3	2		3	2.5	2.5	3	2	3	2	3
<i>Prevention and public health expenditures of total healthcare expenditures [%]</i>	3.5	2.2		2.6	2.4	1.2	1.3	2.2	5.9	4.5	4.1

* Croatia was not included in this study.

5.2.5. 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.

5.2.6. 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 key advantages of primary care reforms in almost all nations include privatization, which allows for independent work, and the acquisition of some competences, but not enough. Additionally, these reforms are recognized as a discipline. The mention of administrative responsibilities sometimes served as an obstacle to achieving higher performance.

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.

Primary physicians are esteemed individuals in nearly every nation.

5.2.7. Life expectancies

It can be hypothesized that the enhancement of living standards resulting from the rise in GDP contributed to comparable shifts in life expectancies, however there is no evident statistical correlation. Advancements in medical services and technology could independently support these developments, regardless of the primary care system.

5.2.8. 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.

5.2.9. 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 gatekeeping 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 [89]. 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 [90]. 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 [91].

6. DISCUSSION

Comparisons made between countries presented visible differences in both research topics.

6.1. Differences between anthropometric parameters of the 6 participated countries

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 [92]. 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 [93]. The *WHO Child Growth Standards* included information on children between the ages of 5 and 19 [56]. A large portion of our data agrees with both of these and the Finnish survey [5]. This research didn't compare national data, and there wasn't much overlap between the countries examined. They tended to have a lot fewer participants.

A few of the follow-up projects have demonstrated the value of the school environment and kids' particular lifestyles. 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 [92,94].

Children aged 7-9 years old in the subsequent *COSI studies'* anthropometric data revealed regional disparities. Greece and Spain had the highest percentage of overweight boys (43%) followed by Bulgaria (30%), Finland and Hungary (28%). Greece (20%), Spain (18%), Bulgaria (16%), Hungary (14%) and Finland (12%), were the countries with the highest obesity rates. While just 26% of Finnish students were overweight, 41% of Spanish, 37% of Greek, 28% of Bulgarian, and 28% of Hungarian girls were overweight among their peers. According to the statistics, 16% of girls in Spain, 14% of girls in Greece, 12% of girls in Bulgaria and Hungary, and just 8% of girls in Finland were obese. Children of parents with greater levels of education experienced a very slight reduction in obesity [87,95].

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 [71].

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 [96]. Different methods of recruitment could result in similar findings as well [97,78]. 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. Long-term effects of behaviour-based prevention programs were limited. Current programs do not effectively reach certain groups at risk of developing obesity. Although universally valid conclusions cannot be drawn due to the heterogeneity of available studies, it is clear that combining behaviour-based programs with community-based prevention to counteract an *obesogenic* environment is critical for future obesity prevention programs' long-term success [8]. In the affected families *obesogen* factors were often present in the *ENERGY Project* [98]. The *IDEFICS study* provided many evidence about the importance of appropriate lifestyle. Physical activity and achieved physical fitness are closely related [99]. The uncontrolled usage of social media, high amount of screen-time often counteract with declared elements of healthy lifestyle [100].

Sustained outcomes necessitate the active participation of families, schools, and communities, along with government engagement in formulating policies that advocate for a nutritious diet and the significance of physical activity [101].

6.1.2. 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, although no comparable national data were found even without representatives. Although in some countries, low SES areas were targeted, the educational level of parents and their economic circumstances were not surely homogeneous. The socioeconomic circumstances of the children's families may influence their individual somatic development.

While the F4D study had only a 2 year long follow-up period, the data of these children was not available before and after the project.

The ongoing F4D project may have a certain effect on the parameters of children, but it could be compared only at individual level.

The year-long age cohorts compared (i.e., 6.0–6.99y, etc.) could be too wide in this growing period of children, but we had no other option for the categorization of these measurements.

Mainly comparisons between countries and trends were described. It would be irrational to count the statistical analysis between countries; therefore, only some Hungary related findings were described and compared.

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.

6.2. Primary care in Eastern Europe

Primary care should address the challenges posed by the ageing European population, evolving health risks and morbidity, workforce advancements, and the expanding potential of technology. Additional issues arise from the escalating frequency of noncommunicable diseases and the rising complexity of demand, stemming from increased rates of multi-morbidity. Simultaneously, there have been notable advancements in the technology infrastructure, such as eHealth, telemedicine, and point of care testing,

which have introduced novel service models in primary care as well. 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.

The role of General Practitioner in most Central and Eastern European nations is technically sufficient, but significant efforts are still required to get the requisite level of recognition and quality. 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.

6.2.1. 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.

Currently, there is no existing baseline to assess how the organization of primary care supply can impact the overall health outcomes of a community.

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.

6.3. Relation between primary care performance and obesity prevalence

As per WHO childhood obesity data regarding F4D countries and the Eastern bloc countries (in 2016), the prevalence of obesity among 5-9 years old children (in both sexes) is displayed: percentage +2 *standard deviations above the median (crude estimate)*

Belgium (BE): 8.7 [5.2-13], Bulgaria (BG): 13.7 [6.1-23.1],

Croatia (CR): 15 [8.1-23.1], Czech Republic (CZ): 12.3 [6-20.4],

Estonia (EE): 8.5 [3.3-16], Finland (FI): 11.7 [5.2-20.1], Greece (GR): 17.8 [11.1-25.4],

Hungary (HU): 14.3 [7.2-22.8], Latvia (LV): 9.1 [3.2-17.6], Lithuania (LT): 9.1 [4-16.2],

Poland (PL): 12.5 [6.9-19.5], Romania (RO): 10.9 [6.8-15.8],

Slovakia (SK): 10.7 [4.3-19.9], Slovenia (SI): 12.5 [7.8-18.2] and Spain (ES): 14.9 [9.3-21.1].

The differences are more visible on *Figure 15* [102].

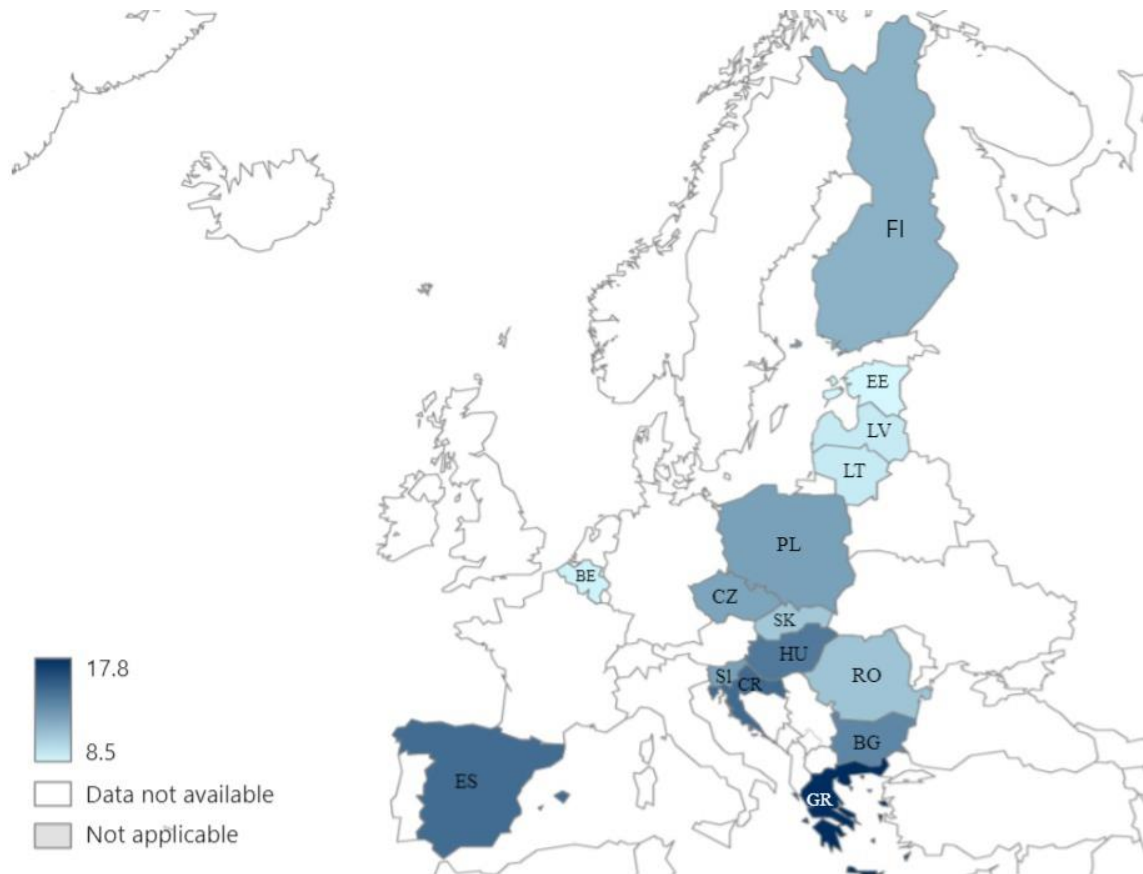


Figure 15. Prevalence of obesity among 5-9 years old children, BMI > +2 standard deviations above the median (crude estimate) % [102]

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 in 2016 as well. Life expectancy at birth in relation to both males and females in these two countries was alike according to data between 1990 and 2015.

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 [103].

In Hungary, there is a lack of explicit guidelines for family physicians to manage childhood obesity. Additionally, general practitioners lack financial motivation. A practical primary care guideline would be necessary. Obesity is regarded often as a complication rather than an independent condition. The obesity-guideline is not universally accessible to

all general practitioners, resulting in significant variations in their knowledge, clinical practices, and personal attitudes [104].

Pre-intervention data gathered to determine the prevalence of childhood obesity across different countries and examine its correlation with socio-demographic factors and parental obesity status regarding F4D study found, that 25% of children were overweight or obese, and 25% of families had at least one parent who was obese. 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. The latest COSI results refute the prevailing notion that low socioeconomic status is regularly linked to unhealthy behaviours and diets. This finding highlights the need of identifying the socio-economic and other environmental factors associated with childhood obesity in nations with varying socio-economic categories [84].

The IOTF use the BMI cut-offs on a global scale to evaluate the occurrence of childhood overweight, obesity, and thinness. Unlike other BMI references, such as the WHO norm, these cut-offs cannot be represented as centiles, such as the 85th percentile. Defining the international cut-offs based on the underlying LMS curves could be used as an option in the future studies, however we used BMI references according to WHO norm [105].

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. Further investigation is warranted to explore these connections across a wider range of countries and varied socio-demographic groups. This information can be used then to shape public health policies that are relevant to each country. Gaining an in-depth knowledge of the factors linked to childhood obesity is crucial, as well as involving primary care

providers in order to develop targeted interventions to address this continuously increasing issue.

7. 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 the 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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9. KEYWORDS

Anthropometric measurements, Body height, Body weight, Childhood obesity, Eastern Europe, Family medicine, Hungary, Obesity prevention, Primary care

10. ACKNOWLEDGEMENTS

First and foremost, I would like to express my sincere gratitude to my supervisor, Professor Imre Rurik for his consistent support and guidance during my PhD study. His immense knowledge, insightful comments, suggestions and encouragement have been invaluable all the time of my academic journey.

I am incredibly grateful for the opportunity to be a part of an exceptional research team at the Department of Family and Occupational Medicine. I am also grateful to my colleagues, Professor István Ilyés, László Kolozsvári, Anna Nánási, Tímea Ungvári and Zoltán Jancsó, for their kindness and endless support.

Special thanks goes to Gergő J. Szöllősi for his statistical assistance throughout my research.

I am thankful to the secretary of the department, Sándorné Ruzsnyák, for her assistance in administrative tasks during these years.

Lastly, I would like to express my deepest gratitude to my family. Their encouragement played an integral role in my accomplishments. It would have been impossible to finish my PhD studies without their unwavering support over the past few years.

To my parents and grandparents: Thank you for everything.

11. APPENDIX

Human resources		
Actual number of GPs		
Trends in the number of GPs?	decreasing/ increasing	
No of GPs for paediatric care		
Does it exist a different network for the care of children?		
Average size of the GP practice (No. patients/practice)		
Age cohort of GPs	mean..... year	
Number of primary care nurses	in a practice	
How are they educated?	do they receive any other education?	
What competencies they have?	Does “nurse practitioners” existing? Did it start any new type of education giving more competencies for nurses?	
Structure, financing		
Status of GPs	private/ public servant	
if private, how is the contractor?	national fund/ private insurance Co-s?	
If public servant, who is the employer?		
How are GPS financed?	based on salary/ on capitation fee for services? please describe?	
Average <i>netto</i> income of GPs? (after deducted with taxes) EUR / range: from -to		
GPs are working..... Please provide ratio, if available?	in single handed practice	in group practices?
Do they employ or contract other health professionals?	if yes, please list them	
is the “gate-keeping function” of the PC strong?	give examples	

do the perform any activities, as <i>prevention</i> ? (primary, secondary)	is this activity financed?	
according to your knowledge, which percent of national healthcare budget is spent for primary care?% please provide relevant website	
Education		
Is PC an academic discipline? Existing Departments of Family Medicine at the medical faculties?	if yes, since when? -after 1990? - before 1990? Recent number of Departments	
Is there a <i>vocational training</i> for family physicians?	since when? how long is it ?years	
Does it exist a <i>board examination</i> of family physicians?	since when? how is the ration of board certified family physicians in the PC system?	
is it an <i>obligatory CME</i> for GPs	organized by the universities?	
Organization		
Are any PC <i>organization(s)</i> in your country?	please provide name and link to the website	
Are any <i>Institute</i> of Primary Care	operated by the government? by universities?	
Please describe the main tasks of this institution		
Additional personal remarks		
Please write about, how is the respect of PC in the whole population?		
How strong is the governmental support for primary care?	only verbal visible	
describe the most important changes	after 1990 /after joining the EU?	
What changes in PC system could be considered as the consequences of EU membership?		

The most important and predictable challenges for the national PC system in the future?	
Is any visible migration of GPs toward other EU member countries - migration of primary care nurses?	Which are the target countries?
any other relevant remarks	give link to a relevant websites



Registry number: DEENK/3/2024.PL
Subject: PhD Publication List

Candidate: Csilla Semánová
Doctoral School: Doctoral School of Health Sciences

List of publications related to the dissertation

1. **Semánová, C.**, Szöllősi, 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. *Children-Basel*. 10 (6), 1-13, 2023.
IF: 2.4 (2022)
2. **Semánová, C.**, Rurik, S. E., Dózsa, C., Jancsó, Z., Kolozsvári, L. R., Nánási, A., Pfeiferová, M., Rurik, I.: Primary care behind the former "Iron Curtain": changes and development of primary healthcare provision in the Eastern part of the European Union. *Prim Health Care Res Dev*. 20, 1-9, 2019.
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List of other publications

3. Rurik, I., Nánási, A., Jancsó, Z., Kalabay, L., Láncki, L., Móczár, C., **Semánová, C.**, Schmidt, P., Torzsa, P., Ungvári, T., Kolozsvári, L. R.: Evaluation of primary care services in Hungary A comprehensive description of provision, professional competences, cooperation, financing, and infrastructure, based on the findings of the Hungarian-arm of the QUALICOPC Study. *Prim. Health Care Res. Dev.* 22, 1-8, 2021.
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IF: 2.763
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Total IF of journals (all publications): 15,383

Total IF of journals (publications related to the dissertation): 3,51

The Candidate's publication data submitted to the iDEa Tudóstér have been validated by DEENK on the basis of the Journal Citation Report (Impact Factor) database.

08 January, 2024

