

Cardiometabolic-Based Chronic Disease in Czechia

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Unlike the traditional adiposity and dysglycemia classifiers, which do not capture the complexity of cardiometabolic pathophysiology, the Cardiometabolic-Based Chronic Disease (CMBCD) model was proposed to incorporate the natural history of the cardiometabolic disease in four stages: 1—risk; 2—pre-disease; 3—diseases; and 4—complications. The CMBCD model combines the dysglycemia and abnormal adiposity drivers into the chronic care model as DBCD and ABCD, with the presence of earlier primary drivers (genetics, environment, and behavior) and later metabolic drivers (hypertension and dyslipidemia) impacting the eventual cardiovascular disease phenotype. The CMBCD model triggers proactive detection and stratification of subjects at risk using a culturally adapted approach to improve successful implementation and precision.

Keywords: adiposity ; cardiometabolic risk ; cardiovascular disease ; chronic disease ; dysglycemia ; insulin resistance ; nutrition ; obesity ; type 2 diabetes

1. Introduction

In contrast to the decreasing burden and mortality related to cardiovascular disease (CVD) and certain related CVD risk factors, such as hypertension, dyslipidemia, and tobacco use, the prevalence of dysglycemia and abnormal adiposity are increasing in Czechia. From 1990 to 2019, the number of disability-adjusted life years (DALYs) increased by 18.6% for dysglycemia and by 10.4% for body mass index (BMI) > 23.0 kg/m² [1][2]. In 2020, epidemiological data affirmed that both dysglycemia and abnormal adiposity increased the risk of severe COVID-19 [2], highlighting the need for urgent implementation of cardiometabolic risk mitigation strategies [3]. On a global scale, there is an array of both biological and cultural/social determinants of disease that interact and drive cardiometabolic-based chronic disease (CMBCD).

This review evaluates the key drivers for dysglycemia and abnormal adiposity in Czechia based on the epidemiology of various biological and cultural/social determinants of health. Particular variables of interest include demographic characteristics, modifiable cardiometabolic risk factors (dysglycemia, abnormal adiposity, hypertension, dyslipidemia, healthy eating, physical activity, and tobacco use), and ethnocultural and social-economic risk factors (healthcare infrastructure, health literacy, disparities in access to quality healthcare, housing/income/educational levels, and mental health). By analyzing the results of a formal literature searching protocol on cardiometabolic drivers in Czechia, discrepancies, emergent relationships, and essential elements of an effective preventive care plan can be identified. Furthermore, this methodology can be replicated for other regions of the world to expose epidemiological differences that warrant refinements and adaptations to current prevention and treatment strategies.

2. Current Analysis on Research Results

A total of 7255 articles were retrieved from the databases, and 1809 duplicates were excluded. Thus, 332 articles were subjected to a full-text review: we excluded 23 studies analyzing the data from the same epidemiological studies, and another 131 studies were not aligned with the purpose of the review. Finally, 38 studies were included in our narrative review (10 on biological risk factors, 11 on cardiometabolic risk factors, 11 on behavioral risk factors, 3 on environmental risk factors, and 3 on mental health). Additionally, a hand search using references in identified articles was performed.

References
Czechia is a unitary state with representative democracy, a parliamentary republic, and decentralized administration with 14 regions and over 6000 municipalities [4]. The main industries include engineering, food processing, chemical, and metallurgy [5]. The Czechian population is linguistically homogenous, the official language is Czech [4]. About 94% of adults aged 25–64 years have at least upper secondary education [4].
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Czechia is denominationally neutral (no official religion) and freedom of religion is granted [4]. In 2019, there were 41 churches and religious societies, the largest being the Roman Catholic Church, Czech Brethren Evangelical Church, and the Czechoslovak Hussite Church [5]. Life expectancy at birth (years) increased from 67.5 in men and 73.3 in women in 1950 to 74.5 in men and 80.5 in women in 2019 [6].
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Since 1989, there has been an increase in the consumption of healthy foods: pulses (from 1.3 to 2.8 kg/person/year), nuts (from 2.6 to 3.6 kg/person/year), vegetable oils (from 12.5 to 17.2 kg/person/year), vegetables (from 68.7 to 87.3 kg/person/year), and fruits (from 70.5 to 80.4 kg/person/year). On the other hand, there was a reported decrease in the consumption of milk and dairy products (from 259.6 to 247.5 kg/person/year), meat (from 97.4 to 80.3 kg/person/year), lard (from 6.8 to 4.5 kg/person/year), butter (from 9.4 to 5.4 kg/person/year), refined sugar (from 39.8 to 34.1 kg/person/year), and salt (from 6.3 to 5.7 kg/person/year)^[12].

Traditional Czech dishes are rich in red meat, potatoes, gravies, and root vegetables. (Czech version of meatloaf, made of minced pork and beef meat, bacon, onions, and garlic), and guláš (meat stew, usually served with bread dumplings or slices of dark bread). (lentils, served with boiled eggs and pickled cucumbers), and "ovocné knedlíky" (yeast/curd cheese/potato dough dumplings filled with seasonal fruits, sprinkled with sugar, grated curd cheese, and melted butter). Soups, including vegetable soups, broth, and legume soups, are also an important part of Czech cuisine.

According to the World Health Organization (WHO), consumption of pure alcohol in Czechia was 14.4 L per person per year, in 2016. This is 47% higher than the average amount in the WHO European region, and one of the highest globally^[13]. On average, one Czechian inhabitant consumes 144 L of beer, 19 L of wine, and 7 L of distillates per year, with 6.1–9.5% consuming alcohol daily^[14]. In a population-based, cross-sectional survey in Czechia^[15] on alcohol consumption in the past 12 months, 28.2% of men and women did not drink alcohol; 45.6% consumed less than 7 or 14 standard drinks per week for women and men, respectively; and 26.2% had at least 7 or 14 standard drinks per week for women and men, respectively.

The prevalence of physically inactive adults (performing less than 150 min of moderate-intensity and less than 75 min of vigorous-intensity physical activity per week) in Czechia has increased from 31.4% in 2013 to 42.7% in 2017^[17]. The time spent sitting per day had also increased from 58% in 2005 to 62% in 2017^[18]. Age and sex inequalities are present in the physical activity patterns of the Czech population. Subjects older than 65 years and middle-age adults (40–64 years old) have a 4 and 1.7 times higher chance, respectively, to be physically inactive in comparison with young adults (18–39 years old)^[19].

The most popular team sports in Czechia are football, floorball, ice hockey, volleyball, basketball, and kickball (an original Czech sport in which the players kick the ball over a low net). The most popular individual activity is walking, followed by jogging, running, cycling, hiking, inline and ice skating, and skiing^[20]. Dog walking is also a frequent activity, as Czechia has the second-highest rate of dog ownership in Europe (38%)^[21]. Local evidence suggests that dog owners display a better cardiovascular health profile than non-owners^[22].

Health literacy reflects one's knowledge, motivation, and competency to access, understand, appraise, and apply health information to make judgments and decisions in everyday life^{[23][24]}. Self-efficacy is the confidence in individuals' ability to perform certain tasks and attain determined goals; it is closely linked with health literacy and is associated with better cardiometabolic outcomes^[25]. In 2014, in Czechia, the prevalence of low level of health literacy was 59% (below the European average 47.6%)^[26], higher in subjects with older age (≥ 40) and with the level of education lower than university degree^[26]. In diverse populations, a low level of health literacy is associated with increased risk of T2D^[27], less knowledge about T2D^[28], lower adherence to diabetes medications^[29], and higher risk for T2D related-complications^[30].

Compared with those with higher education, less-educated men and women showed 11 and 3 years of lower life expectancy, respectively^[31]. Additionally, lower education levels have been associated with a higher presence of prediabetes and diabetes^[6], as well as the presence of adiposity and dysglycemia-related complications, compared with those with higher educational levels^{[8][32]}. Income. There was a low level of disparity in access to quality healthcare and specialized health services among different income and education groups^[31]. Nevertheless, in certain rural regions, especially Liberecký, Ústecký, Zlínský, and Středočeský, there was a lack of primary care clinicians^{[31][33]}.

A few studies, including small samples in Czechia, found that individuals with dysglycemia or abnormal adiposity experience more stress and depressive symptoms^{[34][35][36]}, anxiety^[35], and lower quality of life^[35]. Nevertheless, population-based studies evaluating these associations are lacking in Czechia.

The healthcare system in Czechia is based on obligatory participation of insured persons, with free-for-service healthcare funded by mandatory employment-related insurance plans since 1992 [37]. Health insurance fully covers preventive, diagnostic, ambulant and hospital care (excluding cosmetic surgeries without underlying health reasons), spa care, and patient transport. Insurance also fully or partially covers dental care, medicines, and medicinal aids [38]. If that total amount of supplementary payments paid for partially covered medicines exceeds CZK 5000 (EUR 197) per year, the health insurance is obliged to pay the exceeding amount back to the person [39].

In Czechia, general practitioners provide primary diabetes care for approximately 27.4% of patients with diabetes [40] and are the healthcare professionals who diagnose the disease most frequently [40][41]. A series of regular preventive healthcare checks is established and is covered by insurance [42]. Patients with poor metabolic control, presence of complications, or in need of multi-drug treatment, including insulin, are usually referred to a diabetologist, but overall care is still shared between a general practitioner and diabetologist [43]. Lifestyle and rehabilitation programs are provided by physicians, as well as physiotherapists and dietitians, with close collaboration.

For patients with diabetes, 25 centers of specialized care (“Centers of Diabetology”) are available, offering initial consultations and ongoing care for patients with insulin pumps, severe diabetes complications, or organ failure caused by diabetes. The diabetes transplant program is provided by one of these centers [44]. The diabetes care system in Czechia also offers specialized centers of foot care (33 centers), education (41 centers), and psychological care (42 centers) for patients with diabetes [44]. In short, comprehensive diabetes care is generally covered by health insurance in Czechia [41][45][46].

According to a Czech cross-sectional study focusing on patients with T2D, results showed that 34.2% of patients achieved an HbA1c <7% (53 mmol/mol), regardless of treatment modality [47]. The diabetes control in subjects using insulin for the treatment study (DIAINFORM) showed that the frequency of acceptable metabolic control (HbA1c <7% (53 mmol/mol)) in patients with T2D treated with insulin was 37.1% [48].

In Czechia, obesity care is multidisciplinary, provided by general practitioners, physicians specializing in diabetology/endocrinology, dietitians, physiotherapists, and psychologists [49]. The level of care depends on the stages of adiposity-related complications. For patients with obesity, there are 19 specialized obesity clinics and 5 centers offering an individualized approach to prevent and treat obesity, and 8 centers are providing metabolic and bariatric surgery [50].

A summary of the most successful health-promoting projects implemented in Czechia is presented in **Table 3**. The large scale of those initiatives and the positive impact of the dysglycemia and abnormal adiposity drivers face many challenges, including lack of a scientific understanding of these drivers among diverse population groups, such as implementation, application of project management, use of organizational and procedural tools, and improving cooperation among stakeholders [51].

Table 3. Health promotion in Czechia *.

Project Title	Main Themes	Setting
Healthy aging project <small>[52]</small>	<ul style="list-style-type: none"> • Support of lifelong employment, learning, and social security of senior citizens • Improvement in health and social services for seniors • Awareness raising, anti-stigmatization, and anti-discrimination • Housing and residential social services 	<ul style="list-style-type: none"> • Interdisciplinary cooperation, especially between health and social areas, including local governments, educational institutions, non-governmental organizations, and business. Cooperation with the National Network of Healthy Cities and regional hygienic stations

Project Title	Main Themes	Setting
Health Promoting School ^{[53][54]}	<ul style="list-style-type: none"> • Improving the assortment of food in vending machines, school canteens, and buffets according to dietary recommendations • Regular physical activity in school (providing place and time for physical activity every day) • Educating teachers about healthy nutrition and sport and incorporating this knowledge into the whole educational process • Full-time access to drinking water 	<ul style="list-style-type: none"> • Kindergartens and primary schools
Healthy City ^[55]	<ul style="list-style-type: none"> • Increasing the number of parks and recreation zones in the city • Improving public transport • Improving the level of safety in the city • Improving the cleanliness of public spaces • Raising awareness about importance of sport and nutrition • Raising awareness about non-communicable diseases (diabetes, CVD, oncological diseases) • Tackling the obesogenic environment 	<ul style="list-style-type: none"> • Over 2152 cities and towns with 5423 million inhabitants (52% of Czech citizens)
Healthy Workplace ^[56]	<ul style="list-style-type: none"> • Healthy and safe workplace conditions • Coping with stress • Decreasing the amount of work-related injuries • Prevention of chronic musculoskeletal disorders and back pain • Decreasing the level of noise pollution 	<ul style="list-style-type: none"> • Office and workspaces around the country

Project Title	Main Themes	Setting
Delicious life ^[57]	<ul style="list-style-type: none"> Improving the knowledge of senior citizens about nutrition and motivation to achieve positive changes and be physical activity Improvement in social participation Improving the quality of physical education classes in schools Adding physical activity breaks before and in between classes Creating afterschool clubs of various physical activities Providing all-day access to sugar-free drinks 	• Social care institutions
Educational program physical activity and nutrition ^[58]	<ul style="list-style-type: none"> Increasing the amount of information about healthy nutrition in the curriculum Improving the quality and increasing the variety of food in school canteens Changing the assortment of the snacks in school vending machines in the direction of a healthier one Ensuring the financing of a cycling infrastructure 	• Primary Schools
The National Cycling Development Strategy of the Czech Republic for 2013–2020 ^[59]	<ul style="list-style-type: none"> Increasing the safety of bicycle traffic Methodological support for the development of bicycle transport in cities and the "Cycling Academy" project 	• Whole country

* This is a list of selected examples.

3. Conclusions

According to the findings of this literature search, an effective cardiometabolic preventive care program for Czechia needs to focus on shifting the traditional understanding and management of cardiometabolic factors towards a CMBCD complication-based model with particular attention given to the implementation of targeted interventions to avoid the progression of the cardiometabolic disease. In CMBCD stage 1, more attention should be given to primordial prevention with educational campaigns targeting unhealthy behaviors, incorporating community engagement, and reinforcing healthy eating habits; in stage 2, the implementation of primary prevention programs, e.g., the diabetes prevention program, promoting healthy dietary patterns, regular physical activity, and other lifestyle interventions should be transculturally adapted and scaled up; in stage 3, the emphasis remains on the secondary prevention as a necessary intervention to

mitigate disease progression and development of complications; in stage 4, tertiary prevention strategies to prevent the advance of complications and mortality are implemented with the highest healthcare cost compared to lifestyle preventive strategies.