Public Health and Preventive Medicine



Dana Müllerová et al.

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**Dana Müllerová, Monika Bludovská,
Iva Kladnická, Jana Langmajerová,
Iveta Plavinová, and Pavel Sedláček**

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Reviewers:
Prof. MUDr. Zuzana Derflerová Brázdová, DrSc., Masaryk University
Doc. MUDr. Pavel Dlouhý, Ph.D., Charles University

Authors:
Prof. MUDr. Dana Müllerová, Ph.D.
MUDr. Monika Bludovská, Ph.D.
Mgr. Iva Kladnická
MUDr. Jana Langmajerová, Ph.D.
MUDr. Mgr. Iveta Plavinová
MUDr. Pavel Sedláček, Ph.D.
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Pilsen, May 2021 *Prof. Dana Müllerová, M.D., Ph.D.*

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1 PUBLIC HEALTH AND PREVENTIVE MEDICINE

Public health is a scientific field focused on **population health**. It attempts to **extend life expectancy and improve the quality of life of individuals and populations**. Its methodology includes an analysis of the population health, exploring the most common and the most severe risk factors that impact human health. These include not only environmental and occupational conditions but also genetic factors and lifestyle. The outputs of public health are translated into interventions in social and health policies, but their quality and effect depend greatly on the economic and technical development and possibilities of the country. In developing countries, the lower life expectancy is caused by a very high mortality rate of infectious diseases, which are in turn a result of insufficient personal hygiene, problems with drinking water and food resources, and an absent system of vaccination. In developed countries, new risk factors are present, especially lifestyle ones – excessive mental load (leading to stress responses), reduction of physical activity, high availability of processed food and an imbalance of main nutrients. Environmental problems influencing health of populations have also been changing and have gained new attributes in terms of speed, quantity, and quality of pollution. To sum up, public health looks for factors that can be influenced, studies them, and uses interventions to impact health of populations. Its tools are epidemiological methods, and, with the development of technologies and scientific discoveries, new preventive instruments become available to it.

Preventive medicine in a narrow sense deals with an individual consumer of health care (primary, secondary, and tertiary prevention) provided by the health-care sector. Apart from social and health-care interventions, various medical specialties are also of much use here. In this perspective, **primary prevention** aims at preempting the emergence of particular diseases in a person. Its protective arrangements are complex and of both social and medical nature (e.g., individual lifestyle counselling, particular interventions such as vitamin K and D supplementation of newborns and infants, vaccination, assessment of the social environment of a child, or preventive removal of an organ without obvious pathology on the basis of genetic examination pointing towards a high risk of cancer). More and more, approaches of personalized medicine are implemented as well. **Secondary prevention** is the prevention of consequences of an already developed disease, i.e., the preemption of complications, irreversible changes, disability, and lethality. Its main tools are early detection, proper diagnostics, and preventive therapy (for example the use of screening methods – such as occult blood stool test, screening for cervical carcinoma, mammary screening – or other diagnostic methods in patients at risk – colonoscopy, coronarography, etc.). The goal of **tertiary preven-**

tion is to limit the progression of a disease, preempting recurrence of clinical diseases, disability, and loss of self-sufficiency. It focuses on patients suffering from full-blown diseases and consists of therapy and rehabilitation aimed at reaching the health status as it was before the development of the disease. In addition, tertiary prevention tries to reintegrate the patient and to improve his/her quality of life.

1.1 HEALTH

1.1.1 Definition

According to the WHO definition, health is "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." However, this definition does not take into account the dynamics of health and is outdated, similarly to the statement that everyone is responsible for his/her own health (for example: a smoker, a drug addict, or an obese individual). The new concept considers health as the extent to which an individual or a group is able to realize aspirations and satisfy needs and to change their environment or cope with it. That is, health can be defined as an ability of an organism to continually adapt to constantly changing demands and expectations of the environment. This definition is dynamic, reflecting both phylogenetic and ontogenetic human adaptation. Health is therefore seen as a resource for everyday life, not the objective of living. It brings the ability to realize our expectations and fulfill our needs. Besides physiological needs, this includes our need for safety, belonging, recognition/respect, and self-implementation. Health encompasses three aspects: 1) physical and psychosocial integrity, 2) undisturbed life functions and social roles, and 3) adaptability. Their presence results in well-being, while a disease is therefore an inability to meet the demands of the environment and is a result of exceeding the adaptation abilities of an organism. A disease is often determined by a sudden change of the environment in a short period of time, including lifestyle changes, or by a considerable and maladaptive change of genetic disposition.

A new, positive concept of health emphasizes social and personal resources as well as physical capacities.

1.1.2 Adaptation

Adaptation is a general feature of biological systems. It is the ability to maintain homeostasis, stability, and survival of an organism in changing environmental conditions. The following external conditions play an essential role in the environment we need to adapt to: 1) nutrition including liquids entering through the gastrointestinal system, 2) air with oxygen entering through the respiratory system, and 3) temperature, heat emission, humidity, air circulation, radiation, vibration, and surfaces of surrounding objects that are in contact with the body and which influence its thermoregulatory, mechanical, and chemical processes mainly through the skin. Besides these physical and chemical factors, there is also 4) the biological and immunological load and the specific and the very important 5) psychosocial load, reflecting one's social environment. The psychological load manifests on mental and physical work and the quality of relaxation, including sleep.

Adaptation consists of a variety of autoregulation processes providing survival in changing conditions on both individual and population level (= phylogenetic evolutionary adaptation).

We distinguish between several types of adaptation:

Phylogenetic adaptation: This is a form of species adaptation by selecting those genes in the population that would provide suitable features for survival in a certain environment.

Ontogenetic adaptation: This is an individual adaptation to a prevailing condition present during one's development, for example setting gustatory regulation dependent on prenatal and perinatal nutrition. This plasticity is reduced with age.

Short-term homeostatic adaptation: This includes maintaining homeostasis and a constant control of oscillations (e.g., hypoglycemia, hypotension, or hypothermia). For example, during an acute stress response, the body adapts by means of sympato-adrenal system activation. Short-term homeostatic adaptation is related to maintenance of body temperature, level of glycemia, ions, and liquids, assuring perfusion of crucial organs, etc.

Long-term homeostatic adaptation: This occurs as a consequence of adjustment to long-term environmental changes (i.e., to long-term radical changes of conditions, for example alpine environment, intensive physical training, starvation, or work in extreme temperatures). In this case, besides short-term regulatory mechanisms, long-term physiological processes have to be taken into account (such as an increased level of erythrocytes in alpine environment, more effective utilization of fatty acids in muscles as a source of energy in higher physical activity, or lower energy expenditure during starvation). This type of adaptation can be put to use in health promotion by building the so-called positive health, i.e., achieving higher resistance to external noxious agents.

A specific type of adaptation is **immunological adaptation**, which can be classified as both phylogenetic and ontogenetic. An individual is exposed to external antigens and learns to tolerate them if they are harmless or, if they are not, learns to produce specific mechanisms that provide sufficient protection of the organism in the short-term and long-term period. This adaptation is used in passive and active immunization.

Social (socio-cultural) adaptation is very important. It is associated with social development, social hierarchy, and conscious (as well as subconscious) effort to optimize chances for survival in given conditions. For example, the contemporary society is characterized by technological development, computerization, industrialization, urbanization, and globalization, lower demands on human physical work, partial economic emancipation of women, changes of the family and therefore a significant modification of lifestyle. Watching television passively is a trend of the last 60 years, using computer and electronic communication including social networks is a matter of last 20 years. In the late 90s, spaces for child's play were reduced, as well as paths for walkers or cycling routes (which have started to be rebuilt recently). The use of cars and planes has shortened the distances between people, and the tempo of modern life accelerates. The food industry has enlarged, and the use of highly processed and ultra-processed food has become widespread. Many people nowadays prefer eating out in fast-food restaurants. Men and women have become more independent in certain ways (due to, for example, the decline of religious authority or multi-generation families), but at the same time, they are becoming more isolated and vulnerable. People are exposed to strong pressure to be successful, gain a prestigious position in the society, affluence, and a sense of power. This attitude brings along a lot of disappointment, anxiety, depression, and experience of psychosocial stress accompanied by activation of the sympato-adrenal system

and hypothalamic-pituitary-adrenal-axis dysregulation. According to Hans Selye, **stress** is a nonspecific response of an organism to any load or demand. His theory of general adaptation syndrome describes stress as a three-stage process – alarm reaction, resistance, and exhaustion. If a stress in the third phase lasts too long and is too intense, and if the subject is not able to cope, psychosomatic disorders ("stress diseases") can develop. If a stressor is adequate to adaptability and can be managed, the process is characterized by a high degree of resistance and consequent adaptation, and it reinforces/strengthens the subject. This type of load is considered healthy and is associated with the term "positive health" or "personal growth."

1.3.3 Dimensions

Physical health: Absence of physical disease, the bodily aspect of health.

Mental health: The ability to think clearly and coherently. In a broader sense, the ability to reach mental balance.

Emotional health: The ability to adequately feel and express emotions, such as happiness, sadness, fear, anger, etc. This also means coping with stress, tension, depression, and anxiety.

Social health: The ability to establish and maintain social relationships with other people.

Sexual and reproductive health: The ability to build a valuable partnership and prevent sexually transmitted diseases as well as the ability to conceive and give birth to a healthy newborn.

Spiritual health: This type of health is, for some people, connected with religious beliefs and practices; for other people, it has to do with personal creeds, principles of behavior, and ways of achieving peace of mind and being at peace with oneself. Generally, it could be associated with an effort to find a meaning of life, reaching harmony, humbleness, and a sense of belonging with Nature, God, or some Universe equivalent.

Societal health: A person's health is inextricably related to everything surrounding that person. A "sick" society does not provide the resources for adequate physical and emotional needs (e.g., in situations of insufficient access to food, drinking water, clothing, shelter, and medical care, situations during disasters, economic crises, wars, political oppressions, racism, gender undervaluation). Therefore, societal health means the ability of an individual or group of people to realize aspirations and satisfy needs, change the environment or cope with it. It is a possibility to develop one's potential and fulfill one's needs (freedom, education, work opportunities, self-realization, as well as physiological needs).

Environmental health: This includes living in a clean, unpolluted environment and having access to safe drinking water, food, and healthy indoor and outdoor environment. People's health and lives are adversely affected by global environmental problems like global climate change, ozone-layer depletion, desertification, deforestation, the loss of the planet's biological diversity, the trans-boundary movements of hazardous wastes and chemicals, light and noise pollution, etc.

1.3.4 Determinants

Diseases can be classified as those that are caused exclusively by genetic dispositions (for example Down syndrome) and the opposite category – diseases caused mainly by external factors (injuries, infections). Nevertheless, most diseases are results of the synergy of external factors and genetic dispositions.

Health determinants are genetic and epigenetic factors, lifestyle factors, and external factors (which can be for example physical, chemical, biological, social, and environmental). The external factors are often uncontrollable by an individual and sometimes even by society. It is estimated that what influences health the most is lifestyle factors (50–60 %), environmental factors (20–25 %), health care (15–20 %), and genetic factors (10–15 %).

Lifestyle is defined as a system of significant activities and relationships, life expressions, and habit characteristics of a certain individual or a social group. It is a set of more or less fixed practices, actions, and behavior. It is a feature of social status. A person chooses their lifestyle from a spectrum of possibilities offered by his/her culture, transforming it according to specific conditions and objectives into an individual system. A particular form of lifestyle is therefore a result of individual actions and the environment (living conditions). Living conditions are the external factor – they are determined by a person's demographic characteristics, socio-economic position including financial resources, etc. They can be divided into levels of an individual, family, workplace, community, and others. The internal factor – the actual choice from offered possibilities, its transformation and everyday practice – depends on the individual. It is influenced by his/her values and priorities, attained level of education, orientation, lifestyle of his/her family, etc. External factors do not necessarily modify individual lifestyle. A person can maintain his/her habits, being unwilling or unable to change them.

In today's society, a shift in appreciated values has been in progress. People's lifestyle is now episodic, discrete, and fragmented. Many aspects of lifestyle (such as fashion, ways of spending free time or behavior related to health) adopted by individuals are generated, marketed, and offered by institutions and the private sector, and the choices that a person makes are under strong social pressure. This can be put in use by the so-called social marketing, which encourages beneficial choices and is an important aspect of many community health programs. Lifestyle factors have a great impact on individual health status and population morbidity and mortality.

The most essential determinants of health in lifestyle are nutrition, the level of physical activity, and smoking and other substance abuse including alcohol consumption, psychosocial stress, and sexual behavior. Other important features include type of employment, preferred mode of transport, pattern of sleep and relaxation, and ways of spending leisure time.

External determinants of health are natural (i.e., for example, physical, chemical, and biological) and societal. The societal environment is produced mostly by human actions. It consists of the (1) socio-economic conditions in the living environment, (2) socio-economic conditions related to nutrition and lifestyle, (3) life conditions, (4) education and culture, (5) interpersonal relationships, and (6) systems of health and social care and demographic factors. Societal factors have a vital impact on health because they determine and control conditions people live in, for example the access to drinking water and nutrition and their quality, housing, education, work and working conditions, social care and health care including prevention or legal protection. They also set norms of acceptable behavior, which shape lifestyles and

motivations. All of these factors determine people's health status, longevity, and quality of life.

Determinants of health can be influenced by restrictions (i.e., elimination or neutralization of negative factors) or enhancement of one's life and environment (positive factors). For these interventions, we need medical knowledge as well as social and economic options and political will to accomplish defined goals in time and in an adequate, effective way.

Health and its determinants are also influenced by legislation, local health policy (health protection and promotion), population politics, education of the population, agricultural and nutrition policy, employment and employment policy, quality and accessibility of social care and health care, hygienic and anti-epidemic actions, regional policy including building infrastructure in consideration of hygienic principles, environmental protection, maintenance of ecological balance, protection of vulnerable population groups (especially children), etc.

How much the internal, individual determinants of health, i.e., the genetic, mental, and behavioral factors, can be influenced also depends on local socio-economic conditions, respect for human rights, freedom, and responsibility for the health of oneself and of fellow citizens. The influenceability of genetic factors depends on scientific and technical possibilities with regard to ethical principles. This consists of prevention of mutations, positive and negative eugenic interventions, genetic counselling, and behavioral intervention that suppresses those manifestations of genetic disposition associated with illnesses, etc.

Health behavior depends heavily on awareness, health status, and health education as well as on one's family and school or the economic pressure and social norms.

1.2 ASSESSMENT OF POPULATION HEALTH STATUS

The assessment of population health status and its development in time are important initial points for analysis of risk factors associated with health impairment or protective factors that improve and strengthen health. This assessment is what the design of curative strategies, programs, and interventions is based on.

Regular monitoring of population health status is thus a base for practical interventions, prevention, education of the population, and planning and management of health care and health policy as these processes presuppose a determination of priorities, a cost-effectiveness analysis, etc.

The data obtained in the assessment of population health status are used for comparison of morbidity, mortality, and quality of life in different populations.

1.2.1 Data resources for the assessment of population health status

The assessment of population health status is based on mandatory reporting of health-related data, such as disability, hospitalization, diseases, or changes in health status that must be reported (in the Czech Republic, these include infections such as typhoid fever, pertussis, scarlet fever, tetanus, measles, German measles, infectious hepatitis, infectious mononucleosis, tuberculosis, HIV, sexually transmitted diseases, fungal infections or acute respiratory

infections; malignancies, occupational diseases, abortions, suicides, congenital anomalies, and premature births). Demographic statistical data about the newly born and deceased and the rate of natural increase, migration, etc., are essential, as are data from environmental monitoring, workplace monitoring, and the so-called biomonitoring.

The study of risk factors influencing health uses epidemiological and statistical methods. The design of studies in this field can be **observational** or **experimental**. The observational (also descriptive or analytical) are divided to correlational (ecological), cross-sectional (prevalence), and longitudinal studies (which can be retrospective or prospective) – these are the so-called case-control studies and cohort studies. In analytical studies, the association between exposition to a given factor and occurrence of a disease is observed, and it is assessed whether the relationship between them could be causal. The calculated results are represented by the relative (RR) and attributable risk (AR). Relative risk reflects the potential significance of the risk or protective influence, while attributable risk expresses the resulting manifestation of a given risk in a particular population. The results can be biased accidentally, systematically, or by means of confounding factors. Experimental studies (also called interventional) are based on an intervention into a naturally occurring process, and within this type of studies, we distinguish between clinical controlled trial and population intervention studies. Further details about collecting, classification, and assessment of epidemiological data can be found in textbooks on epidemiology.

The results of epidemiological studies can then be used for obtaining knowledge on the impact of health-affecting factors, both risk and protective. "Evidence-based medicine" classifies different levels of evidence quality and resulting levels of recommendation.

1.3 HEALTH PREVENTIVE PROGRAMS

The WHO identifies and proclaims health priorities for different world regions and periods. For example, the goal of the WHO program "Health for All by 2000" was to ensure equity in health, which was supposed to reduce the differences in health status between various population groups. The main strategies selected to accomplish the goal were active strengthening of health by participation and cooperation of all segments of society, assuring available primary health care for all, raising awareness, motivation, and availability of a healthy way of life. A necessary part of this program was, therefore, international cooperation.

Since 1980, members of the WHO in the European region have been promoting a social and political framework of health development that may be implemented by cooperating countries, which use it as the starting point for their health policies. The WHO's members have also accepted another program called "Health for All in the 21st Century." Its main goal is achieving full health potential for all. The crucial aims are i) to promote and protect people's health throughout their lives and ii) to reduce the incidence of the main diseases and injuries and alleviate the suffering they cause. From an ethical point of view, three basic values are important for this program: i) health as a fundamental human right, ii) equity in health and solidarity in action between and within all countries and their inhabitants, and iii) participation and accountability of individuals, groups, institutions, and communities for continued health development.

Four main strategies for action were chosen:

a) Multi-sectoral strategies to tackle the health determinants, taking into account physical, economic, social, cultural, and gender perspectives and ensuring the use of health impact assessment.
b) Health-outcome-driven programs and investments to health development and clinical care.
c) Integrated family- and community-oriented primary health care, supported by a flexible and responsive hospital system.
d) A participatory health-development process that involves relevant partners for health at home, school, and work, both at local community and country levels. A participatory process like this promotes joint decision-making, implementation, and accountability.

To help governments as well as non-governmental organizations, the civil society, and the private sector to contribute to the health and well-being of the inhabitants in the European region, the WHO adopted the "Health for All" policy framework (HEALTH21) for the WHO European region in 1998. The framework was updated in 2005 and laid out 21 targets for improving health in the area:

1. Solidarity for health in the European region: To foster stronger equity and solidarity in health development between member states of the region (= closing the gap between countries).
2. Equity in health: To ensure better equity in health among groups within each country (= closing the gap within countries).
3. Healthy start in life: To invest early in health (i.e., to support, for example, genetic and dietary counselling, a smoke-free pregnancy, or evidence-based prenatal care to prevent low birth weight and congenital anomalies). To compensate for a deprived start in life and help create supportive families with wanted children and good parenthood capacity. To create a social environment that protects the rights of the child and local communities that support families by ensuring a safe nurturing environment and health-promoting child-care facilities. To prepare health and social service personnel to recognize and treat cases of child abuse.
4. Health of young people: To reduce the harm of drug use, accidents, and unwanted pregnancies, to provide sex education, support, and ready access to condoms for young people, and to help make the healthy choice the easy choice. To enable young people to get the best possible education and the most productive jobs.
5. Healthy aging: To prepare people for healthy aging by means of systematically planned promotion and protection of their health throughout life (through social, educational, and occupational opportunities and physical activity), to create programs to maintain physical strength and correct sight, hearing, and mobility impairments before they lead to the older person's dependence. To provide outreach services to support older people in their everyday lives. To respect their needs and wishes in relation to housing, income and other factors that enhance autonomy and social productivity.
6. Improving mental health: To promote and protect mental health throughout life, especially in socially and economically disadvantaged groups. To design health programs for living and working environments that can help people gain a sense of coherence, build and maintain mutually supportive social relations, and cope with stressful situations. To sharply reduce the suicide rate (by means of, e.g., training for early detection of depression and its appropriate treatment). To replace large mental health "asylums," which are still present