

# *Possibilities for the analysis of fruit and vegetable consumption based on a transtheoretical dynamic COM-B model*

**KEYWORDS:** COM-B (Capability, Opportunity, Motivation – Behavior), BCW (Behavior Change Wheel), HKF (Household Budget Surveys), KASA (Knowledge, Aspirations, Skills, Attitudes), NOA (Needs, Opportunities, Abilities), Albert Bandura's four-step model

## **SUMMARY**

The objective of the transtheoretical dynamic COM-B (Capability, Opportunity, Motivation - Behavior) model is to understand why people take risks when it comes to their health and why they do not follow the instructions to protect their health. The model has been developed as the central part of a larger behavioral system called the Behavior Change Wheel (BCW), the goal of which is to assist the designers of a given intervention with factual data during the process leading from the behavioral analysis of the problem to the planning of the intervention. The COM-B model has been successfully applied in many cases. When increasing the consumption of fruits and vegetables, an essential condition for behavior change is that people have the ability, opportunity and motivation to change. The behavior was measured by the annual per capita spending on vegetables, potatoes and fruits, based on HKF (Household Budget Surveys), the latter being published in the STADAT issued by the Hungarian Central Statistical Office. It was assumed that the capability can be approximated by the expenditure on "Higher education", the opportunity by the expenditure on "Gardens, plants and flowers, and motivation by the expenditure on "Sport, camping goods", "Indoor sports equipment" and "Sports equipment, camping equipment". A correlation was demonstrated between the expenditure on fruits, vegetables and potatoes and the expenditure on flowers, gardening and sports, however, there was no correlation in the case of money spent on higher education.

## **INTRODUCTION**

The objective of the development of the COM-B model (Capability, Opportunity, Motivation – Behavior) of behavior change is to understand why people take risks or neglect to behave properly when it comes to their health [1, 2]. A study carried out at a Brazilian state university in 2011 showed that the food consumption of even 38.1% of nutrition science students was inadequate, because their diet was low in fibers and vitamins [3]. The WHO estimates that, on average, fifty percent of people suffering from long-term illnesses fully comply with the requirements [4].

It is also known that the consumption of fruits and vegetables has a beneficial effect on health, but the consumption of many people does not meet current guideline [5].

Early studies on health behavior focused primarily on the role of doctor-patient communication in following/not following the directions of medication. Other aspects included patient satisfaction, clarity and forgetfulness as key factors for participating in post-communication treatment [6]. However, it has been shown consistently by health behavior research that providing information in itself is not an effective way

<sup>1</sup> Szent István University, Faculty of Food Science, Department of Cargo Handling and Sensory Analysis

<sup>2</sup> Szent István University, Faculty of Horticultural Science, Department of Horticultural Economics

<sup>3</sup> Budapest Business School, Faculty of Finance and Accountancy, Department Section of the Economics Institute

to change behavior. Therefore, research has shifted to approaches and models that consider people's conviction, motivation and planning abilities as the most important explanatory variables. Interventions are unlikely to be effective until we understand the nature of behavior that leads to change [7]. It was mentioned by the philosopher John Dewey already in 1916 that the justification for choosing and using certain theories often remains in the „*shadow zone of the investigation*” [8].

#### THE TRANSTHEORETIC COM-B MODEL

The evolution of the classification of behavior change techniques has led to a new concept in the formulation of the factors that explain or define individual behavior related to health. The basis for this new approach is the psychological model developed for understanding human behavior, the objective of which is to capture all the mechanisms involved in change. The COM-B model is designed to be comprehensive, easy to handle and applicable to a wide range of behaviors. It bridges the gap typical of social cognitive and ecological models that do not take into account automatic processes. Such “factors”, such as impulses and emotions, are ignored by these models on a “systemic level” [4]. The COM-B model was developed on the basis of current behavioral theories and the consensus adopted by behavioral professionals [7]. COM-B is a transtheoretical model based on the elements of change, founded on two social theories that incorporate macro/contextual factors. One is the former KASA (*Knowledge, Aspirations, Skills, Attitudes*) hierarchy of Benett, according to which KASA's capacity change leads to changes seen in activities [9]. It also takes into account the NOA (*Needs, Opportunities and Abilities*) model. According to their arguments, needs and opportunities lead to motivation which, in combination with the abilities, creates behavior change [10]. Individual level models are founded on intent and behavior based on expected results and focus on individual psychological factors. Based on standard economic theories, the origins of behavioral preferences are examined. A well-known example is Ajzen's theory of planned behavior [11].

Social models also cover macro/environmental factors and seek to address environmental factors that restrict behavior. This is more important for decision makers. A well-known example of the NOA model. Change management models, such as transtheoretical models (*stages of change*), have been developed to understand the complex processes of change. Their advantage is that they can explain why an initiative worked or why it did not work, and know exactly what the problem with it was, but their disadvantage is that they require a lot of work and time.

The COM-B model was developed as the central part of a larger behavioral system called the Behavior Change Wheel (BCW, **Figure 2**) [7], the goal of

which is to assist the designers of an intervention with factual data during the process leading from the behavioral analysis of the problem to the planning of the intervention [12]. BCW synthesizes the 19 pre-existing frameworks of behavior changes, thus integrating a behavioral theory, intervention functions and the categories of related guiding principles [13] [14]. The COM-B model serves as the starting point for selecting effective and specific interventions in order to be able to handle one of the proposed components [7]. In certain cases, the model may point out some specific psychological theories (e.g., motivation), if a more expressive theoretical understanding of the behavior is required [12], and in many cases has already been used successfully in practice [4, 12, 15]. The COM-B model has been used, for example, during the design of the testing of smartphone-based dietary intervention and has been found to be useful in promoting healthy eating [8, 16]. Furthermore, based on the model, questionnaires have been developed that were successfully used to create statistically stable clusters in Hungary to identify health-related lifestyles [14].

#### THE FOUR COMPONENTS OF THE DYNAMIC COM-B MODEL

In the case of fruit and vegetable consumption, to change behavior it is essential for people to have the ability, opportunity and motivation to change. Capabilities, that is, the individual's abilities, in other words, their psychological and physical capacities allow them to participate in the activity concerned. Opportunities provided by the environment include all the factors that are outside the individual and allow or encourage the behavior (**Figure 1**) [1]. In our case, this means that it seems “*normal*” to eat more fruits and vegetables, and it seems like everyone is doing it.

The capability approach developed in welfare economics is an analytical framework of subjective well-being that focuses on the environment (practical opportunities) and capabilities that enable people to achieve goals they consider important. However, these two highly related aspects need to be distinguished. Capabilities, that is, the operational aspect are the power to make one's own decisions, and the environmental aspect is the adequate occasion to choose [17]. People may have sufficient food of adequate quality, but may not consume it for cultural or religious reasons, or because he does not like its taste or simply because he usually does not eat the given food [16].

The level of fruit and vegetable consumption is strongly related to the socio-economic status, which is measured by income, occupational classification, qualification or wealth [19]. The varied nature of the diet can also be linked to socio-economic factors [20, 21]. The level of education was used to measure socio-economic status in a recent study on the potential effects of food taxes and subsidies in the

United States on cardiovascular diseases and the burdens and inequalities caused by diabetes [22]. Motivation includes all the mental processes that energize and control behavior, e.g., “I think it’s worth it, but it’s not a priority right now.” [2]. This factor can be further divided into automatic and reflective motivation. In our case, motivation refers to people’s desires, that is, to trying to do something now.

Each COM-B component can directly affect behavior, and the environment and capabilities can influence motivation, thus affecting behavior. This way, it is a dynamic model [4], performing a particular behavior can affect capabilities, the environment and motivation (Figure 2), and it is based on Albert Bandura’s four-step model process [25]. Smokers are less likely to stick to an exercise program [26]. In addition, a person with a low self-esteem (with weak self-confidence and who is uncertain and negative-minded) and a weakly built body is more likely to drop out in such a case [27]. At the same time, in a study in Ireland, 57% of strongly motivated consumers met the recommendations for fats, but only 31% achieved the same regarding daily fruit and vegetable consumption [28]. In a survey that included 1,031 13 to 18 years old teenagers in South Carolina, higher levels of vegetable consumption were reported by those with higher physical activity, regardless of their BMI value. In the meantime, significantly higher fruit consumption was reported by overweight people, regardless of their physical activity [29]. Evidence-based principles of behavior change have a complex and dynamic relationship with the elements of the COM-B model (Figure 3), which justifies our analysis based on household statistics.

The COM-B model is the basis for the Health Communication Survey conducted by the National Institute for Health Development in Hungary in 2015 [1]. Based on their survey, only 26.5% of the adult population consumes fruits and vegetables at least once a day, while only 7.5% does so several times a day. All three measured COM-B factors (capabilities, the environment and motivation) played important roles in fruit and vegetable consumption. 30% of the respondents did not have enough knowledge about the benefits of fruit and vegetable consumption, 30% did not have the opportunity to consume more, and almost 80% were not motivated. Only 41% of those with the right knowledge and opportunity had adequate motivation.

#### CAPABILITIES -EDUCATION

Abilities mean the individual’s personal psychological and physical capacity or, in some cases, their inhibiting factors regarding participation in a given activity. Even in business, many strategic planners assume that if the strategy is logical, then colleagues will know what to do, that is why they do not incorporate any capability development into their plans. Of course, there are people who adapt

very well, learn quickly and act properly in such a situation. Unfortunately, they often form a minority group, and the planners of the intervention rely too heavily on these „usual seniors”. Since these few people are unable to solve everything, the efforts will prove unsuccessful. To overcome such pitfalls, it is necessary to consider capabilities as an integral part of the process [31].

The systematic assessment of abilities can also help explain and treat frequent unhealthy behavior [17]. The psychological abilities of a given person in the case of a proper diet cover their knowledge of the quality and variety of meals [32]. The varied nature of fruit and vegetable consumption hinders the development of chronic diseases and is widely recommended as a critical factor in healthy eating [21].

Better education enhances the more efficient use of the given health resources by improving the individual’s abilities in obtaining and processing health information. Even one more year of education has a beneficial effect on people’s nutrition, but does not necessarily have a positive effect on avoiding health risks or on taking part in preventive health check-ups [33]. Based on the latest results, the longer duration of education has no general effect on the abilities, but it may increase the special cognitive abilities of the individual [34].

The proportion of people consuming fruits and vegetables at least five times a day was higher among highly educated people than among those with low levels of education in EU Member States in 2014 [35]. Even the higher and more frequent fruit and vegetable consumption of children could be correlated to the higher levels of education of their parents in the European population [36, 37], but the same could not be demonstrated in Malaysia [38].

#### ENVIRONMENT (OPPORTUNITIES) – FLOWERS, GARDENING

The environment encompasses all the factors that are outside the individual and that allow for the stimulation of behavior. The environment can be further divided into a tangible „physical” environment and a “social” environment, the cultural milieu that determines how we think about certain things [7]. According to the latest research, the physical distance of the primary supermarket could not be correlated to the quality of the diet. The nutritional knowledge, cultural factors, nutritional preferences and health status of household members are more important in the behavior determining food purchases and in the quality of meals, even in low income areas [39, 40].

Taking environmental diversity into account is critical to success. The interconnected nature of the resources and conversion factors determining the diet supports the assumption that opportunities are often missed [39].

In many cases, the aesthetic value of the living environment, social responsibility and participation in the cultivation of community gardens are significantly related to fruit and vegetable consumption [41] [42]. According to the earlier research of Kaplan, there are many advantages of a close relationship with nature. Among other things, it improves the individual's socialization opportunities, not to mention the psychological benefits, such as functional improvement of attention and stress reduction [43]. According to the findings of a New Zealand study, a group of high school students participating in gardening exhibited somewhat fewer depression symptoms and an increased emotional well-being. In addition, they reported better family and neighborhood relationships than those who did not participate in gardening [44]. Caring for others was one of the most important types of consumption values of flower products in Taiwan, in addition to sensory pleasure, emotional impact, satisfying curiosity and monetary value [45]. Flowers are also purchased to strengthen social relationships because of their associated social symbolic nature. Consumers buy flowers for traditional holidays to show their concern for others and to improve their social relationships [46].

#### MOTIVATION – PHYSICAL ACTIVITY AND SPORTS

According to Hippocrates, „if we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health”. Motivation greatly influences the individual's performance in situations where he or she is physically capable of performing the task, but is uncertain about his or her abilities. In fact, motivation means all brain processes that strengthen and control behavior. For example, the well-known motivation for participating in physical activities is the desire not only to be physically healthy, strong and energetic, but also to improve in pursuits that present a challenge, as well as in activities aimed at acquiring new skills, which enhances self-efficacy. These motivational factors lie behind “social” motivation, which means spending time with friends and getting to know new people, and behind “enjoyment” motivation, which means the feeling that the activity is fun, interesting, stimulating and enjoyable [47].

Confusing motivation with capabilities has the risk that mere objections based on low desires obscure the actual limitations of the action, even though there is a high demand. People usually interpret their capabilities as being motivated to do something, not as their literal capabilities, on the basis of which a given behavior can be performed [48]. Understanding the motivation factor helps individuals in the framework of necessities and concerns, to follow treatment requirements, among other things [49].

Despite the fact that the mental health (*capabilities*) benefits of muscular movement and the exercise-

mental health relationship cannot be ignored, researchers are still working on the details to determine how much exercise is needed, what the mechanisms are behind the benefits of physical exercise and what may be the reason for this [50]. More active or fitter individuals can pay more attention to the environment and can process information faster [51]. In addition, aerobics has been shown to improve brain function, especially in neural networks participating in the cognitive control of inhibition and attention [52]. Regular exercise can be one of the ways of biological reinforcement of the brain, which can reduce the effect of stress. According to another theory, physical exercise promotes normal sleep, which is known to have a protective effect on the brain [53]. In older age, physical fitness may improve brain capabilities by improving memory, problem-solving and decision-making abilities [54].

New research suggests that exercise and nutritional factors play a complementary role in controlling the body's energy balance and synaptic plasticity, which has an important impact on the coordination of cognitive abilities. There seems to be a positive correlation between healthy eating and regular exercise, and exercise is also effective in reducing the effects of an unhealthy diet [50]. It has already been suggested that exercise may play a role in certain aspects of food selection [55]. It has been shown that physical activity can be associated with a higher diet quality and with a higher fruit and vegetable consumption. The rising indicator of health motivation was significantly and positively correlated to healthy eating and exercise in an Irish study. In addition, many studies have found that people's motivation for exercise and healthy eating is generally positive [28].

However, it is still unclear whether a healthier eating behavior is the result of a general health orientation or it can be linked to the biological and psychological results of exercise. It is still difficult to determine a causal relationship between healthy eating motivation and exercise. Particular account should be taken of the optimistic bias in the case of individuals who eat healthy or are physically active, who believe that they are less exposed to risks than average people [56].

#### CALCULATIONS PERFORMED ON THE BASIS OF HOUSEHOLD BUDGET SURVEYS (HKF)

The magnitude of the sampling error was reduced by using the national household statistics data [57]. Researchers have often met a certain optimistic bias in the case of self-filled questionnaires, with false positive answers. Many people respond in a socially desirable way, even if this has no obvious advantages [58]. Behavior was measured by the annual per capita spending on fruits and vegetables (including potatoes) on the basis of HKF (Household Budget Surveys), published in the STADAT by the Hungarian Central Statistical Office. Here, categorization was

carried out on the basis of COICOP grouping. It was assumed that capabilities, i.e., the mental and physical skills, strength and endurance of people can be characterized by their „*expenditure on higher education*”. Opportunity, i.e., the social environment, including the social milieu, social standards, social influences, models and physical environmental resources, opportunities, place and time can be characterized, in our assumption, by the expenditure of people on „*flowers, gardening*”. Motivation, i.e., automatic processes such as habits, emotional states and reflex processes, as well as conscious intentions, beliefs and sense of identity can be characterized by the expenditure on „*sport and camping goods*”, „*indoor sports equipment*” and „*sports equipment, camping equipment*” in our assumption. The expenditure structure of households did not change in the period under review (2007-2016) in the case of the categories examined. Households spent the most on the category „*total fruits-vegetables-potatoes*”. It is instructive that the baseline values of 2007 were reached again in 2015. The further order was flowers and gardening, higher education, and finally sports (**Figure 4**).

If changes are analyzed further, it can be stated that the highest growth, both nominal and real, could be measured in the categories total fruits-vegetables-potatoes and sports. In the case of the latter, the 2007 base value of 28,427 HUF increased to 33,381 HUF. In the case of sports, the absolute value of the expenditure is low, but the growth is significant. The real change in the category flowers and gardening category is not significant. Similar conclusions can be drawn for the category higher education as well (**Figure 4**).

The closeness of interaction between the variables of the COM-B model was measured with the Spearman rank correlation coefficient. Its value is independent of the units of measure and indicates the magnitude and direction of the relationship between the two values. It can be said about the value of the rank correlation that the farther away it is from zero, the stronger the relationship is. If its value is -1, it is a perfect negative correlation, and if it is +1, then it is a perfect positive correlation. Results (**Table 2**) show that the variable of „*total fruits-vegetables-potatoes*” has a strong positive relationship with the variables of „*Sport*” and „*Flowers, gardening*”. The relationship between the „*Sport*” variable and the „*Flowers, gardening*” variable is significant, they are closely intertwined. In the case of the variable of „*Higher education*”, no significant relationship was found with the other variables. It is important to emphasize that the closeness of the interaction cannot be interpreted as a causal relationship.

## LIMITATIONS

Questions related to food consumption are often asked at the household level, while eating is frequently carried out at the individual level. In addition, it can be said that home-grown food is underestimated when compared to food bought at the market. While motivation is often considered to be a global and unified construction, individuals may have different motivational components when participating in different forms of activities [59, 60, 61].

## SUMMARY

Despite the fact that fruit and vegetable consumption has a positive effect on health and well-being, few adults follow current guidelines. The objective of the development of the COM-B (Capability, Opportunity, Motivation – Behavior) model of behavior change was to understand why people take risks against their health or behave the opposite way. It was assumed that elements of the model could be symbolized by HBS variables. We found that there is a strong positive correlation between the per capita annual expenditure on “Fruits, vegetables and potatoes” and the variables “Sports” and “Flowers and gardening” in Hungary in the period 2007-2016. The variable “Sports” also had a significant relationship with the variable “Flowers and gardening”, and they are closely intertwined. In the case of the variable “Higher education”, there was no significant relationship with the other variables. It is important to emphasize that the closeness of the interaction cannot be interpreted as a causal relationship.

## ACKNOWLEDGEMENT

This research was supported by the János Bolyai research scholarship. The research was supported by the VEKOP-2.3.3-15-2017-00022 and EFOP-3.6.3-VEKOP-16-2017-00005 projects. Ákos Nyitrai expresses his gratitude to the Doctoral School of Food Science of Szent István University.



Prepared with the support of the New National Excellence Program of the Ministry of Human Capacities, code no. ÚNKP-17-4.

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Hungalimentaria konferencia  
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**Időpont: 2019. április 24–25.**  
**Helyszín: Aquaworld Resort Budapest**

**Fővédnök:** ZSIGÓ Róbert élelmiszerlánc-biztonságért felelős államtitkár  
**Védnökök:** Dr. BOGNÁR Lajos országos főállatorvos, helyettes államtitkár  
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