THE CONTEMPORARY RESEARCH ON THE CONDITIONS OF CHILD AND YOUTH OBESITY, AS WELL AS PROPOSALS FOR SOLVING THE EPIDEMIC. THE PRELIMINARY REPORT

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Abstract:

Aim. The aim of the report is to draw attention to the studies not included in system reviews and meta-analyzes which are important in the opinion of the authors of the paper – for:
1. estimating the size of the obesity phenomenon and its correlates on a global scale,
2. assessing the effectiveness of promoting physical activity and the approach to changing pro-health behaviors, with particular emphasis on the sedentary and inactive behavior.

Material and methods. The effect of the preliminary literature search in the preparation of a systematic review of publications documenting the existence of regional differences in both the level of obesity and its growth rate in the last decades of the 21st century and assessing the effectiveness of interventions aimed at behavioral changes, mainly in the field of nutrition and physical activity in children and adolescents. Unobtrusive research, content analysis.

Results. The report highlights the results of the research conducted as part of the International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE). They were compared to other European and global results of solving the problem of overweight and obesity in school-age children and adolescents, and to assessing the potential of the determinants of physical activity in several dozen countries around the world. In addition, the American proposals to solve the obesity problem were indicated, with particular emphasis on the theoretical assumptions and practical implications of the NCOOR organization, included in the American four-volume study.

Conclusions. 1. Each country and geographic jurisdiction has its own limited variation in the prevalence of obesity and each of the potentially modifying factors at different levels of prevalence but the international research is able to minimize variability in these factors.
2. The ecological approach to solving the determinants of physical activity and the methods of its evaluation based on the SEM model should be treated with greater interest in the social policy of the individual countries on different continents.
3. The theoretical assumptions of American behavioral epidemiology and solutions to the problem of obesity and the practical implications based on them, resulting from many years of experience in the approach to eliminating the obesity epidemic, should be more widely disseminated and used in the programming of the health promotion outside the United States and in shaping health-oriented physical fitness in children and adolescents Health Related Fitness (H-RF).
1. The American studies on the distribution of the obesity epidemic in the world scale

Since the first research of British doctors [1, 2] who scientifically documented that the cause of cardiovascu-
lar disease amongst bus drivers is the sedentary nature of work, hundreds of publications have confirmed this relationship in adults. Lack of exercise is already widely recognized as the cause of other civilization diseases, such as: mental, respiratory and digestive diseases, non-insulin dependent diabetes mellitus (diabetes mel-
itus type 2) and, above all, obesity. Obesity has become a dangerous and dangerous phenomenon among chil-
dren and adolescents [3]. In this age group, its appearance increased significantly in the first decades of the 21st century [4]. Such a phenomenon is documented in the latest report compiled on the basis of collected evidence of non-communicable disease (NCD) risk in 200 countries and territories of the world by the Global net-
work of scientists The Non-Communicable Disease Risk Factor Collaboration (NCD-RisC), dealing with health and working closely with the World Health Organization via the WHO Collaboration Center for Surveillance and Epide-
miology NCD ad Imperial College London [5].

Given the global nature of the problem, research and efforts are being made to understand the specific cor-
relates of obesity and overweight, and to develop effective interventions [6]. They are mainly inspired by the World Health Organization (WHO) and American central health institutes and scientific societies [the American College of Sports Medicine (ACSM), the Centers for Disease Control (CDC), the American Heart Association (AHA), the National Collaborative on Childhood Obesity Research (NCCOR)].

The results of research on obesity in children and adolescents from the European region are most often cited in the scientific literature, especially those relating to preschool and early school age children, which were carried out in the second decade of the 21st century by the consortium: Identification and Prevention of Dietary- and Lifestyle -Induced Health Effects in Children and Infants (IDEFICS). The European research has provided valuable data on the interplay of social, environmental, genetic, physiological and behavioural factors in the dev-
elopment of major dietary and lifestyle disorders (in-
cluding physical activity) currently affecting children in European [8, 9, 10, 11, 12]. They also confirm that the sources of obesity and overweight can be found in the decline in the human movement as a result of the prog-
ress of civilization.

Knowledge about the relationship between the lifestyle (including physical activity) of girls and school-
age boys has been significantly expanded thanks to the results of the International Study of Childhood Obe-
sity, Lifestyle and the Environment (ISCOLE) project. [9, 10, 11, 13, 14, 15]. It was carried out in the second decade of the 21st century in 12 countries from all con-
tinents. The elaboration of the collected results can be found in over 100 different scientific publications (their list is included in the annex to the cited work [15]). The results of the international research provided important data on obesity and lifestyle at the individual level and the environmental backgrounds of children and adolescents, as well as their relationship with round-the-clock motor behaviour, especially as part of school physical education classes. Compared to the previous international studies of children and adolescents [3, 7], the ISCOLE project progressed in using the advanced measurement and analytical techniques to assess physical activity, diet and sleep.

2. Promoting of the physical activity from the perspective of the Canadian charity Active Helpky Kids Canada

The problem of implementing the WHO recommenda-
tions [16] and the American [17] and Canadian [18] rec-
ommendations regarding the implementation of qualitative and quantitative standards of physical activity, the applica-
tion of which in practice is necessary to achieve the de-
sired health indicators, still remains open. It also appears in Polish [19] and foreign [20] results of the analysis of the usefulness of various models of individual promotion of motor behaviour of children and adolescents. In the second decade of the twenty-first century some hopes for solving the mentioned problem are associated with the use of Canadian experiences [21, 22] based on the pro-
motion of physical activity, based on the socio-ecological model, which is built on the assumptions of the ecological system theory [23, 24, 25, 26, 27].

At the turn of the twentieth and twenty-first centuries it already became apparent that the change in health be-
haviour is a complex and multifaceted phenomenon that has multiple levels of influence [28, 29]. The research suggests that social, physical and political environments affect the ability or likelihood of people participating in physical activity [30]. A human behaviour is difficult to change specially in an environment that is not conduc-
tive to change. To increase physical activity efforts must focus not only on the behavioural choices of individu-
als but also on factors that influence them. The socio-
ecological model (SEM) helps identify opportunities to promote participation in physical activity by identifying many factors that influence an individual’s behaviour. All the behaviour change efforts are more likely to be successful when addressing multiple levels of influence simultaneously [31] On the basis of the assumptions of the socio-ecological model (SEM) a tool was created in
Canada called the Global Matrix Card [32] which is used every two years to conduct international expert opinions assessment, in several countries around the world, for the quality of the system of the domains functioning which condition taking active behavior [33]. Since Poland joined the second series of the international ranking in 2016 [34], the Polish model of the physical activity determinants is assessed in relation to the desired criteria to grade D (in alphabetical order of letters A-F), and on the school grading scale to ‘sufficient’. The weakest link in the socio-economic model of physical activity, as in other countries, is the system of organizing games and activities for children.

The subsequent editions of the international ranking, [35, 36] showed no significant changes over time in the several countries of the individual and environmental determinants of children and adolescents’ physical activity (including those relating to the creation of health policy). The observations resulting from such monitoring are very interesting cognitively, but their application aspect is weak or cannot be stated. In Poland there is no trace of its interest in the research results of the Global Active Health Kids organization in the implemented educational and social policy.

3. The American theoretical assumptions and practical implications of solving the obesity epidemic

Probably the reasons for failures in health promotion and thus the ineffectiveness in inhibiting the development of obesity, could be enumerated. The breakthrough moment in the acceptance of the new paradigm of using physical activity in counteracting obesity is the establishment by the American National Academy of Medicine (formerly the Institute of Medicine) of the decision framework called Locate Evidence, Evaluate it, Assemble it, and Inform Decisions (LEAD) [37], which should condition the progress in the field of obesity prevention research. According to the assumptions of behavioural epidemiology, the standards set by the NAOM are guidelines in all types of decision-making processes (not only in America) regarding the use of physical activity to counteract the effects of sedentary behaviour of children and adolescents.

They were successfully used in the United States to develop the subject of methodological workshops on pro-health policy and the effectiveness of physical activity in the elimination of obesity [38, 39].

In order to standardize resources and methods in behavioural epidemiology research on the distribution and determinants of obesity-related conditions in children and adolescents NCCOR experts issued recently in the United States a methodological guide [40] consisting of four parts: 1. Individual Physical Activity [41], 2. Individual Diet [42], 3. Food Environment [43], 4. Physical Activity Environment [44]. Each of them contains the scientific justification of the research procedure in the domains (physical activity and nutrition) which were classified as the main determinants of positive health as well as its threats considering their inappropriate use. The inappropriate use contributes to the outbreak of adiposity in children and adolescents in the scale of the population of countries on all continents.

In the section which focused on the individual (personal) activity the authors: G. Welk, J. Morrow and P Saint-Maurice [41] pay particular attention to the evaluation and scientific justification of the use of methods and means for its measurement. There were pragmatic and methodological reasons for this. It was considered that: “Considerable attention has been given to improving physical activity assessment methods but progress has been hampered by limitations in the way that physical activity measures are used, scored, and interpreted”[41].

The publication filled the niche by highlighting the question of measurement that need to be considered when selecting and applying measures of physical activity in research and other assessment contexts. The benchmark for measurement tools and methods selection are the previous arrangements made at the American conferences organized by Bridging the Evidence Gap in Obesity Prevention, National Academy of Medicine [45] and the arrangements from the noteworthy methodological workshops and US conferences devoted to developing a research strategy in this field [39, 46, 47]. The presentation of the choice was preceded by an introduction in which its justification was made by referring to the current North American view of behavioural epidemiology on the essence and structure of physical activity.

Practical experience shows that the use of accurate and objective research methods is a necessary condition for achieving objective research results and scientific progress. Their application aspect is also the basis for achieving the desired practical goals. The principle of primum non nocere applies in the medical procedures therefore there is an absolute necessity to use only effective, scientifically proven methods also in promoting the health and well-being of the population. As noted earlier, the origin of the concept of measuring and using physical activity as an effective medical measure in supporting the treatment of civilization diseases should be sought in epidemiology which forms the basis of all research on public health [48, 49]. In the mission of behavioural epidemiology one can find not only detailed theoretical assumptions and the resulting practical implications regarding the health benefits of physical activity but also patterns and correlates that are to influence the quality
of intervention and exercise promotion as an effective means of improving broadly understood health. Currently, the main focus is on the obesity and overweight epidemic issues. Therefore, the search for an effective factor to solve it has become important. Taking into account the current interpretation of motor behaviour the recommendations for measuring physical activity have been clearly justified in the guide issued by NCCOR [41]. Failure to rely on such attitudes may lead to far-reaching consequences in scientific research, in methodological proceedings and even in the social policy of a country.

The Locate Evidence, Evaluate it, Assemble it, and Inform Decisions (LEAD) [37] guidelines were taken into account by the National Collaborative on Childhood Obesity Research (NCCOR) [40] primarily to update the methods and tools used in measuring activity physical. Recommended tools and methods for the assessment of physical activity are presented in the previously mentioned study entitled Measures Registry User Guide: Individual Physical Activity [41]. The presentation of measures used to assess physical activity in it was preceded by a very substantive argumentation of the reasons why the presented register of measures should be considered as “a definitive source to locate evidence”? [41: 3]. In addition, it has been highlighted that the guide has been developed “to evaluate options and to inform decisions about the best ways to assess physical activity”. Among them, the following can be considered the most important:

1. The medical research, and especially public health research, is inherently motivated by the need to develop and evaluate more effective methods for promoting the health and well-being of the population.
2. The models proposed so far did not provide specific mechanisms by which individual influences could influence and effectively influence certain behaviors.
3. There is a belief that behaviour can be explained as a linear process whereby decisions are planned, and actions instinctively ensue. It is apparent that complex behaviours such as PA do not occur in such a way. Instead, behaviour is influenced by multiple levels of factors that interact with one another influencing individuals and subsequent behaviour. As such it is now becoming accepted that behaviour cannot be understood by measuring individual factors alone but rather behaviour emerges due to the complex interactions between multiple levels of influences [50, 51].
4. Increasing acceptance of the complexities involved in human behaviour renders the current linear phase stage approach to understanding PA behaviours incongruous. From a PA perspective, the complexities involved in understanding behaviour can be viewed as a collection of numerous determinants whose actions, though unpredictable, impact upon other determinants [52].
5. Since these determinants of behaviour are often nested within numerous levels of influences as outlined by the ecological framework, to fully comprehend the impact of individual determinants upon behaviour there must be an acceptance of the mediating role of all determinants. Another important premise to acknowledge is that influence of determinants may change over time with a direct influence upon behaviour [53, 54].

Therefore, according to the contemporary views of the representatives of behavioural epidemiology (a new discipline of medical epidemiology), one of the most important issues is the updating of theoretical implications and practical guidelines for evaluation and measures of physical activity. Most often they were and are still based on the traditional assumptions of the model of physical activity [55, 56, 57, 58, 59].

To facilitate progression the research on specific health behaviours is needed the NCCOR guide: G. Welk, J. Morrow, P. Saint-Maurice. Measures Registry User Guide: Individual Physical Activity [41] proposed the use of W. Green’s model [60] titled PRECEDE-PROCEED, used to assess the costs and benefits of an action, which was creatively adapted in the work of G. Welk [47] for the needs of research on physical activity (Fig. 1).

The conceptual model in Figure 1. presents different types or categories of research needed to understand physical activity behaviour and how to promote it more effectively. Five specific types of research are depicted around the perimeter of the figure, with each level building sequentially on the others to systematically advance behavioural research on physical activity.

1. Basic Research provides the foundation for understanding physiological and biochemical.
2. Outcomes Research then establishes specific associations with health indicators and facilitates the establishment of physical activity guidelines.
3. Surveillance Research provides insights about secular trends with regard to physical activity as well as information about patterns, trends, and disparities in the population.
4. Theory and Correlate Research seeks to understand the causes and correlates that influence the behavioural patterns and evaluates theoretical models designed to study and influence physical activity behaviour.
5. Intervention Research applies these insights to plan and evaluate intervention methods to influence physical activity and sedentary behaviour in different settings and populations.

The various types of research are linked to the centre box labelled Physical Activity and Sedentary Behaviour because these are the central behaviours of interest. The
line between this centre box and Intervention Research is a double headed arrow because this is the only form of research designed specifically to promote change in these behaviours.

A prerequisite to advance research in these areas is to have accurate estimates of the underlying physical activity and sedentary behaviours. Therefore, assessment strategies have been placed in the centre of the model. A novel adaptation in this adapted version of the framework is the depiction of three overlapping circles capturing the major categories of assessments:

- **Report-based measures** include various types of self- or proxy-report measures (e.g., questionnaires, diaries, logs).
- **Monitor-based measures** include various measures that directly or indirectly evaluate movement (e.g., accelerometer-based activity monitors, pedometers, multi-sensor monitors (e.g., devices that combine monitor-based measures such as accelerometer and heart rate), heart rate monitors, various smartphone apps, and global positioning system [GPS] devices).
- **Criterion measures** include the doubly-labelled water technique, indirect calorimetry, and various direct observation measures that involve direct coding of behaviour (e.g., time, intensity, type, location).

As seen above such a conceptual model allows health program planners, decision makers to analyse situations in five retroactive steps, and effectively design the health programs or research categories needed to understand physical activity behaviour and how to promote it more effectively.

**Discussion and summary**

Summarizing the materials presented in this study, one should answer the question: what are the reasons for the fact that attention has been paid to a new problem, which is the issue of obesity. It has long been a very frequent topic of research projects and scientific works [62, 63, 64, 65, 66, 67, 68, 69]. The obesity epidemic appeared a long time ago in welfare countries and is spreading despite attempts (e.g. by the World Health Organization) [70, 71] to eliminate its effects and scope. The dynamics of the growth of overweight and obesity, especially in children and adolescents, is causing an increasing public health crisis [1-3, 72, 73, 74], with
inequalities in populations in various socio-economic, [4-6, 75, 76, 77] and ethnic groups [7-10, 79, 80, 81]. Obesity is a complex issue that affects children across all age groups [1-3, 82, 83]. One-third of children and adolescents in the United States are classified as either overweight or obese [84].

Recent estimates suggest that 40 million children under the age of 5 years and more than 330 million children and adolescents aged 5–19 years were overweight or obese in 2016 [85]. Given the global emergency posed by excess weight in children, member states of the World Health Organization (WHO) endorsed “no increase in childhood overweight by 2025” as one of the six global nutrition targets in the “Comprehensive Implementation Plan for Maternal, Infant and Young Child Nutrition” [4, 86]. This is consistent with the same target for obesity and diabetes between 2010 and 2025 in the “WHO Global Action Plan for the Prevention and Control of Non-communicable Diseases” 2013–2020 [5-6, 87–88].

In the light of the presented quantitative and qualitative data, the choice of the issues raised by International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) . The main purpose of the implemented project was to identify relationships between lifestyle behaviours and obesity in a multi-national study of children, and to investigate the influence of higher-order characteristics such as behavioural settings, and the physical, social and policy environments, on the observed relationships within and between countries [14:1]. A priori one could even mistakenly believe that the research carried out will have the hallmarks of the expert opinion and their development in dozens of publications may not contribute much to understanding the phenomenon of obesity and ways to solve its epidemic. Problems with the way of behavior modification related to: lifestyle, physical activity, food consumption, sedentary sleep behaviors have been documented and are still being researched to solve the problem of obesity in the global arena. For example, the Health Behaviour in School-Aged Children Study (HBSC) is currently conducted among 11-, 13- and 15-year-old children in 43 countries (Europe, USA and Canada) [89]. Results from two previous cycles of the HBSC (2001–2002 and 2005–2006) indicate a consistent relationship between self-reported physical activity and overweight across countries; however, the relationship with dietary variables has been less consistent [3, 4, 90–91]. The Healthy Lifestyle in Europe by Nutrition in Adolescents (HELENA) study is a multi-country European collaboration that focuses on the health and health behaviour of adolescents [8]. Recent analyses from the HELENA study have examined associations among obesity and several lifestyle behaviours, including physical activity, sedentary behaviour, dietary habits, and sleep duration [9–11, 92–94]. The European Youth Heart Study (EYHS) was a 4-country examination of cardiovascular risk factors and their related influences in 9- and 15-year-old children [12, 95]. Results from the EYHS indicate a significant association between objectively measured physical activity (using accelerometers) and adiposity (sum of skinfolds) [13, 96]. Further analyses incorporating self-reported television viewing habits suggest that physical activity and television viewing may have independent effects on adiposity and cardiovascular risk factors [14, 97].

In addition to purely observational studies of lifestyle behaviours and obesity in children, several initiatives are under way to develop multi-national childhood obesity intervention consortia and studies [15, 98]. For example, the European IDEFICS (identification and prevention of dietary- and lifestyle-induced health effects in children and infants) study was designed as an 8-country cohort study with an embedded intervention [16, 99].

The results of international research cited earlier have demonstrated significant associations between lifestyle behaviours and obesity within the context of developed countries; however, the role of higher-order environmental correlates of lifestyle behaviours on adiposity and obesity are not well understood. Also other the ENERGY (European Energy Balance Research to prevent excessive weight Gain among Youth) study was designed to explore personal family and school level environmental correlates of energy balance-related lifestyle behaviours in 7 European countries [20, 100].

What is the scientific value and methodological innovation of the project [7-15] carried out under the direction of Prof. Peter K. Katzmarzyk, a well-known American auxologist and kinesiologist? Previous multi-country childhood obesity studies have focused on specific geographic regions (mainly Europe), rather than having a global representation of research sites that included both developing and developed countries. ISCOLE is a multi-national cross-sectional study conducted in 12 countries (Australia, Brazil, Canada, China, Colombia, Finland, India, Kenya, Portugal, South study site determined the best grade levels to target that would ensure a final sample with minimal variability around a mean age of 10 years. The protocol included procedures to collect data at the individual level (lifestyle, diet and physical activity questionnaires, accelerometry), family and neighbourhood level (parental questionnaires), and the school environment (school administrator questionnaire and school audit tool). A standard study protocol was developed for implementation in all regions of the world. A rigorous system of training and certification of study personnel. The targeted sample included 6000 10-year-old children. In a cognitive sense, ISCOLE has made many significant research contributions related to understanding
global patterns of obesity across countries at different levels of human development and identifying correlates of obesity, physical activity, sedentary behaviour, and dietary intake.

In the methodological aspect, the study include the implementation of a standardized research protocol using the same instruments (adapted to the local context as required) and equipment at all study sites, and the inclusion of research sites and investigators from countries that varied widely in human development. Furthermore, the deployment of a web-based data collection and staff training infrastructure that allowed for real-time data entry and verification increased the assurance of quality data.

The results from ISCOLE have application value. The results can help inform the development of interventions targeting promising correlates of obesity in different settings. The findings of ISCOLE could, in turn, inform global efforts, such as the World Health Organization Global Action Plan on Physical Activity 2018–2030 [87,101], and the achievement of the United Nation’s Sustainable Development Goals [88,102]. Furthermore, the results from ISCOLE can inform the development of culturally tailored interventions that can

Based on the presented studies on the obesity epidemic (with particular emphasis on those obtained under the ISCOLE program), it can be generally concluded that lifestyle behaviours such as physical activity and dietary intake have been associated with childhood obesity in many countries; however, the extent to which differences in lifestyle behaviours predict childhood obesity may not be the same across all regions of the world. These behaviours are complex, and are affected by multiple levels of influence, including individual characteristics and higher order factors such as local and national policies, the physical or built environment, numerous behavioural settings and domains, and local cultures.

Key questions about how lifestyle behaviours should be modified to address the problem of childhood obesity on a global stage can be best answered by a multinational study in which both physical activity and dietary intake are measured in a standardized manner, and key measures of the multiple levels of influence are obtained in several countries. Each country and geographical jurisdiction has its own limited variability in the prevalence of obesity and each of the potentially modifying factors at different levels, yet an international study is able to maximize variability in these factors.

There is one more reflection resulting from the analysis of the materials presented in this report. The heterogeneity in levels of obesity across the world also has important implications for global targets and goals. It is necessary to aim only for “no increase in obesity by 2025” in those regions and countries in which a clear upward trend in obesity is observed. However, much stronger political action is needed in those regions and countries where the prevalence of obesity has plateaued at high levels, to raise the priority of multi-sectoral interventions to address obesity and other chronic conditions. In general, there is a need to examine how different policy agendas [88-89, 103, 104, 105] can be integrated and strengthened to promote healthy nutrition and regular physical activity, including preventing overweight. This will require additional efforts that should not overlook low and middle-income countries simply.

With full conviction, it can be recommended to use the presented Canadian method of testing the potential of determinants of physical activity. The Active Healthy Kids Canada (AHKC) [21-22] provided the basis for the creation of the Report Card: The Global Matrix of Physical Activity Grades [32-34]- a tool for conducting international research carried out by the Active Healthy Kids Global Alliance, as well as recommending the National Collaborative on Childhood Obesity Research (NCCOR) proposal, contained in Measures Registry User Guide: Individual Physical Activity [40]. NCCOR’s Measures Registry is widely recognized as a key resource that gives researchers and practitioners access to detailed information on measures in one easy-to-search location. The Registry’s measures focus on four domains that can influence childhood obesity on a population level: 1. Individual Diet; 2. Food Environment; 3. Individual Physical Activity; 4. Physical Activity Environment.

It seems that the choice of materials for presentation in this report may be justified by the following general reflection that results from their analysis:

Excess weight during childhood and adolescence remains one of the most important issues in global health, despite emerging as a concern several decades ago. It is recognized that the key drivers of this epidemic form an obesogenic environment, which includes changing food systems and reduced physical activity. Although cost-effective interventions have been identified, political will and implementation have so far been limited. There is therefore a need to implement effective programmes and policies in multiple sectors to address overnutrition, undernutrition, mobility, and physical activity. To be successful, the obesity epidemic must be a political priority, with these issues addressed both locally and globally. Work by governments, civil society, private corporations and other key stakeholders must be coordinated.

**Conclusions**

The results of the analysis of the presented materials led the authors of the report to the following conclusions:

1. Each country and geographical jurisdiction has its own limited variability in the prevalence of obesity and each of the potentially modifying factors at dif-
ferent levels, yet an international study is able to maximize variability in these factors.

2. The ecological approach to solving the determinants of physical activity and the methods of its evaluation based on the SEM model should be treated with greater interest in the social policy of the individual countries on different continents.

3. The theoretical assumptions of American behavioral epidemiology and solutions to the problem of obesity and the practical implications based on them, resulting from many years of experience in the approach to eliminating the obesity epidemic, should be more widely disseminated and used in the programming of the health promotion outside the United States and in shaping health-oriented physical fitness in children and adolescents Health Related Fitness (H-RF).

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