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THE IMPORTANCE OF CUSTOMIZED BIOMETRIC CORRELATIONS IN THE PREVENTION OF GROWTH AND DEVELOPMENT DISORDERS – A DETERMINING FACTOR IN THE SOCIAL INTEGRATION OF CHILDREN AND ADOLESCENTS WITH MENTAL DISABILITIES

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The Importance of Customized Biometric Correlations in the Prevention of Growth and Development Disorders – A Determining Factor in the Social Integration of Children and Adolescents with Mental Disabilities

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Abstract

This research illustrates a complex, observational, longitudinal, comparative and noninterventional biometric study on the evaluation, in dynamics, of stature-weight development, in children with Down syndrome (DS), compared to children with varying degrees of mental retardation (MR), by repeatedly determining their height and weight, as well as by correlating these two parameters, in order to highlight the harmonious or disharmonious aspect of their stature-weight development. For this purpose, from patients' medical files, we extracted the data regarding the periodic, annual, height and weight determinations of 50 preschoolers and schoolchildren, institutionalized in two Special Schools in Bucharest, which we compared with the standard tables used for Romanian population. The results showed that

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all children with DS show a disharmonious stature-weight development, with excess weight, as a consequence of both chromosomal trisomy and associated congenital malformations, especially heart malformations. In children with MR, the results showed a great phenotypic variability in terms of their stature-weight development. Thus, there were several cases in which the stature-weight development was harmonious, but, in the vast majority of cases, the results showed the presence of harmonious stature-weight development periods, which alternate with disharmonious stature-weight development periods, with weight surplus or weight deficit, alternation, which can be explained both by the involvement of genetic factors, and especially by the involvement of environmental, exogenous or endogenous factors.

Keywords: Down syndrome, mental disabilities, biometric study, stature-weight development, disharmonious development, social intervention.

Introduction

Children and adolescents with multiple disabilities have special needs and represent unique challenges for the society through the fact that many of them struggle to communicate their needs and desires or to learn, in a world that they do not always feel to be friendly (Horn & Kang, 2012)

This year's slogan for World Down Syndrome Day, celebrated on March 21, was "We Decide," a slogan in which patients shout their desire for anyone diagnosed with DS to have full chances to make decisions that affect them or influence their course of life (United Nations, 2020). According to the World Health Organization, the estimated incidence of Down syndrome is 1 in 1,000 live births worldwide (Park *et al.*, 2019). Early and customized social intervention is of major importance, allowing a better understanding of this disease and especially the needs of children with disabilities, to help significantly improve their quality of life, their independence and boundless integration into life and in society (Mohammed Nawi, Ismail & Abdullah, 2013).

Some couples have a higher risk of having a child with DS. Thus, it is known that the risk of giving birth to a child with DS increases exponentially, with maternal age, after the age of 35 (Stern, Biron & Moses, 2016). Each individual with DS, is unique, and the impact of surplus genetic material on his development is extremely heterogeneous (Grieco *et al.,* 2015). In assessing the health of children and adolescents, along with the level and structure of acute and chronic morbidity and neuro-mental development, an indispensable indicator is the physical development, stature-weight. Within this, in addition to physiological data, some somatometric indicators are equally important, such as: height and weight.

Height is the result of the accumulation of favorable or unfavorable influences of the determining factors in the living environment of individuals, such as: diet, activity and rest schedule, microclimate and macroclimate factors, exerted over a longer period of time. If the role of constitutional genetic factors is excluded, an inappropriate stature is the consequence of the negative influence of environmental factors. Weight, on the other hand, is a more unstable indicator, reacting by rapid weight loss to the negative action, even for a short-term, of external or internal environmental factors. The unfavorable evolution of the height/body weight indicators is suggestive in the diagnosis of some genetic diseases, providing us with data on the particularity of the gene-character-environment relationships.

Methodology

This research materialized through a biometric, observational, longitudinal, comparative and noninterventional complex, regarding the evaluation of stature-weight development, in children with DS, compared to children with various degrees of MR, by repeatedly determining their height and weight, as well as by correlating these two parameters, in order to highlight the harmonious or disharmonious aspect of their stature-weight development. The research was conducted in compliance with the standards regarding the implementation of good practice rules in medical research and of the rules on patient confidentiality.

Study groups

The research was conducted on two groups of preschoolers and schoolchildren, aged between 4 and 18, selected from two Special Schools in Bucharest, Romania, during two years (2017 - 2019). The first group consisted of 8 children, diagnosed with DS, belonging to both sexes, 4 girls and 4 boys, and aged between 5 and 16 years. The second group consisted of 42 children, diagnosed with varying degrees of MR, belonging to both sexes (24 girls and 18 boys) and aged between 4 -18 years.

Research methods

The measurement of children's height and weight was performed in accordance with the provisions of the prevention guide for a healthy lifestyle (Popa *et al.*, 2016).

For the *measurement of children's weight,* a standardized digital reading scale was used, which records values up to 150 kg, with an accuracy of 0.1 kg, periodically checked by a specialized service. The scale was placed on a flat, hard surface. Before weighing, the children were helped to remove both their outer clothes and shoes, and to position themselves in the center of the scale. The

digitally indicated value, expressed in kilograms and followed by two decimals, was entered in the children's medical record.

For the *measurement of children's height, a* standardized pediometer, periodically calibrated was used. The children were placed with their backs in the middle of the pediometer tape, their legs slightly apart, their bodies balanced and their backs in the vertical plane.This position was maintained with the help of the evaluator, who hand pulled down the moving component of the thaliometer until it came in contact with the top of the child's head. The value of the child's height was read in centimeters to one decimal, noted in the medical files.

For the *biometric assessment of the stature-weight development* of these children, we compared in dynamics, the values of the two parameters recorded in their medical files, with the values contained in the reference tables of standardized heights and weights, corresponding to children aged between 4 and 18, differentiated by sex and belonging to the urban environment in Romania.

For the body weight parameter we used the following symbols:

VS = very small;
S = small;
M1 = medium 1;
M2 = medium 2;
H = high;
VH = very high.

For the height parameter we used the following symbols:

H II = hypostatural II (very short);
H I = hypostatural I (short);
N1 = normostatural 1;
N2 = normostatural 2;
T = tall;
VT = very talls.

For the correlative interpretation of the two parameters, height and body weight, we used the following symbols:

HD = harmonious development (normal weight);
D+ = disharmonious development (overweight);
D- = disharmonious development (low weight)

If weight and height belonged to the same category of interpretation, it was considered that the individual has a harmonious stature-weight development (HD). If the weight fell into a higher category, and the height into a lower category, it was considered that the individual has a disharmonious stature-weight development (D+). If height fell into a higher category and weight into a lower category, the individual was considered that the individual has a disharmonious stature-weight development (D-).

Results

The research results of the group of children diagnosed with DS

After comparing the height parameter values with the data recorded in the standard tables on height variation with children's age, we found that all cases diagnosed with DS, belonging to both sexes, fell into the category of children with stature deficit (H I, H II).

The dynamic analysis of the body weight parameter values and their comparison with the standard values provided in the reference tables regarding the variation of body weight with age, indicated that all cases diagnosed with DS were included in the category of children with average body weight (M1, M2).

Also, from the personal pathological history, we underline that congenital heart malformations, were found in 37.5% of cases.

Correlating the development in height dynamics with body weight, we found that all children diagnosed with DS, belonging to both sexes, fell into the category of children with stature-weight deficit type D +, corresponding to the constitutional disharmonious type with excess weight (*Figure 1*).

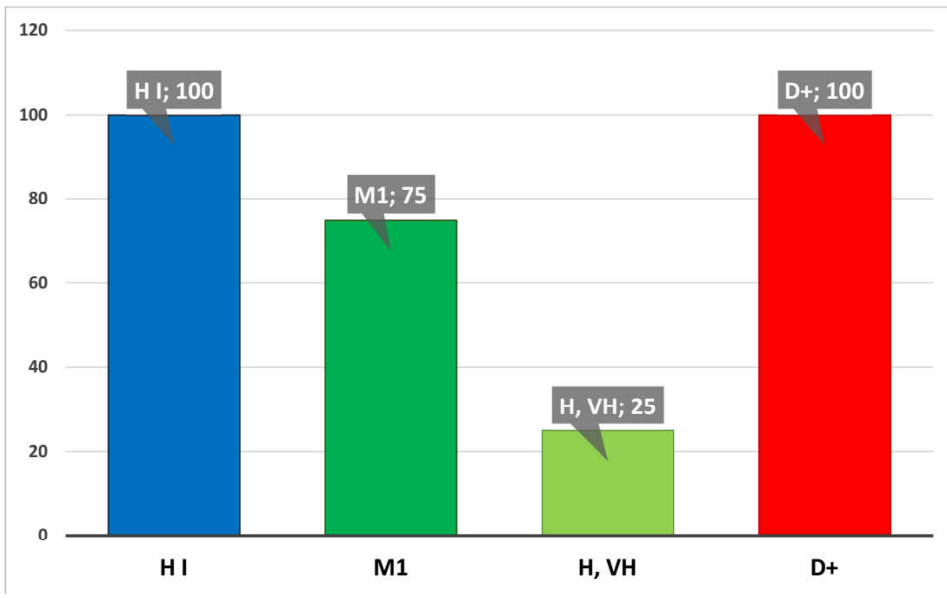

Figure 1. Correlation between height and body weight in children with DS

It should be noted that, in dynamics, none of the children investigated and diagnosed with DS showed periods of harmonious development. These children can be characterized as hypostatural children with an inadequate disharmonious stature-weight development, type D+, the explanation being given by the specific gene surplus, corresponding to trisomy 21, which puts its mark on both stature-

weight development and and on the neuro-psychological development of all affected children.

The results of the research of the group of children diagnosed with MR

Following the comparison in dynamics of the height parameter values with the data recorded in the standard tables regarding the height variation with the age of children, we found that children diagnosed with MR belonging to both sexes fell into the following categories: 38.09% of cases fell into the category of children with stature deficit (H I, H II); 47.62% of cases fell into the category of normostature children (N1, N2); 9.52% of cases, over the years, they recorded oscillating values of height, which alternated their classification between normostatural (N1, N2) and hypostatural children (H1, H2); 4.76% of cases fell in the category of hypersaturated children (T, VT).

The dynamic analysis of the body weight parameter values and their comparison with the standard values provided in the reference tables regarding the variation of body weight with age, indicated that children diagnosed with MR were classified in the following constitutional types, as follows: 73.8 % of cases presented average body weight (M1, M2); 16.66% had low body weight (VS, S); 4.77% had low and average body weight (S, M1, M2); 4.77% of cases had high body weight (H, VH).

Also, from the personal pathological history, we underline that none of the children had congenital malformations associated.

Correlating the development in height dynamics with body weight, we found that children diagnosed with MR, belonging to both sexes, have a specific stature-weight development, characterized by the following features: 4.77% of cases, in dynamics, presented a disharmonious stature-weight development, with weight deficit (D-); 11.99% of cases, in dynamics, in various periods, presented both periods of disharmonious stature-weight development, type D-, and periods of harmonious stature-weight development (HD); 11.99% of cases, in dynamics, in various periods, presented periods of disharmonious stature-weight development, type D +, periods of harmonious stature-weight development (HD), as well as periods of disharmonious stature-weight development, type D-; 4.77% of cases, in dynamics, presented a harmonious stature-weight development (HD); 57,14% of cases, in dynamics, presented periods of disharmonious stature-weight development, type D+, which alternated with periods of harmonious stature-weight development (HD); 9.52% of cases, in dynamics, presented a disharmonious stature-weight development, with excess weight (D+) (*Figure 2*).

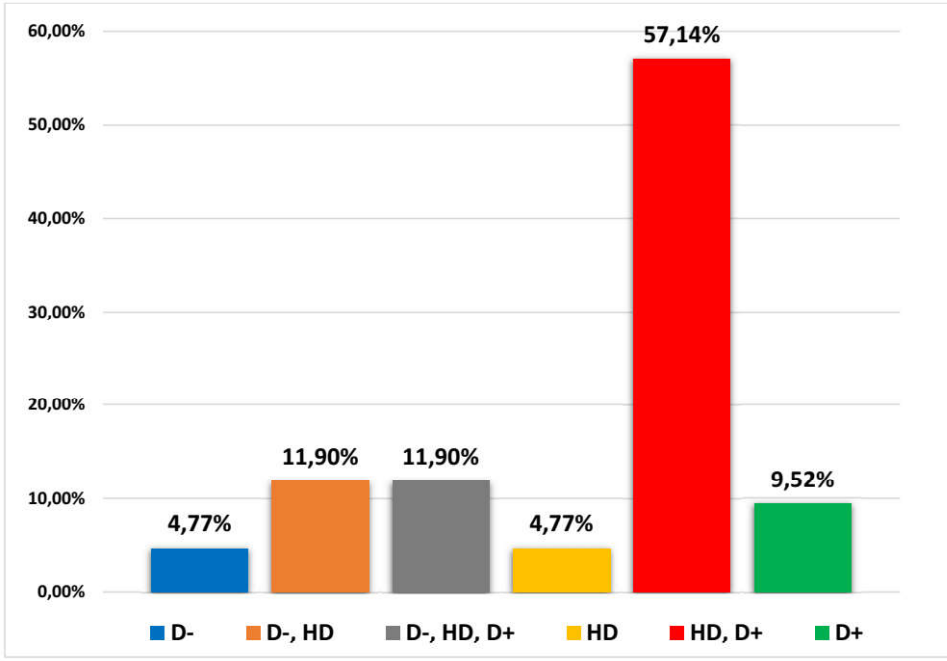

Figure 2. Correlation between height and body weight in children with MR

It should be noted that, in dynamics, most children with MR showed a disharmonious stature-weight development, both during childhood and adolescence, the neuro-psychic deficit affecting especially the height of these children. It can be assumed that, within the complex of genes involved in neuro-psychic development, there are some pleiotropic genes, which affect stature-weight development, or that MR is associated with a deficiency of neurogenic factors involved in somatic development. Height is primarily influenced by internal genetic and neurogenic factors and to a lesser extent by environmental factors.

Discussion

Down syndrome was first described in 1866 by a British physician, John Langdon Down, which is why the disorder is named after him (Akhtar & Bokhari, 2020). The association of Down syndrome with trisomy 21 was established later, in Paris, in 1966, by Dr. Jérôme Lejeune. Down syndrome is the most common genetic disorder in newborns, caused by the presence in the karyotype of an additional chromosome in pair 21 (Albu *et al.*, 2019a).

In Romania there are no official statistics on the number of patients with DS. Thus, in 2009, according to the National Center for Health Statistics and Informatics,

lived about 30,000 people with DS (Boghiceanu, 2009). According to the European Center for the Rights of Children with Disabilities, two years later, other statistical data provided by the Ministry of Labor, Family and Social Protection, showed that in Romania 691,482 people were registered with disabilities, of which 116,000 people with mental disabilities (MD), (ECRCD, 2012).

The main objectives of monitoring height and weight development in children with MD are mainly represented by the possibility of personalized tools for periodic assessment of health and nutrition of each child, necessary to implement effective action in response to growth disharmony and identified development (Reber *et al.,* 2019). Growth monitoring and promoting a balanced diet, adapted to individual needs, are essential components of preventing the installation of stature-weight disharmony in children of all ages, regardless of the associated pathology and especially in risk pathologies (Artioli, 2017).

A better understanding of these disorders as well as social intervention, early and personalized, can significantly increase the quality of life of these children (Allahyari & Branigin, 2018). Awareness of the family and society, regarding the notions of healthy eating, physical activity, genetic disorder and disease, motivates and promotes individual and social initiative towards good practices of raising and caring for children and their development, and especially children with disabilities, by ensuring their direct access to health and social care services, tailored to their special needs (Popa *et al.*, 2016).

Assessing the growth and development of children involves measuring weight and height, followed by comparing data obtained with standard values found in growth tables (Beker, 2006). The methods are simple, fast, non-invasive and provide valuable information about the general condition, growth and development of the child (Harris, 2015). Sometimes these methods can be classified as having a low priority, as a result, often these parameters are recorded in the sheets, but are not clinically capitalized properly, in the sense that they are not analyzed in dynamics and are not compared with the values corresponding to normal growth curves of children of the same age, sex and belonging to the same area (Srinath *et al.,* 2019). Consequently, these opportunities that allow early detection of stature-weight growth and development deficits are missed (Popa *et al.*, 2016).

In Romania, the correct monitoring of the stature-weight development of all children, after the age of 2 years, is recommended to be performed regularly, at intervals of 1 year. Monitoring involves determining the weight and height of children, comparing the results with those provided in the corresponding growth tables, correctly interpreting the child's stature and weight development and discussing the results with family, in order to establish future behaviour, depending on patients' clinical condition (Darling-Hammond *et al.,* 2020; Popa *et al.*, 2016).

The disharmonious stature-weight development characterized by stature deficit with low growth rate and dysmorphic features, is found not only in Down syndrome, but also in other genetic syndromes, skeletal dysplasia or rickets (Gupte & Gomez, 2020).

In other cases, disharmonious hypodevelopment manifested by weight loss and short stature, are caused by a poor diet or may be the only clinical expression of chronic diseases, such as MR associated with chronic neuro-psychiatric disorders, accompanied by swallowing disorders or diet disorders of psychic origin.

At the same time, in these cases, the psycho-social and affective deficiencies, often associated in the etiology of the disharmonious hypodevelopment of children institutionalized with DS and MR should not be neglected or underestimated (Dieleman *et al.,* 2018). The stature-weight disharmony in the psycho-social dwarfism or the dwarfism of maternal deprivation, is given, in these cases, not by inadequate nutrition but by the disorders that are determined by the lack of feeling love and affection (Green, Campbell & David, 1984).

The growing complexity of contemporary family life and the crucial role played by the family in raising and caring for children with MD, is a challenge for social services responsible for the care of institutionalized children, given that they must provide these children with the complexity of the functions ensured by family relations. Deep ignorance of family relationships and failure to apply knowledge about the role and functions performed by the family, in the social assistance of children hosted by these specialized centers, leads to the provision of inefficient social services, with adverse consequences on the harmonious growth and development of these children (Mohammed Nawi, Ismail & Abdullah, 2013).

The disharmonious hypodevelopment, characterized by stature deficit, low growth rate and excess weight, is much more common in children with DS, being associated with generalized muscle hypotonia, ligament laxity and neuro-psychic retardation, which explains the tendency to obesity and thoraco-lumbar kyphosis in these people (Amaricai, 2020). The combination of generalized muscle hypotonia with ligament laxity and muscle hypotonia has harmful consequences, generating multiple and frequent musculoskeletal complications, rarely studied (Foley, MacDermott & Killeen, 2014). The prevalence of obesity is much higher among children with DS, compared to the general population, mainly affecting children aged 2-6 years and females (Pierce, Ramsey & Pinter, 2019).

Through early and effective social intervention, the primary health and social care provider can help manage obesity among children and adolescents with MD, knowing the risk factors involved in overweight. By establishing a screening plan materialized by periodically determining the height and weight of affected children, along with proper and well-led management, can prevent or treat properly, the excess weight gain of these children (Murray & Ryan-Krause, 2010). A relatively recent study indicated that in children with DS the basal metabolic rate is lower than in unaffected children (Artioli, 2017). On average, people with DS burn 200-300 calories/day less compared to those unaffected, hence the need for early social intervention, by combating early and effective obesity in children and adolescents with DS, through a proper, balanced diet and a rigorous program of exercise (DSAWM, 2010). At the same time, by using social strategies specifically

adapted to children with MD, the negative physiological and psychological results associated with obesity can be diminished or avoided (Murray & Ryan-Krause, 2009).

The disharmonious stature-weight development, identified and treated late, has detrimental consequences on the affected children, accentuating with age (Esbensen, 2010). As a result, the late social intervention is inefficient, causing minor neuro-psycho-motor acquisitions or even being completely devoid of results. In the case of children with MD, early social intervention is absolutely necessary and mandatory (De Oliveira *et al.,* 2018). This involves working in multidisciplinary teams, formed according to the personalized needs of these children (Hernandez-Reif *et al.*, 2006). Good results were obtained by combining medical, pedagogical and social sciences in the early social intervention (Paquette & Ryan, 2011).

Kinetotherapy has a decisive role in the early rehabilitation of disharmonious hypodevelopment of children with MD, so that they benefit as much as possible from a proper and harmonious neuro-motor development (Amaricai, Catan & Leorinti, 2019). This therapy is important to start as early as possible in order to achieve an acceptable degree of independence as soon as possible (Carey, 2014).

In terms of physical education, the beneficial effect of sports on improving the cardiovascular and neuromuscular performance of children with MD is well known; it gives them independence of movement, care and leisure. As a result, early social intervention, materialized through social exercise programs, must be effectively designed in terms of benefits and costs, well managed and motivating (Merzbach & Gordon, 2020).

In Romania, the initiatives of non-governmental associations are commendable; they make considerable efforts to create favorable conditions for a good social integration of people with MD, by using the most diverse methods of intervention in their social assistance. The social intervention techniques consist in the integration of these children in specialized sports programs, occupational therapies and socio-cultural activities. Through correctly conducted sports exercises and through a dosed sports program, corresponding to the possibilities and needs of these children, the movement performed periodically allows maintaining at a distance the disharmonious stature-weight development deficit due to excess weight and obesity (Down Plus Association Bucharest, 2017).

Play therapy is also very important and gives very good results; as a result, children with DS must be trained in attractive and personalized recreational activities, in mixed groups, consisting of both children with MD and unaffected children, knowing that the desire of imitation specific to children with DS, helps them to engage in performing physical exercises practiced by other unaffected children, imitating them (Pelosi, Teixeira & Nascimento, 2019; Amaricai, Catan, & Leorinti, 2019).

Occupational therapy is an equally important aspect, being very useful in the early social integration of children with MD, through motor training and motor planning, training fine movements in the oral-maxillofacial sphere, training in self-care activities and sensory social integration (Pelosi Teixeira & Nascimento, 2019; Field *et al.*, 2006). Thus, occupational therapy, by training active movements of the muscles of the tongue, lips and jaws, by eating activities, promotes the strengthening of orofacial muscles, and going to the toilet, getting dressed, putting their shoes on are activities through which children with MD respond to information received from the social environment (Areias *et al.*, 2015).

Early social intervention has a decisive importance in supporting, by all possible means, the integration in society of children with MD. Remarkable results can be achieved through public-private partnerships and programs dedicated to supporting children with multiple MD. The multidisciplinary teams involved in the rehabilitation of these children must be aware that these children represent an unique educational challenge and deserve all the effort to grow, learn and develop, just like all other children (Horn & Kang, 2012).

The main prevention ways in order to prevent the occurrence of DS in offspring, but also of various types of MR, are mainly represented by prenatal screening performed on all pregnant women, early diagnosis of high-risk pregnancies and personalized management of all cases (Albu *et al.*, 2019b). It is very important to specify that the results of prenatal screening tests have major ethical consequences, therefore the decision to accept or refuse to perform these tests must be taken strictly by the pregnant woman, it must be an autonomous decision and taken into full knowledge of cause (Biesecker, 2019).

Conclusion

Genetic disorders, including DS, affect both neuro-psychic and stature-weight development of the affected children, generally associating other congenital malformations, while the stature-weight development of children with MR is influenced by both factors, genetic as well as environmental, which results in the need for a better understanding of these disorders and the importance of early and personalized social intervention, in order to increase the quality of life of these children and their direct integration into society.

Recommendations

We recommend the implementation of the main methods and techniques of intervention in social assistance of people with DS and people with various degrees of MR, specialized and personalized supervision of all cases, through effective dispensary and active physical recovery, in order to establish a functional status to provide them independence.

The results of our study support the necessity of the planned social intervention, local social development, and opportunity-focused social intervention involving early mental rehabilitation of affected children, specialized education of preschoolers and schoolchildren, training and integration of children and adolescents in society, and their professional, theoretical and practical guidance.

We also recommend support and representation for the families of affected children, appropriate socialization and integration activities in the family and community, and last but not least, changing the mentality of society and informing the population about patients with disabilities.

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All authors have contributed equally to the work, so they are main authors.

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