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INFLUENCE OF THE PHYSICAL ENVIRONMENT IN PRESCHOOL INSTITUTIONS ON THE PHYSICAL ACTIVITY LEVEL OF EARLY-AGED CHILDREN

UTJECAJ PROSTORNOG OKRUŽENJA U PREDŠKOLSKIM USTANOVAMA NA RAZINU TJELESNE AKTIVNOSTI DJECE RANE DOBI

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SUMMARY

The aim of the present research is to establish if the physical environment in various rooms of an early education institution (living room, hall, gym, outdoor space) can have a **s**trong effect on the level of children's physical activity.

Participants of the research were two nursery groups belonging to two newly-built kindergartens in the City of Rijeka, with state-of-the-art architecture of the indoor and outdoor space. The experimental group included 19, while the control group included 17 children, a total of 36 children averagely aged 3.1. Variables were formed based on the space in which children spent their time and the measuring instrument – pedometer (Omron HJ-720IT-E2). The basic descriptive parameters were calculated, and to determine the significance of differences the Student's independent sample t-test was applied.

Results show a significant difference (p=0.00) in favour of the contemporary environment which encourages movement. According to statistics, the experimental group children are significantly more physically active and on average they move up to five times more than children of the control group, and at a level of intensity which ensures a significant effect on their health. Such an organised contemporary spatial environment which stimulates movement is adequate to any child and their potentials because it evenly homogenises children at the physical activity level so that there are almost no differences among experimental group children regarding the results of their physical activity level.

The foundations have been set from which the criteria for a new approach to spatial organisation and integrated learning stimulating children's physical activity can be

SAŽETAK

Cilj je ovog istraživanja utvrditi može li fizičko okruženje u različitim prostorima (dnevni boravak, hodnik, sportska dvorana, vanjski prostor) ustanove ranog odgoja značajno utjecati na razinu tjelesne aktivnosti djece.

U istraživanju su sudjelovale dvije jasličke skupine dva novoizgrađena dječja vrtića sa suvremenom arhitekturom vanjskog i nutarnjeg prostora u Gradu Rijeka. Eksperimentalna skupina je obuhvaćala 19, a kontrolna 17 djece, ukupno 36 djece prosječne dobi 3,1 godine. Varijable su formirane na temelju prostora u kojem djeca borave i mjernog instrumenta pedometra (Omron HJ-720IT-E2). Izračunati su osnovni deskriptivni parametri, a za utvrđivanje značajnosti razlika primjenjen je Studentov t-test za nezavisne uzorke.

Rezultati su ukazali na značajnu razliku (p=0,00) u korist suvremenog prostornog okruženja koje potiče pokret. Djeca iz eksperimentalne skupine su statistički značajno tjelesno aktivniji te se u prosjeku kreću do pet puta više u odnosu na djecu iz kontrolne skupine i to na razini intenziteta koji osigurava značajni zdravstveni učinak. Ovako organizirano suvremeno prostorno okruženje koje potiče pokret, primjereno je svakom djetetu i njegovim potencijalima jer djecu ravnomjerno homogenizira u razini tjelesne aktivnosti te gotovo da ne postoje razlike među djecom eksperimentalne skupine u rezultatima razine tjelesne aktivnosti.

Postavljeni su temelji iz kojih se mogu razvijati kriteriji za novi pristup organizacije prostora i integriranog učenja koje potiče tjelesnu aktivnost djece. Radi se o suvremenom pristupu koji značajno motivira dijete na motoričko kretanje, omogućuje njegov cjeloviti razvoj, integrirano učenje,

developed. It is a contemporary approach which significantly stimulates children's motor movement, enables their integral development, integrated learning, is applicable in all spaces of a preschool institution and has a significant health effect.

Keywords: *early-aged children, integrated learning, movement, physical environment, preschool institutions*

primjenjiv je u svim prostorima ustanove ranog odgoja i ima značajan zdravstveni učinak.

Ključne riječi: *djeca rane dobi, integrirano učenje, pokret, prostorno okruženje, ustanove ranog odgoja*

INTRODUCTION

For a longer period of time mankind has been going through a downfall in the level of physical activity, and almost each new generation has a lower level than the former one, while poorer and poorer results among children and young people are especially worrying (14). In the last few years research has indicated an extremely low level of physical activity as early as among children of an early age (39) which may be a sign of serious health problems even at this age (17). One of the ways to increase the level of children's physical activity can be the arrangement of their environment which would stimulate them to move.

The early childhood and preschool period are the most sensitive sensible phases in a child's life (12). Children of this age go through processes in their organism which are key for the development of potentials, while preschool teachers are expected to be professionals who know how to connect science and practice in an adequate way, thus enabling each child to optimally develop these potentials (26). Children usually develop their potentials by moving, or being physically active because movement is one of their biotic needs. A stimulating spatial environment encourages children to move and ensures their motor development which must not be neglected in their early childhood (29). Contemporary research studies put an ever-growing emphasis on the importance of forming efficient and innovative learning environments (5) highlighting that the space where children spend their time should be made as functional and polyvalent as possible (36;6;4).

In the early childhood and preschool period the lack of basic motor literacy can be noticed more often, and this is the foundation for children's further development and the quality of their life (26). Research has shown that by the children's enrolment into educational institutions their motor skills stagnate or deteriorate (21). Institutional education, in spite of modern paradigms, is still dependant on the structure which often neglects the importance of children's movement (3). Setting physical activities as the base for integrated learning in early education institutions represents one of the greatest challenges for today's scientists, but also a necessity if children's health wants to be preserved and improved.

A larger number of research studies about the correlation between the environment and children's health have been published recently (15;19;20;18). Physical activity is a significant social capital for mankind, while the spatial environment of world's cities and their building policy can significantly influence the level of their citizens' physical activity (15). Besides the mentioned global level, it is today known that the spatial environment in early education institutions can have a significant influence on children's physical activity (2;37). Most research has included the outdoor environment and specific knowledge and linked them to children's physical activity (37;8;23;1;10). What is missing is a larger number of research studies about the correlation between the early education institutions' indoor spaces and children's physical activity (35).

Early education institutions have a significant possibility of influencing the development of children's motor literacy and the creation of habits linked to movement (39). Therefore, the question is asked about the possibility of also establishing the modern paradigm of understanding children on movement as a natural way of integrated learning, i.e. if the spaces in an early education institution can be arranged in order to stimulate children's physical activity. Different biological, clinical and pedagogic research confirm the strong relationship between physical activity and learning, but also indicate that the relationship between movement and learning continues throughout the whole life (12). This research can be exceptionally significant because the results can set the basis of a new theory of teaching which has an extremely significant contribution to the integral development of a child and his or her health.

The aim of this research is, therefore, to establish if the physical environment in various rooms of an early education institution (living room, hall, gym, outdoor space) can have a strong effect on the level of children's physical activity.

METHODS

Sample of participants

Two newly-built and modern kindergartens of the City of Rijeka participated in the research; one was considered the experimental kindergarten, the other control. The first kindergarten is the year-long preschool teacher training kindergarten of the University of Rijeka, while the other kindergarten has recently become one. In each of the

kindergartens the research encompassed one mixed nursery group, more precisely 36 children of an average chronological age of 3.3 years of age. The experimental group consisted of 19 children, while the control group had 17 children. Each group's preschool teacher was appointed mentor and was continually involved in professional development programmes in line with contemporary approaches to the organisation of educational processes in the institutional context. It can be said that all preschool teachers were competent for the realisation of the educational process based on the contemporary paradigm of understanding children and childhood.

Sample of variables

The variables were formed based on the measuring instrument pedometer (Omron HJ-720IT-E2). It was placed on a child's left hand waist. It estimates movement in a vertical plane (frequency of movement) and the data can be read directly from the device (27). The number of steps made by each child in 60 minutes was measured in each of the aforementioned spaces, and the following variables were created: Frequency of steps in the living room – *LIVING ROOM*; frequency of steps in the hall – *HALL*; frequency of steps in the gym – *GYM*; frequency of steps in the outdoor space – *EXTERNAL SPACE*; total frequency of steps – *TOTAL*.

Measurement protocol and research description

The research was approved by the competent research coordinator in the chosen kindergartens and is part of the project "Establishment of the system for monitoring children's physical activity by modern technology in early and preschool institutions" financed by the University of Rijeka, reference number *uniri-drustv-18-268*. Preschool teachers had been informed with all research details and actively participated in all phases, especially in the creation of stimulating spatial arrangement. On a parents meeting they informed parents about the project and collected their consents. The research was conducted at the end of May and beginning of June 2019. Each of the early and preschool education institution had to be visited four times, once to record each space and measure the children's 60 minutes physical activity.

Both kindergartens have similar material conditions, are equally equipped and in collaboration with the professors who teach methodologies in the integrated curriculum of the Teacher Training Faculty of the University of Rijeka they develop a contemporary approach to the educational process, i.e. understanding children and childhood. In other words, both kindergartens have the characteristics of modern organised spaces (according to 31) organised in activity centres in order for the child to have the possibility to choose and satisfy his or her need for (self)learning; an open space to meet children from different educational groups; reassigned spaces for children's activities; exhibition of children's works and stimuli for learning; organised by both preschool teachers and children; adaptable and changeable in line with the children's growing needs and interests. In the experimental kindergarten, besides the already mentioned modern organisation characteristics, children have been stimulated to motor movement for a continual period of three pedagogic years. Table 1 brings forth the differences with regard to spaces in the experimental group.

Table 1. The difference between the experimental and the control spatial environment
Tablica 1. Razlike između eksperimentalnog i kontrolnog prostornog okruženja

The living room. All centres are arranged to stimulate a child to move during solving research tasks, which means that children have to use almost all the biotic motor knowledge units (climbing, jumping, throwing, aiming, crawling through, etc.) to successfully solve various research tasks. The space between all the activity centres is filled with stimuli willingly mastered by children using various types of movements so as to reach the activity centre they want. The space is adaptable to any child, his/her interests and needs, while most of the materials are unstructured and can be used in many ways.
The hall. It is equipped with various stimuli which are constituent parts of various activity centres. There are almost no ready apparatus and solution, while along certain plastic materials there a numerous sport apparatuses and props and natural materials (wood, sand, rope, etc.). Activity centres are meaningfully arranged along the hall in order for children to move according to their needs and interests. They are fully adaptable to children and set as a challenge which encourages them to find different solutions.
The gym. It is organised in motor centres which enable children to train their biotic motor knowledge in all domains (mastering space, mastering obstacles, mastering and manipulating objects). Children choose the order and modality of solving the set motor challenges themselves. All activities occur continuously (without children having to wait for their turn), in line with children's needs and interests.
Outdoor space. It is organised in activity centres which are predominantly equipped with natural materials (sand, water) and various unstructured materials, constructed according to children and their interests. They are adapted to children and represent a stimulus for children to explore by moving. All is meaningfully arranged in order for children to move as much as possible and to look for solutions to different challenges.

Data processing

The measured data was processed by the programme SPSS Statistics 21. The basic descriptive parameters (arithmetic mean and standard deviation) for the experimental and control group were calculated. To determine differences between them the independent sample Student's t-test was used. All results were presented in tables. The statistical significance was tested at the level $p<0.05\%$.

RESULTS

Table 2 presents the descriptive parameters for the distance covered in 60 minutes. The spatial environment in the living room stimulated the experimental group children to make an average of 5,500 steps more than the control group children. Deviation from the average value in the experimental group is somewhat higher than 8%, while in the control group it amounts to almost 15%. The spatial environment in the hall stimulated the experimental group children to make an average of 5,350 steps more than the control group children. Deviation from the average value in the experimental group is somewhat higher than 21%, while in the control group it amounts to almost 77%. Regarding the gym, the deviation is for both groups somewhat higher than 19%. It can be said that the gym, considering its characteristics and purpose, stimulates the level of physical activity in each child to an equal extent. Nevertheless, children from the experimental group did averagely 6,331 steps more than children from the control group thanks to the organisation of the space in the gym. In the outdoor space, the experimental group children made an average of 2,000 steps more than the control group children in the measured 60 minutes. Deviation from the average value in the experimental group only reached 8%, while in the control group it rose to almost 24%.

If the total distance covered in 60 minutes in all spaces is considered (Table 2), the experimental group children did averagely almost 5,000 steps more than children in the control group. Deviation from the average in the experimental group equals to only 34%, while in the control group it comes up to 78%. In general, it can be established that children from the experimental group are more homogenised in the level of physical activity and that their environment is more adequate for the development of all the benefits stimulated by physical activity, especially for growth and development.

Figure 1 presents the average values achieved by both groups in all spaces, as well as the variable of the total number of steps. It can be seen that children from both groups did most of their movement in the gym. Next, the experimental group children made almost the same number of steps in the living room and hall, while the smallest number of steps was made in the external space. After the

Table 2. Descriptive parameters (arithmetic mean – AM, standard deviation – SD) for the frequency of steps done in 60 minutes
Tablica 2. Deskriptivni parametri (aritmetička sredina – AS, standardna devijacija – SD) za frekvenciju koraka u 60 minuta

Group	Living room	Hall	Gym	Outdoor space	Total
Experimental	5754.4 ± 520.6	5820.8 ± 1272.5	8981.6 ± 443.01	3857.6 ± 320.8	6103.6 ± 2123.6
Control	271.2 ± 39.7	468 ± 360.2	2650.8 ± 514.8	1845.6 ± 147.86	1308.9 ± 1136.1

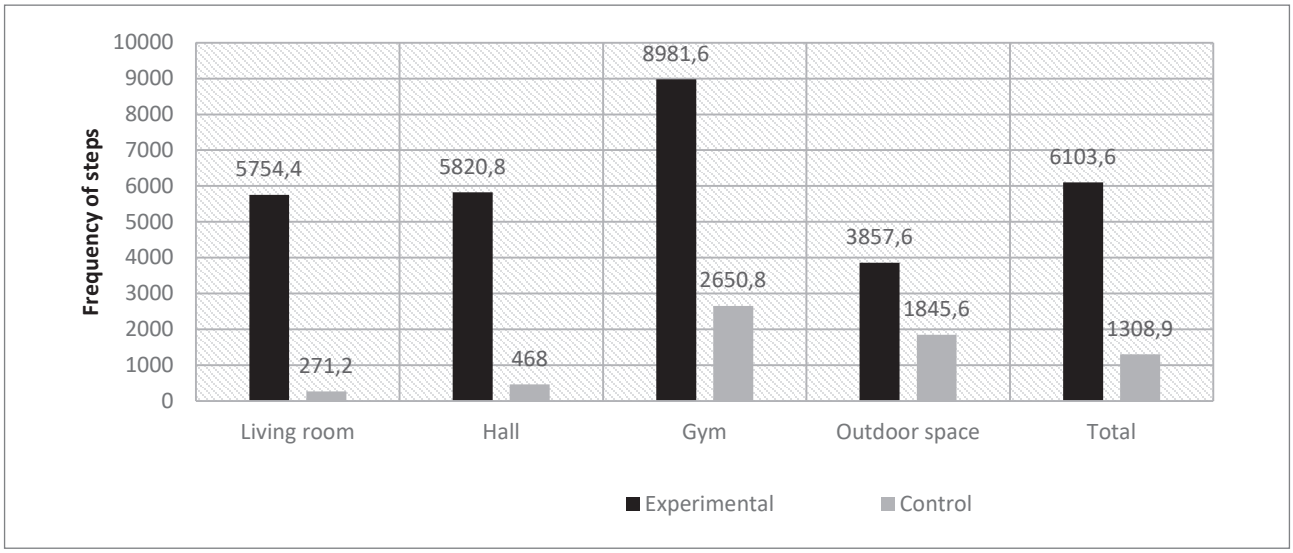

Figure 1. Average values of step frequency in all spaces for the experimental and control group
Grafički prikaz 1. Prosječne vrijednosti frekvencije koraka u svim prostorima za eksperimentalnu I kontrolnu grupu

Table 3. Difference in the frequency of steps between the experimental and control group
Tablica 3. Razlike u frekvenciji koraka između eksperimentalne i kontrolne grupe

VARIABLE	Mean – EXPERIMENTAL	Mean – CONTROL	t-value	p
LIVING ROOM	5754.4	271.2	-23.48	0.00
HALL	5820.8	468	-9.05	0.00
GYM	8981.6	2650.8	-7.67	0.00
EXTERNAL SPACE	3857.6	1845.6	-8.21	0.00
TOTAL	6116.6	1305.9	3.98	0.00

gym, children from the control group made most steps in the outdoor space, then in the hall and the smallest number of steps was made in the living room.

Table 3 presents the results of differences in the achieved level of physical activity in various spaces of the early education institution. Children from the experimental group achieved statistically better results (p=0.00) in the level of physical activity in all spaces and in total than children from the control group.

Contrary to the standard modern arranged spaces in early education institutions, a contemporary organised space which stimulates individual organised movement has a statistically higher stimulus on the children's physical activity. The experimental group spaces are better organised according to activity centres and it is extremely rich in all types of stimuli, arranged in order to support the development of biotic motor knowledge in all domains.

DISCUSSION

A lack of basic motor literacy, which is the foundation for children's further development and their life quality, can be more and more observed at an early and preschool age (27). Children's motor skills are directly connected to the development of the central nervous system, while the lack of movement in early childhood is irrecoverable later on in life (33). Each new generation of children is worse than the former one in terms of their physical activity level, which leads to a serious vulnerability of their growth and development (28). Research has shown that enrolment in educational institutions makes children's motor skills stagnate or even deteriorate (21), which may indicate preschool teachers' limited understanding of the importance of implementing movement in everyday activities (3). Institutional education, despite contemporary paradigms, still depends on structures which often neglect the importance of children's movement. Vujičić et al. (39) point to the significance of movement in early education institutions and suggest movement as one of the basis of integrated learning since it represents a man's biotic necessity and is the precondition for a child's optimal growth and development.

Results established that statistically the experimental group moved significantly more than the control group in all spaces, i.e. it covered on average almost five times the distance, or averagely 4.811 steps more in 240 minutes, than the control group. Both groups did most of their movement in the gym. The experimental group made averagely almost 9,000 steps, while the control group made 2,649 steps.

The physical activity level is expressed in metabolic units (MET), which represents the relation between the "working metabolism and quiet metabolism" (1 MET). A moderate physical activity equals to 3 – 5 MET, a high-intensity physical activity is > 6 MET. Only moderate and high-intensity physical activity have a significant health effect (25). Research about children indicates that for a moderate to high physical activity level it is necessary to make approximately 4,000 steps in 30 minutes (11), which is approximately 120 steps in one minute (7). According to this, the experimental group children achieved a significant intensity of movement in all spaces, especially in the gym where they made almost 9,000 steps in 60 minutes. If the experimental group results are compared to similar former research, significant differences can be noticed. Tomac et al. (38) have studied the daily physical activity of children in early and preschool education institutions by using pedometers and noting the number of steps done during the morning, between 8:30 and 11:30. Their results indicate that children make between 2,280 and 5,460 steps, depending on the conducted daily activity programme. The authors concluded that an early education institution did not stimulate children's physical activity to a sufficient extent, and as a suggestion they mentioned creating spatial-material environment which would stimulate movement. This research results which regard the experimental group have proved that the aforementioned can rally be one of the solutions to increase children's physical activity in early education institutions. Except for being clear that the contemporary spatial environment which stimulates movement significantly influences the level of children's physical activity, it also has a significant health effect. It can be seen that experimental group children made on average 6,116 steps, which is more than the average results obtained by other studies where in three times more time children made an average of only 3,870 steps (38).

The health effect of the spatial environment in the experimental group is strongly emphasized by the intensity of children's movement. In all spaces they achieved an average of 102 steps in one minute, which is almost a

moderate to high physical activity with a significant health contribution (according to 7). The experimental group children made averagely 150 steps in one minute in the gym, which exceeds the recommended value of a minimum of 120 steps in a minute (7). Former research, as well as this one (both experimental and control), confirmed the fact that children make most steps on kinesiological activity days in the early education institution's gym (38). The control group is in line with the rates of movement which have been stated in former research.

It is a fact that early and preschool children fulfil their need for movement to a lesser extent, and consequently their motor achievement deteriorates which directly influences their health (32). Lack of movement leads to the deterioration of a harmonious growth and development. A contemporarily arranged space which stimulates movement can be one of the solutions which excellently connects integrated learning and physical activity. The experimental group shows much smaller deviations from the average, which means that children are more homogeneous in the level of their physical activity measured in early education institution premises. This indicates that such a spatial organisation is adequate to each child, and each child makes an improvement according to his or her possibilities. Research often emphasises that it is the early education institutions' obligation to care about the level of children's physical activity since it ensures a harmonious growth and development and significantly prevents many diseases (24).

Today it is known that motor skills are directly connected with the development of the central nervous system (12), while the early and preschool age is the most intense period of a human's growth and development and key for the development of motor skills and acquisition of motor literacy (26). A special importance of this research lies in the fact that movement is the best cure for the brain (34). The same authors have proved the correlation of an adequate level of physical activity and better learning, at the same time lowering stress, anxiety, depression, attention deficit, hormonal changes, etc. Furthermore, the correlation between obesity and the physical activity level as early as in the early and preschool period has also been proved, so scientists pay more and more attention to this period because by physical activity children of an early and preschool age diminish the risk of obesity in later periods of life (22).

Many authors agree that the level of children's physical activity in early education institutions mostly depends on the spatial environment, material conditions on disposal and professionalism of preschool teachers (26;9). Physical inactivity is considered as the fourth leading factor of mortality throughout the world, and when it comes to the educational system, children meet organised physical activity for the first time in early education institutions. Their significance in the contribution to children's growth and development is unquestionable, while the timely provision of basic motor literacy is one of their primary tasks.

Contemporary spatial environment which stimulates movement may have a significant role in the formation of a child's habits and need for regular movement, and consequently significantly influence the quality of their life and health. This may be one of the ways of organising a certain space in line with children's needs for and interests in movement. Children connect a space and occurrences in it with personal experience to the extent to which they felt relaxed and the space was stimulating for their interests and needs (13). Children's movement, their independence and interaction, are basic characteristics to be satisfied in a certain space (16; according to 30). Preschool teachers are obliged to turn children's environment in a laboratory in which they will do research and acquire invaluable experience (30). It is known today that contemporary stimulating environment and children's positive experience in it lead to the fulfilment of their maximum biological potentials, as well as influence the expression of their genes during growth and development. The organisation of spaces as in the experimental group can be a model of how to achieve integrated learning with movement and significantly influence children's integral development, the quality of their lives and the preservation and advancement of their health. A meaningful spatial arrangement affects children's development, at the same time enabling preschool teachers to educate children in a more natural and better way.

The drawback of this research is a relatively small number of examinees, but the results are really unique and can have a significant effect on the direct work of preschool teachers and their educational practice. They are an indication of a new approach to integrated learning which stimulates movement as a child's biotic need, so it is suggested to repeat this research on a larger number of examinees and early education institutions.

CONCLUSION

The research aim was to establish if the spatial environment in different spaces (living room, hall, gym, outdoor space) of an early education institution can influence children's physical activity level. Each of the spaces (living room, hall, gym and outdoor spaces) of the experimental group differs from the control group in the sense of organisation. It also influenced the fact that the experimental group children were significantly physically more active according to statistics, and on average moved up to five times more than the control group children, at a level of intensity which ensures a significant health effect. Besides, it has been proved that such an organised contemporary spatial environment which stimulates movement is adequate to each child and his or her potentials because it evenly homogenises children in the level of their physical activity. In other words, there is almost no difference among experimental group children in the results of their physical activity level.

This research sets the basis from which the criteria for a new approach to the organisation of spaces and integrated learning can be developed, all in the support of movement and the provision of significant health effect on children. It is a modern approach which significantly motivates children for physical activity, enables their integral development, integrated learning, is applicable in all spaces of an early education institution and has a significant health effect.

Preschool teachers face daily challenges in which they have to organise, prepare and form an environment which seeks for movement as the children's biotic need for the achievement of their integral development. The environment which is pedagogically prepared to fulfil the children's present needs for movement should be lived on a daily basis, while the educational process should be in the function of integrated learning. It can be concluded that the success of such an approach mostly depends on preschool teachers, their competencies and abilities to use spatial environment to make the children learn in an integrated way by movement, and to advance in line with their present possibilities.

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