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DYSPHAGIA IN PEOPLE WITH INTELLECTUAL DISABILITIES

Original scientific paper

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ABSTRACT

People with intellectual disabilities often face a number of disorders that can impair their health and even endanger their lives. One of these disorders is dysphagia, which is often unrecognized in this population. The main goal of the research was to determine the differences in the severity of dysphagia relation to the degree of intellectual disability in persons placed in institutional accommodation. The study involved 31 respondents diagnosed with intellectual disabilities. The results showed that people with a higher degree of intellectual disability have more pronounced dysphagia. Caregivers of people with intellectual disabilities should be aware of the presence of dysphagia in people with intellectual disabilities, and refer them to a speech-language pathologist in a timely manner with the goal of timely diagnosis and treatment to improve the overall health and quality of life of people of this population.

Keywords: swallowing disorder, degree of intellectual disability, institutional accommodation

INTRODUCTION

A human's ability to feed and swallow is a basic function essential to his/her health and well-being, providing him/her with the necessary nutrition and satisfaction. Swallowing involves the interaction of complex anatomical, neurological, and physiological systems. Even small changes in these systems such as swallowing time, deviations in anatomy or changes in swallowing physiology can have a profound impact on the whole process and significantly impair a person's quality of life (Lerner & Tan, 2012, according to Begic & Salihovic, 2018). Pathological changes in swallowing mechanisms lead to dysphagia, nutritional and social consequences (Kolundzic, 2012). Dysphagia is a symptom, and possibly a consequence of certain diseases.

It manifests as a disorder of bolus swallowing, with a frequent feeling of physical disturbance in its flow, regardless of its consistency, and can occur in any of the three phases of bolus flow from the oral cavity to the stomach (oral, pharyngeal and esophageal phase) (Begic & Salihovic, 2018).

Dysphagia is a common occurrence in people with intellectual disabilities (Lindsay, 2011). According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), intellectual disabilities are disorders that occur during the development period, and include intellectual deficits and deficits of adaptive functioning in the conceptual, social and practical areas.

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To diagnose intellectual disabilities, three criteria must be present, namely: Deficits of intellectual functions related to reasoning, problem solving, planning, abstract thinking, judgment, academic and experiential learning, and that they are confirmed by clinical assessment and individualized, standardized intelligence testing; Adaptive functioning deficits refer to difficulties in meeting developmental and socio-cultural standards related to personal independence and social responsibility, and adaptive deficits limit functioning in one or more activities of everyday life such as communication, social participation or independent living in different environments such as home, work, school and community; The occurrence of intellectual and adaptive deficits is in the developmental period (American Psychiatric Association, 2013). The DSM-5 lists four levels/degrees of intellectual disabilities (mild, moderate, severe, and profound). However, levels/degrees are not determined based on IQ as in previous editions, but based on the level/degree of adaptive functioning with the explanation that adaptive functioning is what determines the level/degree of support required (American Psychiatric Association, 2013).

Swallowing and feeding disorders often occur in people with intellectual disabilities and can persist from birth to adulthood (Sheppard & Hochman, 1988; Sheppard, 1991; Rogers & et al., 1994; according to Sheppard, 2006). Dysphagia in people with intellectual disabilities has a high level/degree of complexity and variability, primarily affecting people with more pronounced cognitive impairments. The high prevalence of dysphagia affecting all stages of swallowing, and its progression with increasing age, indicate the need for a high level/degree of clinical caution (Sheppard, 2009).

Causes of dysphagia in a population of people with intellectual disabilities include oral-motor dysfunction, neurological abnormalities, psychiatric and behavioural disorders, gastroesophageal reflux, and musculoskeletal deformities (Walsh & Feigelman, 1989, according to Sheppard, 1991). Some anatomical abnormalities may exacerbate dysphagia, such as the Gothic palate, while other abnormalities may be the primary cause of dysphagia, such as esophageal stenosis (Samuels & Chadwick, 2006, according to Chadwick & Jolliffe, 2009). The National Patient Safety Agency (NPSA) lists dysphagia as one of the five key risks to the safety of patients with intellectual disabilities (NPSA, 2004, according to Leslie, Crawford & Wilkinson, 2008). Dysphagia has health implications that can be life threatening. These include poor nutritional status, dehydration, asphyxia, and aspiration that can lead to respiratory tract infections, which is one of the leading causes of death in the population of people with intellectual disabilities (Day & Jancar, 1994; Helfrich-Miller et al., 1986, Kennedy et al., 1997, Rogers et al., 1994, Wood, 1994, according to Chadwick, Jolliffe, & Goldbart, 2003). Dysphagia occurs more frequently in people with severe and profound cognitive impairment and severe physical

disabilities, although it has been found that people who are mobile and have mild or moderate intellectual disabilities also suffer from dysphagia (Chadwick & Jolliffe, 2009). The results of a study by Bastiaanse, van der Kamp, Evenhuis, & Ehteld (2014), involving people with intellectual disabilities with an average age of 61.6, showed that dysphagia was significantly associated with intellectual disability, age, and body mass index.

The signs and symptoms of dysphagia in this population may not be as obvious as they are in the typical population. Dysphagia is less self-identified, and identified by support staff/caregivers of people with intellectual disabilities (Migliore, Scoopo, & Robey, 1999, according to Dennis, Forgeron, Morgan, & St-Denis (2016).

Sheehan, Gandesha, Hassiotis, Gallagher, Burnell, Jones et al. (2016) cite the results of a study that included 176 hospitalized patients with intellectual disabilities. The results showed that any assessment of the swallowing status was done in only 19.3% of patients. In a study by Bastiaanse et al. (2014), the results showed that swallowing problems were not stated in the medical records of 89.5% of respondents with intellectual disabilities and dysphagia. Often, signs of dysphagia in this population are attributed to intellectual difficulty rather than a fundamental problem with the biomechanics of swallowing (Leslie et al., 2008).

Evaluation and treatment of dysphagia should be appropriate to the aetiology of the disorder and the symptoms shown by the particular patient. This requires an individualized and interdisciplinary team approach (Sheppard, 2009). The treatment of swallowing disorders is a unique challenge for professionals. Speech-language pathologist, as well as other rehabilitation specialists involved in the treatment of dysphagia, must take into account possible anatomical changes and the functional status of the swallowing mechanism in each patient. In addition, factors such as cognitive status, environment, and psychosocial aspects involved during feeding and swallowing must be considered. Therapy of swallowing disorders can begin after completing tests and detailed acquaintance with swallowing disorders in a particular patient (Murry, 2006, according to Begic, Duranovic, & Jovanovic-Simic, 2018).

The main aim of this study was to determine the differences in the severity of dysphagia in relation to the level/degree of intellectual disabilities in persons placed in institutional accommodation.

METHODS

Sample of respondents

A total of 31 respondents with intellectual disabilities and dysphagia participated in the study, of whom 15 were male (48%) and 16 were female (52%). The age of the respondents ranged from 10 to 81.

According to the findings and recommendation of a specialist neuro-psychiatrist, the respondents were placed in the PI "Institution for the Care of Mentally Disabled Persons Drin", Fojnica.

Sample variables

The variables used in this study can be divided into two groups:

1. Anamnestic variables: Level/Degree of intellectual disability: People with mild intellectual disabilities, People with moderate intellectual disabilities, People with severe intellectual disabilities, and People with profound intellectual disabilities.
2. Variables for dysphagia testing: Total result of direct swallowing test for semi-solids; Total result of direct swallowing test for fluid; Total result of direct swallowing test for solids; Total swallowing test result: Successful swallowing of semi-solids, liquids and solids, Successful swallowing of semi-solids and liquids and unsuccessful swallowing of solids, Successful swallowing of semi-solids and unsuccessful swallowing of liquids, Preliminary test of successful or unsuccessful swallowing of substances; Severity of dysphagia: Slight / No dysphagia, minimal risk of aspiration, Mild dysphagia with low risk of aspiration, Moderate dysphagia with risk of aspiration, Severe dysphagia with high risk of aspiration.

Method of conducting research and measuring instruments

The research was conducted in the PI "Institution for the Care of Mentally Disabled Persons Drin", in the city of Fojnica. After obtaining the consent, the manner of conducting the research was agreed in cooperation with a speech-language pathologist employed at the Institute. The sample consisted of 31 respondents with intellectual disabilities. Anamnestic data were taken from the medical documentation of the respondents. The swallowing was performed in the presence of a caregiver or medical technician, individually with each respondent, in accordance with the test propositions.

GUSS - The Gugging Swallowing Screen (Trapl, Enderle, Nowotny, Teuschl, Matz, Dachenhausen, & Brainin, 2007) was used to detect and examine the characteristics of dysphagia in people with intellectual disabilities (translated and adapted into Bosnian). GUSS - The swallowing screening test is divided into two parts. The first part of the test refers to the preliminary test / indirect swallowing test, while the second part refers to the direct swallowing test. The preliminary test / indirect swallowing test assessed the patient's alertness, voluntary cough and / or throat clearing, ability to swallow saliva, as well as possible voice changes. The mentioned areas of the indirect swallowing test are evaluated with the answers "yes" or "no", where each of the given answers carries a certain number of points.

The maximum number of points that could be achieved on the indirect swallowing test was five points. After the indirect swallowing test, a direct swallowing test was performed. The following materials were required to perform the direct swallowing test: water, a flat tablespoon, a food thickener, and bread. The direct swallowing test assessed the ability to swallow three food consistencies, i.e. the ability to swallow semi-solids, liquids and solids. Using a direct swallowing test, for all three food consistencies, the ability to swallow was first assessed, and the ability was assessed by the answers offered, which describe: that swallowing is not possible, that swallowing is delayed, or that swallowing is successful; with each given number of points. Also, for all three food consistencies, the presence or absence of involuntary cough was assessed, before, during, or after swallowing — up to three minutes after swallowing, with each of the given responses carrying a certain number of points. In addition to the above, a direct swallowing test, for all three food consistencies, assessed the presence or absence of drooling, as well as possible changes in voice before and after swallowing. Also, each of the given answers for drooling and voice changes carries a certain number of points. The maximum number of points that could be achieved on the direct swallowing test was 15 points. The total result of the swallowing test, using the indirect and direct swallowing test ranges from 0 to 20 points. An achieved score of 20 points indicates successful swallowing of semi-solid, liquid and solid textures. A score of 15 to 19 points indicates successful swallowing of semi-solid and liquid textures and unsuccessful swallowing of solid textures. A score of 10 to 14 points indicates successful swallowing of semi-solids and unsuccessful swallowing of fluids, and a score of 0 to 9 points indicates severe dysphagia with a high risk of aspiration. Based on the total result of the swallowing test, the severity of dysphagia was obtained, which can be described as: Slight / No dysphagia - minimal risk of aspiration; Mild dysphagia with low risk of aspiration; Moderate dysphagia with risk of aspiration; Severe dysphagia with high risk of aspiration.

Statistical data processing

The data were processed using the statistical program SPSS 21.0 for Windows. Statistical significance was considered for $p < .05$. Basic statistical parameters were calculated: arithmetic mean, standard deviation, minimum and maximum result, and frequencies. A chi-square test was used to test the differences in the severity of dysphagia in relation to the level/degree of intellectual disability of the respondents. Correlation analysis (Spearman's correlation coefficient) was used to determine the relationship between the variables in the severity of dysphagia and the level/degree of intellectual disability.

RESULTS

Table 1 shows the distribution of respondents with dysphagia in relation to the level/degree of intellectual disability. Out of a total of 31 respondents with dysphagia, only one respondent (3%) was diagnosed with a mild level/degree of intellectual disability, seven respondents (23%) with a moderate degree of intellectual disability, and 23 respondents (74%) were diagnosed with a severe, or profound intellectual disability.

Table1. Level/degree of intellectual disability of the respondents

Level/degree of intellectual disability	N	%
Respondents with mild intellectual disabilities	1	3
Respondents with moderate intellectual disabilities	7	23
Respondents with severe, and profound intellectual disabilities	23	74

Table 2 shows the average value of points achieved on the variable “Total result of the indirect swallowing test”, which was M = 5.0 (SD = .0). All respondents (100%) achieved the maximum number of points (5) and successfully passed the indirect swallowing test, which was a prerequisite for conducting a direct swallowing test in the continuation of the study.

Table2. Total result of the indirect swallowing test

	M	\bar{x}	MIN	MAX
Total result of the indirect swallowing test	5.0	.0	5.0	5.0

Table 3 shows the average value of the achieved points on the variable “Total result of the direct swallowing test for semi-solids” which was M = 5.0 (SD = .0). All respondents (100%) achieved the maximum number of points (5) on the direct swallowing test for semi-solids, after which the liquid swallowing test was performed.

Table 3. Total result of the direct swallowing test for semi-solids

	M	\bar{x}	MIN	MAX
Total result of the direct swallowing test for semi-solids	5.0	.0	5.0	5.0

Table 4 shows the average value of the achieved points on the “Total result of the direct swallowing test for liquids” which is M = 4.5 (SD = .9). The lowest score is two points and the highest is five points. Nine respondents (29%) scored less than a maximum of five points on the overall result of the direct swallowing test of liquids. The other 22 respondents (71%) successfully swallow the liquid, after which they were tested for swallowing of solids.

Table 4. Total result of the direct swallowing test for liquids

	M	SD	MIN	MAX
Total result of the direct swallowing test for liquids	4.5	.9	2.0	5.0

Table 5 shows the average value of the achieved points in the “Total result of the direct swallowing test for solids”, M = 1.6 (SD = 1.6). The lowest achieved result is zero points, and the highest achieved result is four points.

Table5. Total result of the direct swallowing test for solids

	M	\bar{x}	MIN	MAX
Total result of the direct swallowing test for solids	1.6	1.6	.0	4.0

Table 6 shows the average value of points achieved on the “Total result of the swallowing test” which is M = 16.1 (SD = 2.2). The lowest achieved result was 12 points, and it was achieved by two respondents (6.5%). The highest achieved result was 19 points, and it was achieved by five respondents, or 16.1%. The range of points that can be achieved on the “Total result of the swallowing test” is from 0 to 20 points.

Table 6. Total result of the swallowing test

	M	\bar{x}	MIN	MAX
Total result of the swallowing test	16.1	2.2	12	19

Considering the achieved total result of the swallowing test, the severity of dysphagia in the respondents was obtained. Table 7 shows the distribution of respondents in relation to the severity of dysphagia. 22 respondents (71%) showed mild dysphagia with low risk of aspiration, and nine respondents (29%) showed moderate dysphagia with risk of aspiration. None of the respondents had severe dysphagia.

Table 7. Severity of dysphagia of respondents

Severity of dysphagia	N	%
Mild dysphagia with low risk of aspiration	22	71
Moderate dysphagia with risk of aspiration	9	29
Severe dysphagia with high risk of aspiration	0	0

Since there was only one respondent with a mild level/degree of intellectual disability in the sample, due to the need for further statistical processing of the results, this respondent was included in the sample of a moderate level/degree of intellectual disability. A chi-square test was used to verify the existence of statistically significant differences in the severity of dysphagia in relation to the level/degree of intellectual disabilities of respondents.

From Table 8 it can be noticed that in the group of people with mild and moderate intellectual disabilities, in 100% of respondents there is mild dysphagia. In contrast, in the group of people with severe, and

profound intellectual disabilities, 61% of respondents have mild dysphagia and 39% of respondents have moderate dysphagia.

Table 8. The severity of dysphagia in relation to the level/degree of intellectual disability

The severity of dysphagia	Level/degree of intellectual disability			
	People with mild to moderate intellectual disabilities		People with severe, and profound intellectual disabilities	
	N	%	N	%
Mild dysphagia with low risk of aspiration	8	100	14	61
Moderate dysphagia with risk of aspiration	0	0	9	39
Severe dysphagia with high risk of aspiration	0	0	0	0

Table 9 shows the result of the chi-square test which showed the existence of a statistically significant difference in the severity of dysphagia in relation to the level/degree of intellectual disability ($\chi^2 = 4.41$, $df = 1$, $p = .04$). According to the obtained results, respondents

with severe, and profound intellectual disabilities have statistically significantly stronger dysphagia compared to respondents with mild, and moderate intellectual disabilities.

Table 9. Statistical significance of dysphagia severity according to the level/degree of intellectual disability

	Value	df	p
Pearson Chi-Square	4.41	1	.04
Continuity Correction ^b	2.72	1	.10
Likelihood Ratio	6.56	1	.01
Fisher's Exact Test			
Linear-by-Linear Association	4.27	1	.04
N of Valid Cases	31		

It was also checked whether there was a statistically significant correlation between the level/degree of intellectual disability and the severity of dysphagia. Based on the results shown in Table 10, it is observed that the level/degree of intellectual disability has a

statistically significant positive correlation with the severity of dysphagia (.38) and it can be concluded that persons with a higher level/degree of intellectual disability have more pronounced dysphagia.

Table 10. Correlations of measured factors

	Level/degree of intellectual disability	The severity of dysphagia
Level/degree of intellectual disability	1.00	.38*
The severity of dysphagia		1.00

* $p < .05$

DISCUSSION

According to the propositions of the GUSS - Screening of the swallowing test, the severity of dysphagia of the respondents was obtained by summing the achieved points on the test. The results showed that 22 respondents (71%) had mild dysphagia and nine respondents (29%) had moderate dysphagia. None of the respondents had severe dysphagia. Respondents with dysphagia (N = 31) were divided into two groups according to the level/degree of intellectual disability.

One group consisted of respondents with mild, and moderate intellectual disabilities (N = 8), and the other group consisted of respondents with severe, and profound intellectual disabilities (N = 23). The analysis of the results showed that in the group of respondents with mild to moderate intellectual disabilities, 100% of the respondents had mild dysphagia. On the other hand, in the group of respondents with severe, and profound intellectual disabilities, 61% of respondents have mild dysphagia (N = 14) and 39% of respondents have moderate dysphagia (N = 9).

The results showed the existence of a statistically significant difference in the severity of dysphagia between these two groups. According to the obtained results, it is concluded that respondents with severe, and profound intellectual disabilities have statistically significantly stronger dysphagia compared to respondents with mild, and moderate intellectual disabilities.

Numerous studies have been conducted to establish the relationship between dysphagia and the level/degree of intellectual disability. For example, people with severe, and profound intellectual disabilities have a number of physical health problems, and research shows that the number of these problems increases with increasing the level/degree of intellectual disability (Kinnear et al., 2018, according to van Timmeren, 2019). Also, due to receiving a larger amount of prescribed medications, people with severe, and profound intellectual disabilities are often exposed to the side effects of such drugs (van Timmeren, 2019). Intellectual, motor, and sensory difficulties reinforce each other so that people with severe, and profound intellectual disabilities have less ability to compensate for the difficulties present (Kiestra, 2005, according to van Timmeren, 2019) and thus swallowing disorders. Decreased attention, reduced ability to compensate for swallowing disorders along with the listed primary, congenital, difficulties and those arising from them, lead to more pronounced dysphagia in persons with severe, and profound intellectual disabilities.

In a study by Matson, Fodstad and Boisjoli (2008), 14 of 23 (60.9%) STEP test items (Norms and patterns of feeding problems for the screening tool of feeding problems) were present in respondents with profound intellectual disabilities versus respondents with mild to severe intellectual disabilities. Some of these items include the following: does not show the ability to chew (13.2% profound, versus 3.4% mild to severe intellectual disability); chokes on food (3.5% profound vs. 2.3% mild to severe intellectual disability); does not show the possibility of swallowing (3.8% profound vs. 1.1% mild to severe intellectual disability); swallowing without effective chewing (5.7% profound vs. 3.4% mild to severe intellectual disability); special positioning for feeding is required (26.1% profound vs. 3.4% mild to severe intellectual disability). Another factor that has had a significant impact on dysphagia in people with intellectual disabilities is the presence of cerebral palsy. Calis, Veugelers, Sheppard, Tibboel, Evenhuis and Penning (2008), on a sample of 166 children with cerebral palsy and intellectual disabilities, received a result showing that only 1% of respondents did not have dysphagia, 8% had mild dysphagia, 76% moderate to severe dysphagia, and 15% profound dysphagia. The same study also showed an association between the severity of dysphagia and the severity of motor difficulties. An association between the level/degree of intellectual disabilities and dysphagia was shown in children with cerebral palsy in the study conducted by Waterman et al. (1992, according to Robertson, Chadwick, Baines, Emerson,

& Hatton, 2017). According to their results, dysphagia was present in 12.5% of children with mild, or moderate intellectual disabilities, in 40% of children with severe intellectual disabilities, and in 44% of children with profound intellectual disabilities.

Thacker, Abdelnoor, Anderson, White and Hollins (2008) examined the incidence of suffocation episodes in people with intellectual disabilities, which may be a direct consequence of dysphagia. The results of the study showed that 42% of respondents with intellectual disabilities had one or more episodes of suffocation. The occurrence of suffocation episodes, according to the results of their research, was significantly more common in people with a higher level/degree of intellectual disabilities, with Down syndrome, with incomplete dentition and in people who use psychotropic drugs more often.

CONCLUSION

In the conducted study, the level/degree of intellectual disability had a significant impact on the severity of dysphagia. The largest percentage of respondents with intellectual disabilities (71%) had mild dysphagia with a low risk of aspiration. Moderate dysphagia with a risk of aspiration was present in 29% of respondents with intellectual disabilities. Severe dysphagia with a high risk of aspiration was not reported in any of the respondents in this study. According to the level/degree of intellectual disability, statistically significantly stronger dysphagia was experienced by persons with severe, and profound intellectual disabilities compared to persons with mild, and moderate intellectual disabilities. In the group of people with mild, and moderate intellectual disabilities, 100% of respondents had mild dysphagia, in contrast to the group of respondents with severe, and profound intellectual disabilities where 39% of respondents had moderate dysphagia and 61% of respondents had mild dysphagia. The severity of dysphagia, and the level/degree of intellectual disabilities have a statistically significant positive correlation and it can be concluded that people with a higher level/degree of intellectual disability have more pronounced dysphagia.

Given all the results obtained in this study, it can be concluded that dysphagia is a significant problem in the population of people with intellectual disabilities, especially in those with severe, and profound intellectual disabilities. It is important to point out the importance of early detection, monitoring and treatment of dysphagia in this population, in order to reduce the possible progression of dysphagia and reduce its complications.

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A PROSPECTIVE EVALUATION OF ORTHOTIC DEVICE IMPLICATION ON THE LOWER LIMB IN CHILDREN WITH CEREBRAL PALSY

Original scientific paper

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ABSTRACT

CP is the foremost cause of motor disability in children and affects two to five children in 1000 live births worldwide. It is been recognized as a global concern medically, socially, and economically due to the increasing financial burden to the states. About half of the children with cerebral palsy suffer a range of motion difficulties. The study aims to understand the role of orthotic devices and its efficacy in the treatment of the patient with cerebral palsy and gait improvement. An online database of Pubmed, Science Direct, Google Scholar, etc. searched to find the articles with the keywords, cerebral palsy, orthotic devices, orthosis, lower limb, and results were synthesized and narrated to explore the effectiveness of the devices on the gait pattern and quality of life of a patient with cerebral palsy. The database search was done without the barrier of dates and regions. Orthoses applied externally appear to be supported and had a diverse effect on gait depending on the type of orthosis. However, the relationship between gait pattern and AFOs and ankle properties is yet to be established. Additional research in this area is needed to complement the development of passive and active AFOs to provide larger improvements in walking capabilities.

Keywords: cerebral palsy, orthotic devices, orthosis, lower limb

INTRODUCTION

Cerebral palsy is a neurological condition following brain injury that occurs before the complete development of cerebral as brain development occurs during the first two years of life. It can occur during prenatal, perinatal, or postnatal periods (Bass, 1999; Krigger, 2006). It is non-progressive motor disorders of movement and posture, which is heterogeneous and permanent (Olama et al., 2013). In conjunction with other treatments like orthopedic and neurosurgery, therapy, baclofen, and botulinum toxin type A, an orthosis is used to prevent or assist joint movement or

restrict contracture (Morris, 2007). CP is the foremost cause of motor disability in children and affects two to five children in 1000 live births worldwide. It is been recognized as a global concern medically, socially, and economically due to the increasing financial burden to the states (Lee et al., 2014). About half of the children with a cerebral palsy suffer a range of motion difficulties and later on, this impairment limits the movement in cerebral palsy patients causing deformed joints and gait pattern deviations (Maas et al., 2012).

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The importance of orthoses is important in pediatrics to implicate it as a conservative treatment method due to the flexible nature of the condition. However, it can be applied in all age groups (Schwarze et al., 2019).

Hypothesis

The hypothesis is children with cerebral palsy using orthosis like AFO, KAFO, FRO, etc for their lower limb may help in minimizing complications like contracture, improves gait pattern, postural stability, and quality of life in contrast to children left untreated. This study was done to understand the role of orthotic devices and its efficacy in the treatment of the patient with cerebral palsy and gait improvement through research literature available online. it also tries to find the future direction of the implementation of the orthotic devices for the same.

METHOD AND MATERIALS

A thorough search of major databases published in English is done without restriction on dates and regions. The major database searched were PubMed, Science Direct, Google scholar. Apart from that other search engine as BioMed Central, Cochrane Library, Wiley online library, Sage journals, PLOS ONE. The search was carried out using keywords cerebral palsy, orthotic devices, lower limb, and Mesh words of the relevant. 1699 articles found using the relevant words containing research articles, review articles, encyclopedia, and book chapters. A total of 97 articles scrutinized for the review based on inclusion criteria and 44 articles meet the study purpose.

The articles included in the study have targeted the outcome of the various lower limb orthosis like AFOs, FROs, etc. on children with cerebral palsy. Articles with various study designs are selected for the study and analysis to find the effectiveness of the result.

Critical Analysis:

In a single randomized controlled study performed on 66 children with cerebral palsy to measure the ankle dorsiflexion at full knee extension, ankle, and knee flexion during gait and gross motor function. Participants were divided into three groups each of 22 participants. where as the first two groups were treated with orthosis to prevent a decrease in ankle ROM for one year and the third group acted as a controlled group given therapies and manual stretching. The results of this study indicated a positive treatment approach for children with cerebral palsy and advocate further studies to emulate the effects on gait patterns (Maas et al., 2012).

Twister Wrap Orthosis (TWO) could be effective in foot pressure distribution and postural balance in children with spastic diplegic cerebral palsy. An effectiveness measure on the Biodex stability system pre and post 12 weeks done. Thirty children of ages ranging from 6 to 8 participated in the study. all were the case of spastic diplegic cerebral palsy and inclusion criteria were similar.

The study group consisted of fifteen children went through conventional therapy program, AFO implication, and Twister Wrap Orthosis (TWO). Whereas the control group was given only therapy and AFO consisting of the same number of children (Eid et al., 2018).

A hinged AFO with 10 degrees of dorsiflexion would have a positive effect on the gait pattern of a cerebral palsy child preferably bearing a barefoot and general hinged AFO by improving cadence, step length, stride length, and gait velocity. GAITRite® was used for the gait analysis in conditions of barefoot, wearing regular hinged AFO and hinged AFO with 10-degree dorsiflexion. The child undergone the study was diagnosed with spastic diplegia but ambulated independently with the use of hinged AFO (Son et al., 2019). The hinged AFOs shortened the duration of Sitting to Standing (STS) by increasing initial knee flexion and the final angle of dorsiflexion contrast to barefoot (Park et al., 2004a).

In support of that hinged AFOs may help in improving the postural control mechanism. Nevertheless, postural stability in side-by-side needs further studies to establish the result (Rha et al., 2010). and AFOs and hinged AFOs can be helpful in ambulation for children with cerebral palsy having dynamic equinus deformities and reducing energy expenditure (Balaban et al., 2007; Chen et al., 2017; Dursun et al., 2002). Also, a cross-sectional study on 2200 children with CP (Cerebral Palsy) confirms that over 73 percent of children with CP (Cerebral Palsy) achieved their functional goals, and maintenance or improvement in ankle-dorsiflexion using AFOs (Wingstrand et al., 2014). However, randomized cross-over Wilcoxon signed-rank test study results on 11 children with CP suggests larger studies. The results of this study were not consistently enhanced the walking activity (Bjornson et al., 2016).

Walking with tuned AFO-FC in contrast to barefoot and non-tuned results in efficient gait parameters in several key points (Abd El-Kafy, 2014; Eddison et al., 2020). A quasi-experimental design study results on 30 spastic diplegic CP concluded that hinged AFOs gives better result in improving gross motor function than solid AFOs on standing and walking (Dalvand et al., 2013). and FRAFOS (Floor Reaction Ankle Foot Orthosis) may upgrade the knee alignment, but postural control may not improve (Bahramizadeh et al., 2012).

A case study utilizing quantitative biomechanical techniques favors the more natural ankle motion and better lower limb symmetry, and reduced knee moments during stance while using a hinged AFO contrast to solid AFO. WATSMART video system and Kistler plate were used to collect kinematic coordinate data and ground reaction force data respectively (Middleton et al., 1988). Night orthosis is also assumed to be vital in providing postural control in children with CP (Mol et al., 2012).

The pre-post experimental study design included 32 children with (Spastic Cerebral Palsy) SCP to evaluate

the effects of optimized FROs for ankle stiffness. a homogenous group of patients walking with excessive knee flexion in midstance were studied on the walking energy cost in children with (Spastic Cerebral Palsy) SCP, in contrast to walking with shoes alone. The FROs resulted in the reduction of knee flexion during single stance phase and will help to identify predictors of treatment success (Kerkum et al., 2013a). The best outcome of knee extension and sagittal plane knee extensor momentum can be achieved in midstance using Floor reaction ankle-foot orthosis (Rogozinski et al., 2009a).

Three-dimensional kinematic data were collected through ANOVAs to measure dependent measures of 21 children with spastic diplegia walked with the bilateral orthosis. Eleven patients used solid orthosis and ten used articulated orthosis. However, the results show an increase in stride length, energy recovery, and potential energy and kinetic energy for both groups. and AFOS can reduce work to walk (Bennett et al., 2012a). Nevertheless, step length shown improvements along with speed and ankle function for the average AFO users. this data extracted from 378 individuals with 601 visits using statistical analysis consisted of paired *t*-tests and multivariate analysis of variance scores (Ries et al., 2015). Foot orthosis acts as a medical device and minimizes the pathologies loading on the structural components of the foot to allow more natural motion and balance and postural controls (Olama et al., 2013).

To measure gait quality analysis Edinburgh Visual Gait Score (EVGS) is used as an authenticated observational gait analysis scale. In ambulatory children with cerebral palsy Edinburgh Visual Gait Score (EVGS) used for gait analysis evaluation. A cross-sectional cohort study was conducted using EVGS to determine the effects of AFOs and sensomotoric orthoses (SMotOs) in children with Cerebral palsy gait patterns. All the included participants (eleven) were using SMotOs and AFOs. The results showed improved gait with SMotOs and it can be an appropriate option in clinical settings for this population. However, further study is needed (MacFarlane et al., 2020).

A study performed with ventral shell spring-hinged AFO (vAFO) to know the implication effect of varying AFO stiffness on individual gait biomechanics and efficiency in cerebral palsy. a 3D-gait analysis and a 6-minute walk test on Fifteen children who walk with couch gait/excessive knee flexion in the stance phase investigated. all vAFOs improved the knee angle, net moment, and decreased the net energy cost contrast to shoes-only (Kerkum et al., 2015). Also, the data proves that optimized vAFOs reduce knee flexion in stance and enhance gait in CP children (Kerkum et al., 2016).

RESULTS AND DISCUSSION

Orthoses applied externally appear to be supported and had a diverse effect on gait depending on the type of orthosis (Lampe et al., 2004). However, the older

age of users got less effective development of skill and only young children benefited more (Bjornson et al., 2006a).

About 90 % of children with Cerebral Palsy had imbalance problems during walking and 54% were unable to walk without assistance. So, ambulation disorder is an essential limiting factor in children with Spastic diplegic Cerebral Palsy (Kadhim & Miller, 2014). The first study to find the effect and efficacy of individually optimized FRO on a homogenous group, together with effects evaluation on multiple ICF levels may result in optimal FRO treatment in the defined patient group (Kerkum et al., 2013b).

It is recommended that AFOs can help in improving the characteristics of gait in an individual patient and this finding is not new. However, the relationship between gait pattern and AFOs and ankle properties is yet to be established and focus needs to be paid to the individual gait characteristics and the features of AFO would be beneficial (Bennett et al., 2012b).

Gait analysis using tuned AFO-FC produced improvement in hip flexion and extension, posterior pelvic tilt, and knee extension (Eddison et al., 2020). However, there was no pelvic change in pelvic tilt and hip flexion observed using the hinged AFOs (Park et al., 2004b). and such instrumented protocol may use as a quantitative tool to support and reveal an appropriate line of orthotic treatment (Contini et al., 2019). So, the dysfunction or foot deformities either maintained or improve using long-term different kinds of AFOs (Liu et al., 2018).

In inhibiting spastic activation, hinged ankle-foot Orthosis /Orthotic management may be an effective management technique in cerebral palsy patients (Lindskov et al., 2020). However, The ideal knee and hip flexion contracture of less than or equal to 10 to 15 degrees were found to the limit of efficacy using Floor reaction Ankle-Foot Orthosis (Rogozinski et al., 2009b).

Floor Reaction Ankle Foot Orthosis (FRAFO) was also effective to improve knee and ankle extension in stance (Lucareli et al., 2007). The FES (Functional Electrical Stimulation) application to Children with Cerebral Palsy produced evidence of muscle plasticity in the tibialis anterior (TA) anatomical cross-sectional area and muscle thickness increased. However, permanent improvement in voluntary ankle control was not evidenced (Damiano et al., 2013).

CONCLUSION

Different kinds of AFOs improved gait patterns in children with cerebral palsy in contrast to barefoot walking resulted in efficient progression of the foot in stance and restricts premature movement (Abel et al., 1998). All the studies performed could fail to deliver knowledge about the effect of materials and orthosis design. Hence, that needed to be conduct research in such a direction. There still a need for more research on kinematic effects of using various kinds of AFOs and devices (Eddison et al., 2020).

Further research needs to understand the long-term effect of orthoses on gait patterns and gross motor skill development (Bjornson et al., 2006b). Detailed information on the design features of AFOs according to the severity and limb impairment may be the future aspect in children with cerebral palsy (Chisholm and Perry, 2012). Additional research in this area is needed to complement the development of passive and active AFOs to provide larger improvements in walking capabilities.

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FEAR IN MATHEMATICS TEACHING AMONG PRIMARY SCHOOL STUDENTS

Original scientific paper

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ABSTRACT

The aim of this work is to research does exist a fear of mathematics, what are the causes of fear of mathematics, in what forms fear is manifested and what parents do to repress a fear of mathematics at students in higher grades of elementary school. For the purposes of the research, two separate scales were created which measured the fear of mathematics at students from the perspective of parents and students. The research was conducted in the elementary schools in Central Bosnia with students of fifth, sixth, seventh, eighth and ninth grades. We leave the survey questionnaire at the end, in attachment, so that it can be viewed. Analysis or data processing we worked and we got results which we've presented in this work. There shouldn't be fear in the teaching process. Students shouldn't come to school under pressure or in fear; but should find ways to motivate themselves to work because of their personal progress and training for life. Parents and teachers help them with that. Achievements in mathematics are researched more than achievements in other subjects because mathematics is important for researching and comparing different educational systems. Because of this importance, we need to find ways to repress the students' fear of math. Students, except motivation for working, should give encouragement and support. Communication with the child, and communication in the parent-school-student relationship is very important in repressing the child's fear.

Keywords: fear, mathematics (math), student, elementary school

INTRODUCTION

Mathematics is not just a school subject, it is our daily habit that we face every day, so it is very important how students will accept mathematics as a school subject. Today, mathematics is taught to students in primary and secondary schools, as well as at numerous faculties. We will base our research on mathematics as a school subject in primary school. When they remember mathematics from primary school, some students remember with discomfort, and individuals blush, their palms sweat, their hearts beat faster. They wonder why all these feelings, because they do not need a lot

of teaching materials that they learned during primary school in the continuation of life. Other students have different thoughts and think that mathematics is an understandable and useful science. Students in the school are not even aware that mathematics has always been and will be one of the most important subjects. Why? Because success in this society largely depends on the ability to professionally use mathematical actions and skills. Applying math is everyday from winding up a lesson that reminds us of going to school, to work to compiling a family budget based on monthly income.

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When we talk about mathematics in our country, it is generally accepted that mathematics is difficult for students and that it creates fear in them and they have great stress from mathematics as a school subject. This fear, called mathematical anxiety, was previously described and examined, along with the remaining factors, in this paper. Parents and teachers have an important role in mastering the teaching content. From the first meeting with the school, they should work closely together to solve problems at the outset, if any. And what if there is a fear of school? What if there is a fear of math? What are we to do? How to suppress it? What are the causes of all of the above? In this paper, I will answer the questions of whether there is a fear of mathematics, what are the causes of fear of mathematics, in what forms fear is manifested and what parents do to suppress the fear of mathematics in students.

The importance of mathematical education and the historical development of mathematical ideas

Mathematics occupies a special place in the system of science “in that it does not deal with any specific matter but with relations in themselves, abstracted from the material basis - to return to this in the phase of application” (Printer, Petrovic, Sotirovic, & Lipovac, 1996, p. 9). The application of mathematics in other sciences gives these sciences certainty. The subject of study in mathematics are those characteristics of relations between phenomena in the material world that do not depend on the specific nature of phenomena and conclusions that can be drawn logically in such a view of relations. Mathematics arose during concrete problems in the real world through mathematical modeling. Numerous documents tell us that the skill of computation has been studied since ancient times. An example is clay tablets found in the temple of God Baal in Ni Ppur on which are imprinted signs representing symbols of numbers and arithmetic operations. Numerous instructions on how to perform arithmetic operations have been found on Egyptian monuments and papyri. The Egyptians and Romans had aids to calculate, the so-called. ABAK (plate with vertical grooves in which there were movable stones). It was calculated orally, not in writing as it is today. Instrumental calculus was also nurtured in the Middle Ages. In the history of mathematics and the history of human culture, a great advance has been made by introducing systems into positional computation. Computer rules are memorized without understanding. The credit for the introduction of positional calculus belongs to Adam Ries (1492-1559). In the 17th century, mathematics was introduced in primary schools as a compulsory subject. The basis of the methodology of teaching arithmetic was mechanical learning of rules and mnemonic - technical procedures. In the first half of the 18th century, the rule according to the rules prevailed, and the main representative was Kristijan Pesek (Christian Pescheck). In the second half of the 18th century, the formal goal of teaching mathematics was emphasized (logical

calculation was approached, and the aim was to strengthen and develop mental functions). Methodists Busse and Rochow, as well as Heinrich Pestalozzi, made great contributions in this field. According to Pestalozzi's thinking, numbers are the best means of developing psychic powers, and Zor is the absolute foundation of all cognition. He introduces the teaching of arithmetic. Radical changes in the teaching of mathematics in secondary and primary school were hinted at by the Meran conferences held in 1905 in Merano. The teaching of mathematics tried to get closer to the life and interests of the students. J. Kinel (Kuhnel), Weber (Weber), psychologists Wittman and J. Piaget made a great contribution to the improvement of mathematics teaching. At the beginning of the 20th century, laboratory teaching, ie polytechnic teaching, was represented, where the teaching of mathematics was practically emphasized. In the second half of the twentieth century, the opposite direction to practicality emerged, “modern mathematics”, which put formalism, abstractness and logic in the forefront.

Fear

Emotions play a central role in an individual's life. They are primary experiences that occur before all others in the development of a living being and, although we know what is meant by the term emotion (experiences caused by an external or internal situation, characterized by the fact that they are mostly pleasant or unpleasant, and sometimes ambivalent) a term in psychology so undefined (Petz, 1992). In the broadest sense, emotions can be defined as an excited state of the organism that manifests itself in several ways: by physiological arousal or activation; cognitive interpretation or assessment; external signs or expression; by behavior or reaction. According to the degree of complexity, we divide them into:

The primary emotions that we find in all cultures and in all people, and are manifested in the characteristic facial expression that is universally recognizable. Such emotions are: joy, sorrow, anger and fear. *Secondary emotions* are assemblies of different emotions or cultural variations of emotional experiences. While primary emotions appear very early in individual development, complex emotions such as jealousy require a certain level of development of cognitive processes and the ability to perceive interpersonal relationships, so they occur somewhat later in the development of children. While joy and anger are in a sense “emotions of approach,” fear is the opposite of “emotions of avoidance”. It is characterized by escape from danger. An essential characteristic of a situation in which fear occurs is the perception of a dangerous object or threat, and the crucial here is the perception of a lack of power or ability for an individual to fight danger. An important component of many situations in which fear occurs is a time perspective facing the future.

Namely, the individual predicts what will happen in the future, and keeping thoughts on these events creates states of strong anticipatory fear. It is this anticipation of impending danger that is usually perceived as anxiety - a complex and uncomfortable feeling of anxiety, fear, tension and insecurity, accompanied by activation of the autonomic nervous system. We distinguish it from fear in that fear is a "more concrete" emotion (Arambashi, 1988), ie the person who is afraid usually knows what he is afraid of. The term itself was introduced into psychology by Freud in 1894, describing anxiety neurosis, and in modern psychology the term is used to describe emotional reactions caused by unknown and / or unrecognizable causes, but also for emotional states aroused by real or predictable danger. Like other emotional reactions, anxiety has a motivating effect. Thus, moderate levels of anxiety often have a positive effect on performance in many activities, while extremes such as complete absence or very intense anxiety can visibly reduce an individual's performance in some activities. (Agic & Resic, 2011) Fear is a feeling that a person has when he assesses that he is endangered or some of its value, without being able to adequately oppose the object or situation that threatens him. Fears are an integral part of childhood. It is estimated that over 90% of children aged 2 to 14 have at least one specific fear, and most have multiple fears. Intense and long-lasting fears in childhood have been shown to be the strongest vulnerability factor for the development of anxiety disorders in adolescence. Fear and anxiety occur on a continuum from normal, common, in intensity and duration, all the way to various anxiety disorders. Thus the fear of unclean objects can turn into an obsessive-compulsive disorder. When we talk about childhood fears, different authors cite different classifications of children's fears. Children's fears are defined as reactions to a perceived threat that include avoiding the object or situation that is causing the threat, subjective feelings of discomfort, and physiological activation. If the perceived danger, that is, the threat, is real, we speak of fear, and if the danger is objectively non-existent and if the experience of danger is anticipatory, we speak of anxiety. Therefore, anxiety is the fear of situations that have not yet occurred. It is about the fear that something bad will happen.

Authors Berce and Lepuvscek (2011) divide children's fears into four categories:

1. social fears (fear of strangers, fear of meeting new people, etc.),
2. specific fears or phobias (fear of darkness, water, animals, etc.),
3. agoraphobic fears (fear of exposure to situations such as elevators, bridges, crowds, loneliness, etc.) and
4. multiple fears, which represent a combination of several previously mentioned fears

Fear of school also occurs in children whose parents have very high expectations and in the best of intentions tell the children: "You will certainly be very good, you will have all fives, everyone will admire you." The child's desire to meet the expectations of his parents leads the child to fear of failure, and that he will disappoint his parents if he is not successful in school, which causes various difficulties in which parents do not recognize the fear of school. Fear of school also occurs in children growing up in families in which parents are overprotective (often because of their separation fears). Fear of school often occurs in children growing up in a family where family dynamics are disrupted (eg parental divorce, intense conflict, parental illness) so that the child rejects school because he or she needs to "control the new, unfavorable family situation and thus prevent disintegration. families." Very often the fear of school is a consequence of the child's exposure to physical and verbal peer violence, on the way to school or at school, but also, for example, isolation from other students in the class, difficulties in establishing social contacts. "Using factor analysis, fears can be grouped into the following categories:

1. fear of failure and criticism,
2. fear of the unknown,
3. fear of injury and small animals,
4. fear of danger and death,
5. fear of medical procedures" (Koludrovic &

Radnic, 2013, p. 65).

Phobias

The term phobia derives from the Greek word phobos meaning fear, escape. Phobia is a strong, irrational, lasting fear of certain situations, objects, activities, people; exaggerated perception of impending danger associated with a specific situation or specific object. Milivojevic (2007) states that the basic symptoms of phobia are considered to be a strong, constant, uncontrollable conscious desire to avoid a certain unpleasant situation and a whole range of physical manifestations such as redness, trembling, dry mouth, sweating palms, increased desire to urinate, urinate, palpitations (feeling of rapid or irregular heartbeat) and panic attacks. It is important to understand and draw the line between phobia and fear. Fear is a normal and expected reaction to a threat from the environment. It is essential for survival because it warns us that circumstances can be physically or mentally dangerous. Phobia differs from fear in its intensity, which is much higher than expected, and differs in maladaptation and duration. Phobias are beyond the control of our will. Psychopathologists believe that a phobia is actually an avoidance that interrupts the normal course of life, and is disproportionate to the actual danger of an object or situation. Most often, the phobic person himself notices that this fear is unfounded.

Born (2008) states that the symptoms of a phobic disorder include the following:

1. The victim suddenly feels irrational and lasting fear, panic, horror when he finds himself in a certain situation that is not otherwise threatening.

2. A phobic person is otherwise aware that his fear exceeds the limits of the normal and that there is no real danger.

3. The phobic reaction is automatic, pervasive. A person cannot control it, and practically everyone is obsessed with the imagination of threat and danger.

4. A phobic person shows all the bodily reactions present in great fear: rapid heartbeat, feeling short of breath, shallow breathing, trembling, and a strong desire to escape from a phobic situation.

5. A phobic person avoids objects and situations that he is afraid of and deviates from the normal or usual path in order to avoid them.

Phobias can be divided into: phobias from social activities and situations (social phobia) and specific, ie isolated phobias (fear of one particular type of object or situation). Specific phobias represent intense fear and avoidance of one particular type of object or situation. Fear and avoidance are strong enough to disrupt daily routine, work, or relationships and cause significant mental suffering. Although phobia involves avoiding a particular object or situation, there is often an interrelationship between phobia of social activities and phobia of certain situations or objects. This is exactly the case we have with children who have a school phobia and a phobia of mathematics.

Metaphobia

School phobia is a child's resistance to going to school due to intense fear. The child apparently wants to go to school, but manifests a series of physical manifestations that mislead parents and the environment, so parents look for the cause in a physical problem instead of a psychological one. This is a fear that usually occurs at the age when the demands and expectations of children increase (in primary school in the first, second and sixth grade, and in secondary school at the beginning of the first grade), but this does not have to be the rule because fear can arise later as a result some unpleasant experiences. Metaphobia manifests itself as a fear of mathematics. A person who has a fear of math avoids contact with math in situations that have to do with math. The range of symptoms ranges from a feeling of mild discomfort when encountering quantitative information to complete avoidance of anything resembling mathematics. The causes of mathematical phobia lie in the child's first encounters with mathematics and the first difficulties that arise. There can be several patterns of such difficulties: cognitive immaturity, insufficient readiness, too high expectations, poor teaching methods, etc. Metaphobia manifests itself in two forms, specific and general metaphobia.

A student with a specific metaphobia does not offer resistance to mathematics in general, but only in certain areas of mathematics. This form of fear arises due to certain, specific situations related to mathematics. For some reason, a specific mathematical area creates a mental block in the process of adopting new mathematical concepts or in repeating learned material. Sharma (2001) states, students who are afraid of anything to do with mathematics have a general metaphobia. These students are usually equally unsuccessful in all subjects, but as precise answers are sought in math classes, which students do not encounter in other subjects, this makes the fear more intense. People with this form of fear have difficulties in all areas of mathematics, so their reaction is general.

RESEARCH METHODOLOGY

Research problem

The topic is interesting to research given that math is a ghost subject all over the world. It records the lowest success compared to other subjects. Mathematics is interdisciplinary, it occurs in other disciplines. As a subject, it occupies a very important place in all programs. The significance of this research work is that we will reach new results that will enable us to improve the educational work in the teaching of mathematics.

Subject of research

We can look for the fear of mathematics in the first inconveniences and failures that children experience when they encounter mathematics. And there should be no fear in teaching. The subject of the research is the extent to which fear occurs in students, and what are the ways to suppress the fear of mathematics.

Research goal

The aim of the research is to investigate whether there is a fear of mathematics, what are the causes of fear of mathematics, in what forms fear is manifested and what parents and teachers do to suppress the fear of mathematics in subject students.

Research tasks

Based on a certain goal of the research, the research tasks were left, as follows:

1. Examine whether there is a fear of mathematics in upper elementary school students.
2. Examine the causes of fear of mathematics in upper elementary school students.
3. Examine the forms in which the fear of mathematics is manifested in students in the upper grades of primary school.
4. Examine whether there is a difference in fear of mathematics in boys and girls in the upper grades of primary school.

5. Examine what parents do to suppress the fear of mathematics in students in upper elementary school students.

General hypotheses

Main hypothesis: There is a fear of mathematics among upper elementary school students.

Subhypothesis 1: There is no statistically significant difference with respect to the demographic characteristics of the parents.

Subhypothesis 2: There is no statistically significant difference in the perception of fear of mathematics in students with respect to the demographic characteristics in the child.

Subhypothesis 3: There is no statistically significant difference between boys and girls in the amount of fear of mathematics.

Subhypothesis 4: There is no statistically significant difference with respect to class in the amount of fear of mathematics.

Research variables

In order to obtain the most accurate data in the research, dependent and independent variables were determined. Dependent variables are the characteristics of the phenomena that interest us most in research, so we bring this variable in connection with other variables that describe or explain it. And variables that describe or explain a dependent variable are called independent variables. The dependent variable is always in the research problem (Vujevic, 2006).

Research methods

The descriptive method, the method of theoretical analysis, the comparative method and the Survey method were used in the research. **Descriptivemethod**-is a source of essential knowledge about the nature of the studied subjects, the possibility of developing a particular situation from one interval to another, so that the researcher can plan and predict future actions and interventions (Halmi, 2003). In this research paper, the descriptive method was used in describing and interpreting the research results. **The method of theoretical analysis**-involves the use of pedagogical-psychological literature, manuals, textbooks, professional and scientific papers, encyclopedias and allows to study new sources and scientific conclusions after studying sources, collected facts and analyzed connections and relationships, studied objects and phenomena (Muzic, 1986). This method was used in the study of the literature that was needed for the theoretical settings of this research. **Comparative method** - involves comparing the same or similar facts, phenomena, processes and relationships, and determines their similarities in behavior and intensity, as well as differences between them (Muzic, 1986).

This method was used to compare the obtained results of the student survey and the parent survey in order to draw conclusions in accordance with the set goal and objectives of the research. **Survey method** — allows the application of various measurement instruments and a variety of data processing procedures (Halmi, 2003). The Likert scale was used in this study. It is a kind of scale of attitudes that consists of a series of statements dedicated to different aspects of an attitude.

Research techniques

Survey were used as a research technique. Students and parents were interviewed. Interviewing is a procedure by which respondents respond in writing to questions related to facts that are known to them or to questions related to their personal opinion (Muzic, 1999). The importance of this procedure lies in the fact that often only a poll can provide the required data, and that it is much more economical than interviewing.

Research instruments

For the purposes of the research, two separate scales were created which measured the fear of mathematics in students from the perspective of parents and students. Scales for parents and students were originally created with 30 questions each. However, after a preliminary analysis of the scales, certain issues are excluded because their parameters are not satisfactory and thus impair the reliability of the entire scale. The scale for parents in final form has 27 questions, and satisfactory reliability from Crombach $\alpha = .74$. The scale for students consists of 19 questions, and the reliability of the scale is Crombach $\alpha = .73$.

Table 1. Crombach reliability coefficient of the scale

	Reliability (α)	Number of particles
Scale for parents	.74	27
Scale for students	.73	19

Both scales are Likert-type scales with 5 degrees and the results on both scales were obtained as the arithmetic mean of the answers to all questions that fall within the scale with the aim of easier interpretation of the results in relation to other groups. A higher score represents a higher perceived level of fear in students. It is important to emphasize that the results of these two scales are not mutually comparable. The questionnaire for students contains two open-ended questions in which it was necessary to describe situations in which one feels fear of mathematics and how that fear manifested itself. The parent/guardian questionnaire contained three open-ended questions to describe situations in which fear of mathematics was felt, how the fear manifested itself, and how parents suppressed their child's fear of mathematics.

Sample research

The research sample consists of fifth, sixth, seventh, eighth and ninth grade elementary school students in Central Bosnia and their parents.

Students

The sample of students is the largest sample in the study with a total of N = 104 respondents, of which 44.30% (n = 46) are boys and 55.70% (n = 58) are girls. The distribution by classes is relatively even. The largest number of students attends the sixth grade (22.11%), followed by the fifth grade (20.19%), followed by the seventh, eighth and ninth grade with the same number of students (19.23%).

Table 2. Gender of students

Gender	f	%
Boys	46	44.30
Girls	58	55.70
Total	104	100.00

Table 3. The class that students attend

Class	f	%
V	21	20.19
VI	23	22.11
VII	20	19.23
VIII	20	19.23
IX	20	19.23
Total	104	100.00

Parents

The sample of parents included N = 68 respondents whose children attend subject classes in mathematics. Of these, 29.41% (n = 20) were fathers, and 67.64% (n = 46) were mothers who participated in the study.

The study also included n = 2 tutors. Most parents have completed higher education (63.23%), and 35.29% of parents have a high school diploma. About two-thirds of parents are aged 36-45 (61.76%). 27.94% of parents belong to the age group of 46-56 years, while 10.29% of them belong to the group of 25-35 years. 89.71% of parents state that they are employed, while 10.2% are unemployed.

The distribution of classes attended by the children of the parents included in the research is even.

Table 4. Parents/Tutors completing the questionnaire

Parents	f	%
Father	20	29.41
Mother	46	67.64
Tutor	2	2.94
Total	68	100.00

Survey procedure and experiences

The survey was conducted in November and December 2020. One class of V, VI, VII, VIII and IX grades was interviewed.

The application of the questionnaire was group, at once in the whole class in the classes of the class community. Each student received a survey questionnaire for themselves and for one parent. Students are asked to read the instructions carefully, and to be as honest as possible in their answers since the research is anonymous. The annexation lasted 20-25 minutes. During the survey, students were interested and motivated. They wondered if their math teachers would be able to see what they were writing. It was explained to them that the school pedagogue will receive the results of the research due to the improvement of teaching. When it comes to survey questionnaires for parents, about 34% of students did not return the survey questionnaire for parents. These 34% also include parents with more than two children included in the research sample.

RESEARCH RESULTS

Table 5. Descriptive indicators - survey questionnaire – STUDENTS

	Mean	Std. Error	Std. Deviation
I am happy to have 4 math classes a week	2.85	.13	1.33
When I enter the math classroom I feel fear	2.22	.12	1.23
Learning math is boring	2.99	.14	1.45
Some kids just aren't born for math and can never learn it.	3.18	.15	1.51
When I have to answer math I feel fear	3.29	.15	1.50
I'm not afraid to ask if something isn't clear to me.	3.51	.14	1.44
The teacher reviews the homework and points out mistakes, if any	2.84	.15	1.53
When I write important homework I feel fear	1.82	.12	1.20
The math is hard	3.13	.13	1.36
I don't understand basic mathematical phenomena	2.47	.13	1.31
A lot of the things I learn in math, I don't need out of school	3.16	.14	1.42
The math teacher explains in detail if something is not clear	3.63	.13	1.37
Homework makes it easier for me to learn math	3.36	.14	1.42
The math is interesting	2.89	.13	1.37
When I have written checks I feel fear	3.19	.15	1.57

Continuation of the Table 5. Descriptive indicators - survey questionnaire – STUDENTS

	Mean	Std. Error	Std. Deviation
I prefer oral answering to written task solving	3.00	.14	1.44
I am happy when we practice arithmetic / problem solving with arithmetic operations	2.99	.13	1.36
I am happy when we practice text assignments	2.31	.14	1.40
I am happy when we practice geometry	3.05	.16	1.62
I am happy when we practice algebra	2.77	.14	1.46
In math class, I feel lost	2.39	.14	1.39
I spend at least 5 hours a week practicing math	2.29	.13	1.28
When I talk to my friends about math I feel fear	1.82	.12	1.19
Parents / Tutors expect me to know a lot more	3.16	.15	1.51
When I hear the word math, I don't feel comfortable	2.35	.14	1.47
Out of fear, I experience a blockade when it rings for the start of class	2.26	.14	1.46
When I answer, my palms sweat, my mouth is dry, my heart beats fast.	3.12	.15	1.57
When I have an announced test, I don't come to school	1.46	.09	.89
When a teacher mentions math in BHS language, history and geography classes, I feel uneasy.	2.14	.14	1.39
My parents find math very difficult	2.26	.13	1.29

By looking at Table 5, which shows the descriptive indicators obtained by the research, we can state the following important facts. Namely, the question “Teacher of Mathematics explains in detail if something is not clear” is the largest arithmetic mean of 3.63, while the largest deviation from the arithmetic mean, ie the standard deviation is recorded on the question

“I am happy when I practice geometry” and it is 1.62. Furthermore, by looking at the above table, it can be concluded that the least arithmetic mean was recorded on the question that reads “When I have the announced test, I do not come to school” and the same is 1.46. Also, which is very interesting on the same issue, the smallest deviation from the arithmetic mean is recorded - .89.

Table 6. Descriptive indicators - survey questionnaire – PARENTS

	Mean	Std. Error	Std. Deviation
My child loves math	3.49	.14	1.13
My child solves math homework with ease	3.53	.13	1.09
My child feels fear when it comes to math	2.85	.16	1.32
My child feels fear when he asks what is not clear to him	2.24	.15	1.25
My child does not feel comfortable when math is mentioned	2.04	.13	1.03
My child has difficulty learning other subjects where math is mentioned	1.85	.12	1.00
My child feels fear when he has written checks	2.91	.16	1.29
My child prefers oral answers to written assignments	3.01	.16	1.29
My child feels fear of math not of teachers	2.16	.13	1.09
My child spends 5 hours a week practicing math	2.40	.14	1.14
My child talks about math with a smile	2.85	.13	1.06
As a parent / tutor, I find math very difficult	2.53	.15	1.24
As a parent, I think that a lot is required of children in teaching mathematics	2.69	.16	1.28
I practice math with my child every day	2.51	.13	1.09
My child feels afraid to ask me for help in learning math	1.62	.11	.92
The math teacher is pleasant, professional, cheerful and understandable	3.84	.13	1.08
A math teacher does his job well	3.76	.13	1.07
I talk to my child about math	3.47	.11	.91
I expect my child to know more about math	3.57	.12	.98
I expect my child to have a better grade in math	3.12	.16	1.30
Fear of math arises because children do not learn regularly	3.69	.14	1.12
I think math needs talent	2.49	.13	1.06
Math takes a lot of time to learn	2.60	.12	.98
As a child, I also felt a fear of math	2.34	.15	1.22
Conversation can prevent fear of math	3.71	.12	.95
Exercising tasks can prevent fear of math	4.04	.12	.97
More additional classes free children from the fear of mathematics	3.68	.13	1.03
Talking to a math teacher has a positive effect on the child	3.97	.12	.98
More homework suppresses the fear of math	3.15	.14	1.14
Correlation / Relationship of mathematics with other subjects has a positive effect on the child	3.49	.14	1.14

Table 6 shows us very important descriptive indicators, which, among other things, reflect the opinion and attitudes of parents about their children’s fear of mathematics. If we look at the arithmetic mean, we see that the largest question is “Talking to a teacher about mathematics has a positive effect on the child” and it is 3.97, while the largest deviation from it was recorded on the question “My child feels fear when it comes to answering math”, and the same 1.32 th most common. Insight into the mentioned Table also shows that the smallest arithmetic mean was recorded on the question that reads “My child feels afraid to ask me for help in learning mathematics” and it is 1.62, while the smallest standard deviation was recorded on the question “With his I talk to my child about mathematics” whose value is .91. Based on the descriptive indicators presented, it can be slowly seen that fear in children exists and is

expressed, which will be expressed below through sub-hypotheses and tests that imply the same.

Subhypothesis 1: There is no statistically significant difference with respect to the demographic characteristics of the parent sample. From the table 7, which shows the results of the t test for all variables with two levels, we see that there is no statistically significant difference in the perception of fear of mathematics regardless of parental sex, child sex or parental employment, and thus our subhypothesis as such and confirmed. That is, both fathers and mothers have equal results when it comes to the perceived fear of mathematics in their children, and the same is true for male and female children, and the same result is obtained for employed and unemployed parents.

Table 7. t-test for differences in students’ perception of fear of mathematics with respect to the demographic characteristics of the parent sample

Variable	Group	N	M	SD	t-test	df	p
Parent	Father	20	2.84	1.108	-.67	64	-.79
	Mother	46	3.04	1.09			
The sex of the child	Male	24	2.94	1.05	-.25	66	-1.23
	Female	44	3.01	1.12			
Working status	Employed	61	2.96	1.116	-.56	66	-1.14
	Unemployed	7	3.22	.933			

Table 8 presents the remaining analyzes on variables containing more than two independent groups. The ANOVA test showed that there are no statistically significant differences in the perception of fear of mathematics in parents with respect to demographic differences.

Subhypothesis 2: There are no statistically significant differences in the perception of fear of mathematics in students with regard to the demographic characteristics of the child sample.

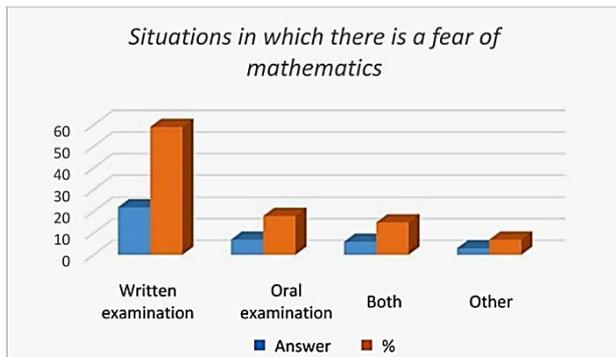
Table 8. ANOVA test for differences in the perception of fear of mathematics in students with regardon the demographic characteristics of the child sample

Variable	Group	N	M	SD	F	df	p
Education	Elem.	1	2.16		1.18	2,66	.52
	High	24	3.07	1.05			
	Higher	43	2.98	1.08			
Age	25-35	7	3.16	1.136	1.11	2,65	.46
	36-45	42	3.02	1.09			
	46-56	19	2.82	1.09			
Class	V	15	2.89	1.144	1.59	4,63	.50
	VI	20	3.16	1.01			
	VII	14	2.76	1.134			
	VIII	16	3.05	1.04			
	IX	3	3.05	.77			

In the following, the situations in which the fear of mathematics occurs, the ways in which this fear is manifested in students and the ways in which parents suppress their fear of mathematics are analyzed. About

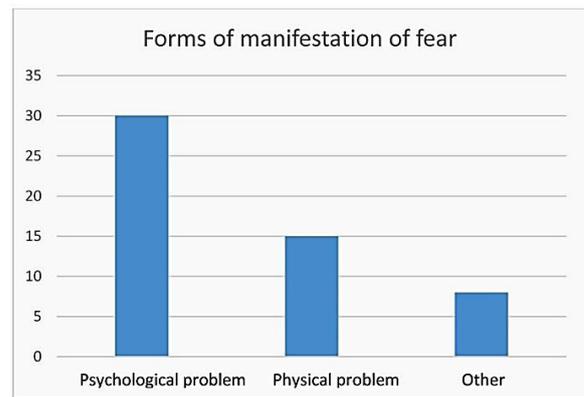
50% of parents did not give answers to these questions, so it is difficult to generalize the conclusion. The answer was most often given by parents who perceived a higher amount of fear of mathematics in their children.

The answers are divided into several categories for easier analysis of the results. Graphs 1, 2, and 3 show the frequencies of coded responses. From Graph 1 we see that the fear of mathematics in students most often occurs in the case when both oral and written tests, about 60%, if the case is only oral tests 18%, written tests 15%, while 7% of the answers stated some other reason for the appearance of fear, first of all a bad grade or fear of not meeting the expectations of the parents.



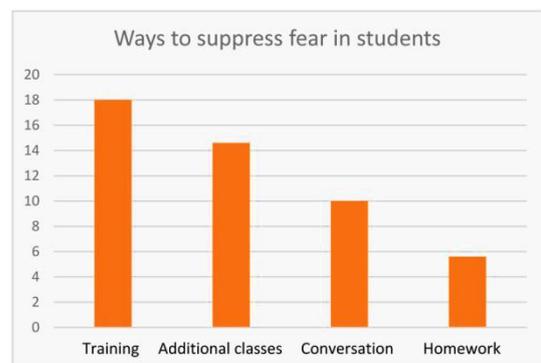
Graph 1. Situations in which there is a fear of mathematics

Graph 2 shows the form of the manifestation of fear. According to the answers of the parents, in most children, this fear is manifested through psychological symptoms, nervousness, blockage, confusion and similar behaviors, in 30% of them. 15% of parents' answers say that fear is manifested in students through physical symptoms, trembling, sweating, rapid heartbeat, while 8% of parents state other types of manifestation, most often crying.



Graph 2. Forms of manifestation of fear

To combat the fear of mathematics, as we see in Graph 3, parents work through exercise with the child 18%, then compulsory additional classes 14.6%, through conversation 10% and more homework 5.6%.



Graph 3. Ways of suppressing fear in students

Subhypothesis 3: There is no statistically significant difference between boys and girls in the amount of fear of mathematics. The results of students, similar to the previous results of teachers and parents, were analyzed with regard to the

demographic characteristics of the sample, and then the situations in which fear occurs and the way in which it manifests itself were analyzed. Table 9 shows the results of the t-test which examined the differences in the amount of fear of mathematics in students with regard to gender.

Table 9. t-test for differences in perception of fear of mathematics with respect to student gender

Varijable	Group	N	M	SD	t-test	Df	p
Gender	Male	46	2.78	1.41	.38	104	-.41
	Female	58	2.69	1.35			

The results show that there is no statistically significant difference between boys and girls in the amount of fear of math.

Subhypothesis 4: There is no statistically significant difference with respect to class in the amount of fear of mathematics.

Table 10. ANOVA a test for differences in the perception of fear of mathematics with respect to the class of students

Variable	Group	N	M	SD	F	Df	p
Class	V	21	2.62	1.50	1.95	3,10	-.52
	VI	23	2.89	1.27			
	VII	20	2.55	1.34			
	VIII	20	2.85	1.28			
	IX	20	2.71	1.37			

In Table 10 we see that there is no statistically significant difference in students with regard to grade, as in the case with regard to gender. Students also had the opportunity to write about the situations in which they develop a fear of mathematics and how it manifests itself. More than 70% of students answered these two questions, mostly students with a pronounced fear of math. The largest number of students, 45.19% cite oral examinations as the biggest source of fear, written examinations cause fear in 33.9% of students, fear of excessive parental expectations is in 18.3% of students, about 2.9% of students stated another situation, most often a raised tone of teachers during teaching.

DISCUSSION

Fear of mathematics has been recorded in all countries and all education systems. Mathematics is treated as a difficult subject and scientists are researching it more than other subjects. She is objectively a difficult object because her nature is pure abstraction. On the other hand, its structure is solid and collapses if only one segment is missing in it. The aim of this research was to investigate whether there is a fear of mathematics, what are the causes of fear, whose basis is actually the main hypothesis of this research,

CONCLUSION

The teaching process is a series of joint activities of teachers and students during the class aimed at achieving learning outcomes that are defined in accordance with the Curriculum. There should be no room for fear in the teaching process. Students should not come to school under pressure or in fear, but should find ways to motivate themselves to work because of their personal progress and training for life. Parents and teachers help them with that. Achievements in mathematics are researched more than achievements in other subjects because mathematics is important for examining and comparing different educational systems. Because of this importance, we need to find ways to suppress students' fear of math. In addition to motivation for work, students should be provided with support and encouragement. The main research hypothesis has been partially confirmed. It has been proven that there is a fear of mathematics in primary school subject teaching but there is no statistically significant difference between boys and girls. The way in which teachers suppress the fear of mathematics is conversation, while parents, in addition to talking to students, also mention work / exercise with the child, compulsory additional classes and more homework. Fear of mathematics manifests itself in two forms, metaphobia and anxiety. Rapid heart rate, tremors, nausea and fainting, headache, sweating, dry mouth, nervousness, panic attack, mental blockage, lack of concentration - all these are symptoms of metaphobia and anxiety.

in what forms fear is manifested and what parents and teachers do to combat fear of mathematics in students. The main hypothesis of this research has been confirmed and it has been proven that there is a fear of mathematics in primary school subject teaching. By analyzing the results, we see that there is no statistically significant difference in the perception of fear of mathematics in students with regard to the demographic characteristics of the teacher sample. Research has shown that parents feel that children are afraid of math but no differences have been found in the perception of fear of math regardless of the gender of the parents. When it comes to the working status and age of parents, no differences were found in the perception of fear of mathematics in children. Regarding the education of parents, no differences were found in the perception of fear of mathematics in children. Students build on their parents and an equal amount of fear of math has been demonstrated regardless of the class that students attend. This is especially important, because the research sample consisted of fifth and sixth grade students. Sixth graders, who have just finished class, a teacher who teaches all subjects, possess the same amount of fear as ninth graders. This means that the fear of mathematics can also be found in the classroom, and that at the very beginning we need to find ways to combat this fear.

Nowadays, when most parents are employed, it is necessary to allocate quality time and work with the child. Communication with the child, and communication in the parent-school student relationship is very important to suppress the child's fear. Parents believe that compulsory additional classes for all students would greatly reduce the fear of math. The question is whether another math class would suppress the fear of math or whether it is necessary to change the ways of teaching. The teacher is not only a lecturer but a person who should direct the teaching process with his communication style in which students, with his support, research and build their knowledge. It is very important to establish proper communication with students and for students to feel that the teacher cares about his opinion. From the school year 2016/2017, teachers plan the Plan of written tests for both the first and the second semester, so that students are acquainted with the dates of tests, written tests and tests. Preparation classes for the written test should be done well and after that students should be motivated to work independently at home. The grade should motivate the student and the students are aware that during the year they create their own grade, that it is composed of several components and that it depends exclusively on themselves. On the other hand, it is necessary for teachers to constantly do self-evaluation of their work, to re-examine their role and make corrections to their work. This is the only way to achieve success in the educational process.

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SENSORY INTEGRATION AND ACTIVITIES THAT PROMOTE SENSORY INTEGRATION IN CHILDREN WITH AUTISM SPECTRUM DISORDERS

Original scientific paper

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ABSTRACT

The aim of this review was to systematically identify, analyze, and summarize research involving interventions based on sensory integration and activities that promote sensory integration in children with ASD. Based on the selection criteria ten out of thirty studies were selected and described in terms of: a) participant characteristics, b) assessments used in the studies, c) intervention procedures, d) study goals, e) intervention outcomes and whether or not there was improvement in behavior or clinical conditions. The results of the analyzed studies indicate a remarkable heterogeneity profile of sensory function in children with ASD, which affect the applicability of different forms of treatment. Based on the results of these studies, we can conclude that treatments based on SI theory can reduce stereotypical, aggressive, auto-aggressive, irritable, and hyperactive behavior, as well as improve self-regulation of behavior.

Keywords: Autism, sensory integration, sensory disorders, therapy, auditory intervention training, sensory intervention therapy

INTRODUCTION

Sensory integration therapy (SIT) or sensory processing therapy (SPT) and activities that promote sensory integration are widely used diagnosing and treating disabilities in children with Autism Spectrum Disorder (ASD). Treatments based on the theory of sensory integration that are most often used in working with people with ASD are sensory integration therapy (SIT), auditory integration training (AIT) and deep pressure therapy (DPT) (Green et al., 2006).

Sensory integration (SI) is a neurological process, also described as Sensory Processing (SP) that allows us to take information we receive from our five senses, organize it, and respond appropriately.

The development of the sensory system begins in the intrauterine period and continues throughout the life of the individual (Mamic, Fulgosi Masnjak, & Miller, 2010). Sensory system consists of seven areas of sensory modalities: auditory, visual, tactile, olfactory, gustatory, vestibular, and proprioceptive (Mamic & Fulgosi Masnjak, 2010). Interacting with others and with the environment relies on sensory information we receive through the sensory system (Van Dam, Paris, & Ernst, 2014). Although cortical structures responsible for receiving, processing, integrating, and interpreting sensory information are the same in all people, the way an individual experiences and responds to external sensa-

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tions varies from person to person (Sobočko & Zelenski, 2015). The basic capacities of sensory integration are genetically determined; the development of this complex process takes place through interaction with the environment and cerebral and bodily adaptation to external conditions, which is mutually conditioned by adaptive reactions (Macesic-Petrovic, 2014). A child, while interacting with its environment, both physical and social, acquires new and upgrades previous experiences. The quality of these experiences is significantly influenced by the quality of processing information (Bojanin, 2015).

The development of the individual is significantly influenced by the ability to integrate sensory stimuli as one of the key neurobehavioral processes (Fernández-Andrés, Pastor-Cerezuela, Sanz-Cervera & Tárraga-Mínguez, 2015). Most everyday human activities require multisensory information processing (Hainaut & Bolmont, 2013) that has a significant impact on the quality of the experience and behavior of the person (Boterberg & Warreyn, 2016). Typical perceptual experience is characterized by perceptual unity, which is reflected in multisensory integration. At the level of subjective experience this perception is a unique experience, regardless of the characteristics of integrated sensation. Studies have shown that often comes to the modulation process sensory information perception by a sensory perception of other modalities (Bayne, 2014). Adequate sensory integration enables accurate representation of external stimuli, which requires an appropriate orientation in the environment in which we live, adequate perception of the environment and, therefore, a coordinated reaction (Mamic et al., 2010; Panzeri, Harvey, Piasini, Latham, & Fellin, 2017).

If a person cannot “organize sensory information for use” (Ayres, 1972, p. 4) they can be described as having sensory integration disorder (SID) or sensory processing difficulties. SID or sensory processing difficulties include disorders of perception, modulation, integration and organization of sensory information and the characteristics of the sensory profile of a person with these difficulties are manifested in the adaptive behavior of the individual (Gal, Dyck, & Passmore, 2010).

According to the theory of sensory integration, sensory processing is the basis of adaptive behavior, learning and socio-cognitive functioning, so it is not surprising that difficulties in sensory processing are manifested in the behavioral, cognitive and social domain, as difficulties in (self) regulation of behavior, planning and motor activities (Jirikowic, Olson, & Kartin, 2008). Sensory processing difficulties significantly affect the sensory-motor, cognitive and social development of the child, and the effects are observed in a limited ability to function in daily life which affects the quality of life of an individual (Dunn, 1997).

In the DSM-5 classification of the American Psychiatric Association (APA, 2013), autism spectrum disorders (ASD) belong to the group of neurodevelopment disorders. This group of disorders is characterized by persistent deficits in social communication and social interactions, as well as persistence of stereotypical be-

havior, repetitive forms of behavior, interests, or activities (Fernández-Andrés et al., 2015). In addition to these basic characteristics, the latest edition of the classification includes the presence of sensory processing difficulties as a diagnostic criterion of ASD (Sanz-Cervera, Pastor-Cerezuela, Fernández-Andrés, & Tárraga-Mínguez, 2015). Although the first description of ASD includes difficulties in sensory processing, those in earlier classifications were not accepted as a diagnostic criterion, due to the scarcity of empirical evidence, as well as because the focus was on the cognitive and social deficits (Novakovic et al., 2015).

This is a review article of existing research involving interventions based on SIT and activities that promote sensory integration in children with ASD. The aim of this review is to determine if SIT and activities that promote sensory integration can be classified as a scientifically based intervention for children with ASD. Forgoing we examined the effectiveness of procedures and interventions conducted with the goal to enhance sensory integration of children with ASD and doing so we determined if SIT can be classified as a scientifically based intervention for children with ASD.

METHOD

The service of the Consortium of Libraries of Serbia for Unified Procurement (KOBSON), Google Scholar, SCIndeks, as well as the search engine ScienceDirect were used in the literature review. Literature was searched in both Serbian and English language. The following phrases were used as keywords in the search: sensory processing, sensory processing difficulties, sensory integration, sensory integration therapy, sensory development, and sensory dysfunctions, crossed with the following words: autism, autism spectrum disorders, developmental disorders, developmental disability.

After the initial search, 30 papers were analyzed based on their titles and keywords. Selection criteria henceforward was as follows: that the article dates from 2010 to 2020; that it is not a theoretical article or a review article; that the sample included subjects with ASD; that the topic focuses on the interventions and procedures of sensory integration and / or activities that can encourage sensory integration in children with ASD; that the paper presents activities that promote the sensory integration of children with ASD. Ten articles were selected for this review based on the selection criteria.

LITERATURE REVIEW RESULTS

For the purpose of this review ten papers were selected based on previously determined criteria. Table 1 summarizes: a) participant characteristics, b) assessments used in the studies, c) intervention procedures, d) study goals, e) intervention outcomes and whether or not there was improvement in behavior or clinical conditions.

Participants:

There were a total of 410 subjects in the ten presented studies, 319 (77, 80%) of the subjects were diagnosed with ASD, 39 (9, 51%) of them had ID, 11 (2, 68%) had Asperger's syndrome, 16 (3,90) were diagnosed with PDD-NOS and 25 (6,10) had other types of disabilities. As for gender the majority of the subjects were males 338 (82, 44%) and 72 (17,56%) were females. Participants ranged in age from 3 to 18 years. Overall, participants involved in these studies were mainly of elementary school age with autism and a large percentage also had moderate to profound ID.

Assessments used:

Three studies used the Short Sensory Profile (SSP; Dunn, 1999) to confirm the presence of sensory processing issues prior to implementing SIT (Kashefimehr, et al., 2017) or AIT (Brockett, et al., 2014; Al-Ayadhi et al., 2018). SSP is a standardized assessment tool intended for children 3 to 10 years old. It's a 5 point Likert scale with 38 items that measure how the child responds to various sensory stimuli and is usually completed by primary caregivers. Scores are provided in seven categories (tactile sensitivity, taste/smell sensitivity, movement sensitivity, under responsive and seeks sensation, auditory filtering, low energy, and visual and/or auditory sensitivity) intended to identify how a child's nervous system regulates and processes sensory input.

The Sensory Processing Measure (SPM: Glennon, Miller-Kuhaneck, Henry, Parham, & Ecker, 2007) was used in two studies (Bagatell et al., 2010; Pfeiffer et al., 2011) to identify sensory processing issues and describe them. The assessment tool can be used by primary caregivers and teachers or clinicians. The SPM consists of 75 items (form for primary caregivers) and 62 items (classroom form completed by teachers). Scores are generated into eight standards that describe social participation, vision, hearing, touch, body awareness, balance and motion, planning, and total sensory system and children's sensory processing is classified as "typical", "some problems" or "definite problems".

The Childhood Autism Rating Scale (CARS) was used to measure the severity of autism in three of the analyzed studies (Al-Ayadhi et al., 2013; Al-Ayadhi et al., 2018; Wenix et al., 2019). CARS measures 14 dimensions such as interpersonal relationships, emotional responses, adaptation to environmental changes, visual responses, anxiety responses, non-verbal communication, and so on.

The higher the score the severe the condition is.

For example a total score above 30 points can be considered to have autism, whereas those with 30–36 points are divided into mild to moderate autism and those with a score above 36 points with more than 5 indicators achieving 3 or more points can be considered to have severe autism.

Three out of the ten studies used The Social Responsiveness Scale (SRS) to measure interpersonal behavior, communication, and stereotypical traits in autism (Pfeiffer et al. 2011; Al-Ayadhi et al., 2013; Al-Ayadhi et al., 2018). The SRS has five subscales a) social awareness, b) social cognition, c) social communication, d) social motivation, and e) autistic mannerisms. The Autistic Behavior Check List (ABC List) (Lu et al. 2004) was used to determine if a child had autism in two studies (Brockett, et al., 2014; Wenix et al., 2019). This check list has 57 items and the final score is used for evaluation, the higher the score the likelihood of a subject to have autism is higher. For example if the total score is below 31 points, then the subject is considered not to have autism at all. But those with a total score of 53–66 points can be considered to have suspected autism, while if the total score is 67 points or more, then the subject can be considered to have autism.

Pfeiffer et al. (2011) used QNST-II (Mutti et al., 1998) to assess areas including praxis, dexterity, visual tracking, spatial orientation, tactile perception abilities, and motor skills. Vineland Adaptive Behavior Scales, 2nd Edition was used to measure adaptive behavior that assesses the domains of communication, daily living skills, socialization, and motor skills. And the Goal Attainment Scaling was used to determine intervention outcomes expressly relevant to individuals and their families. The goals focused on the three categories of sensory processing, motor skills, and social functioning.

In one study the Autism Treatment Evaluation Checklist (ATEC) was used to evaluate treatment efficiency in subjects with ASD (Ayadhi et al., 2013). This assessment tool is divided into four subscales labeled Speech/ Language/ Communication, Sociability, Sensory/Cognitive Awareness, and Health/ Physical/ Behavior. The subject is more impaired if the subscale and total scores are higher.

Citation	Participant characteristics	Assessment	Intervention/procedure	The purpose of the study	Results	There was improvement in which behaviour	The intervention did not improve the following behaviour
Al-Ayadhi et al. (2013)	Total subjects: 72 (M 70/F2) Dg.: ASD; Age: 3 to 17 yrs.	Childhood Autism Rating Scale (CARS), Social Responsiveness Scale (SRS), and the Autism Treatment Evaluation Checklist (ATEC).	Auditory integration training (AIT). 18 to 20 listening sessions, lasting for 30 minutes, over a 10- to 20-day period in most cases, and had a 1- or 2-day break after 5 days of listening. During the listening sessions, the child listened to processed music. Overall, the music was played at a moderately loud, but not uncomfortable, level.	The aim of the study was to determine the effectiveness of AIT in people with ASD.	Mixed. All subjects demonstrated improvement 3 and 6 months following the AIT. ASD subject showed 22% and 26% percentage improvement in SRS scoring 3 and 6 months respectively following the AIT intervention.	There were statistically significant changes in social awareness, social cognition, and social communication. Similar results were achieved with the ATEC checklist: ASD subjects showed 19.5% and 22.5% improvement 3 and 6 months following the AIT intervention. Those changes are due to statistically significant ($P < 0.05$) improvement in speech, communication and sociability only.	No improvement was registered in the domain of social motivation and stereotypical behaviour, as well as in the sensory and cognitive domain.
Al-Ayadhi et al. (2018)	Total: 15 subjects (M14/F1); Dg.: ASD Age: 3–12 years.	CARS, Social Responsiveness Scale (SRS - Constantine, Gruber, 2007) and the Short Sensory Profile (SSP)	AIT was performed over 2 weeks, for duration of 30 min, twice a day with a 3-h interval between sessions. The listener received 18–20 listening sessions. The intensity level (volume) during the AIT listening sessions did not exceed 80 dBA (low scale) and was set at much lower intensities depending on the individual's comfort level. Overall, the music was played at a moderately loud, but not uncomfortable level.	This study investigated the impact of AIT on transforming growth factor (TGF)- β 1 and its effect on behavioural and social emotions in children with ASD.	Plasma levels of TGF- β 1 significantly increased to 85% immediately after AIT (20.13 ± 12 ng/mL, $p < 0.05$), to 95% 1 month after AIT (21.2 ± 11 ng/mL, $p < 0.01$), and to 105% 3 months after AIT (22.25 ± 16 ng/mL, $p < 0.01$) compared to before AIT (10.85 ± 8 ng/mL).	Results also revealed that behavioural rating scales CARS, SRS, and SSP improved in terms of symptom severity after AIT.	Not specified
Bagatell et al. (2010)	Total: 6 boys with autism spectrum disorder (ASD), all in first grade	The sensory processing pattern of each participant was assessed using the Sensory Processing Measure that was scored by the teacher.	The procedure was divided into stages; all of them were set in the classroom. Phase A: Baseline lasted 5 days used to collect data during Circle time. Phase B: Intervention: occurred over 9 days during Circle time but children, teacher, and instructional aides sat on therapy ball chairs with a ring stabilizer. Phase C: Choice. During the final phase (5 days), the children were given the choice of sitting on a regular seating device (chair) or on a therapy ball chair.	The goal was to examine classroom participation—specifically, in-seat behaviour and engagement and social validity.	Of the six respondents one student with ASD showed the most significant progress after using the therapeutic sitting ball, also the higher degree of participation and better self-regulation of sitting behaviour after the application of therapeutic sitting balls.	The ball chair appeared to have a positive effect on in-seat behaviour for the child who had the most extreme vestibular–proprioceptive seeking behaviours.	The use of the therapy ball chair did not positively affect engagement.

Citation	Participant characteristics	Assessment	Intervention/procedure	The purpose of the study	Results	There was improvement in which behaviour	The intervention did not improve the following behaviour
Bestbier & Williams, (2017)	Total: 13 students; Gender: 2 girls and 13 boys; Gender: 2 girls and 13 boys; Dg.: 8 with ASD and 7 ID; Age: ranged from 7 yrs and 10mths to 18 yrs and 7mths	Pretest-posttest design was employed to evaluate the effects of deep pressure sessions on young people with ASD and severe intellectual disabilities. Visual analogue scale was to measure mood and activity of the young people by school staff.	Setting: quiet places with minimal distraction in the school. Three deep pressure techniques were used, by care and education staff that had been trained by an occupational therapist with a sensory integration qualification: brushing, massage, and squeezing. The sessions lasted between five and fifteen minutes, up to three times per day during school hours. The deep pressure was delivered over a period of three months on weekdays when the young people were in school.	This study was designed to provide information about the extent of variability of the immediate responses of young people with ASD and severe intellectual disability to deep pressure by providing regular access to deep pressure	Results mixed. Four of the young people showed benefits in all areas measured, two showed no benefits in any area, and further two showed benefits on three and two ratings each.	On the Calmness subscale results indicate improvement for 75% of the participants. On the Engaged subscale results indicate improvement for 62.5% of the participants. On the Responsively subscale results indicate improvement for 62.5% of the participants. On the Happy subscale results indicate improvement for 50% of the participants. On the Communicative subscale results indicate improvement for 62.5% of the participants.	On the Calmness subscale results did not indicate improvement for the 25% of the participants. On the Engaged subscale results did not indicate improvement for the 37.5% of the participants. On the Responsively subscale results did not indicate improvement for the 37.5% of the participants. On the Happy subscale results did not indicate improvement for 50% of the participants. On the Communicative subscale results did not indicate improvement for 37.5% of the participants.
Brockett, et al. (2014)	Total: 54 children Gender: 45 males (83%) and 9 females (17%). Dg. 35 autism/PDD-NOS, 7 speech/language disorders, 6 sound sensitivity/auditory processing disorders, 5 ADD, 4 SPD and 5 no diagnostic label Age: 3–10 years (M 6).	The SSP (Dunn, 1999) checklist which measures behavioral response to specific sensory stimuli that occur during daily life activities, such as (1) Tactile Sensitivity, (2) Taste/Smell Sensitivity, (3) Movement Sensitivity, (4) Under-Responsive/Seeks Sensation, (5) Auditory Filtering, (6) Low Energy/Weak and (7) Visual/Auditory Sensitivity was completed by primary care givers. The ABC behavior rating scale was used to measure behavior such as irritability, stereotypic, lethargy, hyperactivity, inappropriate speech.	All children participate in a standard protocol of Berard AIT that consisted of two 30-minute sessions of listening each day for 10 consecutive days. With a three-hour break from the auditory stimulation between sessions. Music for Berard AIT is generally a variety of light rock, reggae, and jazz, selected specifically to assure that it contains a wide range of frequencies from 20 Hz to 20 kHz.	The purpose of this study was to determine if behaviors specifically related to sensory modulation showed positive changes following 10 days of Berard AIT.	Analysis of variance indicated that SSP total test scores and individual factor sections improved from pretest to post-test (P 0.01). Behavioral problems reduced on all five factors of the Aberrant Behavior Checklist (ABC) (P 0.01). Most changes occurred within one month of intervention and maintained at three and six months. Correlations among the ABC and SSP factors indicate that sensory modulation as measured by the SSP is a significant contributor to four of the behavioral factors measured by the ABC.	The children's results improved in the following domains: tactile sensitivity, taste/smell sensitivity, movement sensitivity, under-responsively, auditory filtering, low energy/weak, and visual/auditory sensitivity. The results measured on ABC scale indicate improvement in following domains: irritability, lethargy, stereotypy, hyperactivity, inappropriate speech.	Not specified

Citation	Participant characteristics	Assessment	Intervention/procedure	The purpose of the study	Results	There was improvement in which behaviour	The intervention did not improve the following behaviour
Iwanaga et al. (2014)	Total:20 children; Gender: 18 males and 2 females. Dg. 9 autism and 11 Asperser's syndrome Average age 4.7 years.	JMAP (Tsuchida et al., 1989), a re-standardized version of the Miller Assessment for Preschoolers (MAP) for use with Japanese children was used to measure five major developmental indices: 1) Foundation Index; 2) Coordination Index; 3) Verbal Index; 4) Non-verbal Index; and 5) Complex Index. A trained practitioner administered the test individually before and after the treatment.	8 children received individual SIT and 12 children received group therapy (GT). 17 of the subjects were treated in Nagasaki Prefectural Medical Treatment and Education Centre. Twelve children of them received GT and five received SIT. Three children who received SIT were treated in the clinic at Nagasaki University. Durations of SIT and GT were between 8 to 10 months. SIT included the 10 key therapeutic strategies identified by Parham et al. (2007).	The aim was to examine the effectiveness of SIT on cognition, verbal, and sensory motor abilities in children with ASD.	Results mixed; For SIT group interventions before and after therapy there were significant gains for Total score (p =0.012), Foundation Index score (p = 0.035), Coordination Index score (p = 0.012), Nonverbal Index score (p = 0.018), and Complex Index score (p=0.018). Verbal Index score showcased no significant changes (p=0.401). For the GT group therapy Total score showed a significant gain from before to after therapy (p = 0.015), Foundation Index score (p = 0.138), Coordination Index score (p=0.08), Verbal Index score (p=0.075), Non-verbal Index score (p= 0.433).	Improvement in both groups in the domain of fine and gross motor skills, oral motor and visual-motor abilities, nonverbal memory, sequencing, visualization, solving complex problems that require the engagement of certain cognitive and sensory-motor abilities.	Verbal abilities have not significantly improved.
Kashefimehr, et al. (2017)	Total: 35 children; Gender: 28 boys and 3 girls; DG. ASD Age: 3 to 8 years \	The Short Child Occupational Profile (SCOPE, Kielhofner, 2002) was used to compare the two groups in terms of the changes in their occupational performance and the Sensory Profile (SP, Dunn, 1999) was used to assess sensory problems. The study used a pre and post test design.	The children were divided into two groups intervention group (n = 16) receiving SIT and a control group (n = 15). SIT was described as a clinic-based intervention that uses play activities and sensory-enhanced interactions to elicit the child's adaptive responses. In this intervention, the therapist creates activities that encourage the child's participation and challenge his sensory processing and motor planning skills following the 10 key therapeutic strategies identified by Parham et al. (2007). Each participant in the intervention group received 24 SIT (two per week), each 45 min. in length with an additional 15 Min. devoted to parent education. No information was given about the control group.	This study examined the effect of SIT on different aspects of occupational performance in children with ASD.	Results showed that significant difference were observed in SCOPE domains in pre intervention data but a significant difference was observed between the two groups in terms of the sensory seeking, sensory sensitivity, and behavioral outcomes (p < .05). A significantly greater improvement was observed in the intervention group in all domains of SCOPE including volition, habituation, communication and interaction skills, process skills, motor skills, and environment of occupational performance and also in the total score of the child (p < 0.001). Of the 35 ASD children participating in the study, 31 (88.6%) showed difference in sensory profile according to SP.	The intervention group showed significantly greater improvement in all the SCOPE domains, as well as in some of the SP domains	There was not improvement on the SP scale for the "emotional reactions" and "emotional/social responses" domains, (p < .05).

Citation	Participant characteristics	Assessment	Intervention/procedure	The purpose of the study	Results	There was improvement in which behaviour	The intervention did not improve the following behaviour
Pfeiffer et al. (2011)	Type of sample: convenient. Total: 37 children; Gender: 32 males and 5 females, Dg.: 21 had autism and 16 with PDD-NOS. Ages between 6 and 12 (mean [M] age 5 8.8) .	All assessments were used as a pre and post test and were carried out by parents and clinicians, who were not aware of the group assessment. Sensory Processing Measure was used to measure sensory processing disorders. QNST-II (Mutti et al., 1998) was used to assess areas including praxis, dexterity, visual tracking, spatial orientation, tactile perception abilities, and motor skills. Social Responsiveness Scale was used to measure social impairments. Goal Attainment Scaling was used to determine intervention outcomes expressly relevant to individuals and their families. The goals focused on the three categories of sensory processing, motor skills, and social functioning. Vineland Adaptive Behavior Scales, 2nd Edition was used to measure adaptive behaviors that assess the domains of communication, daily living skills, socialization, and motor skills.	Two interventions SIT and fine motor intervention (FMT). Participants were randomly assigned 20 undergone SIT and 17 FMT intervention- control group. Both interventions consisted of 18 treatment interventions of 45 min each over a 6-wk period, SIT included the 10 key therapeutic strategies identified by Parham et al. (2007). FMT focused on three main activity areas: constructional, drawing and writing, and FM crafts.	Was to address the question of effectiveness of SI interventions in children with ASD.	Results were mixed. Both SIT and FMT groups had significant improvements toward goals on the GAS, but SIT demonstrated more significant improvement than the FM group in the attainment of goals as rated by parents ($p < .05$.) and teachers ($p < .01$).	Improvements were registered in significantly fewer autistic mannerisms in SIT group than in FMT group.	In both groups no significant differences were found processing standardized scores.
Thompson (2011)	Sample type: random. Total: 50 participants, Gender: 26 female students and 24 male students Dg.: 10 of them had autism, 32 intellectual disabilities and 8 children with multiple disabilities. Age: from 6 to 17.	The authors created an observation system to measure sustained focus.	Observations were conducted by trained observers stationed within secluded locations in the regular classrooms and multi-sensory centre. Students were observed individually within three types of environments and during three time periods: (1) initial observations was conducted within the regular classroom before treatment; (2) during the multi-sensory intervention; and (3) after the multi-sensory intervention in the classroom.	Was to examine the observed impact of multi-sensory experiences on the sustained focus of students with special needs.	Generally results were positive, the ability to maintain attention in learning conditions (during class) increased by 14%, while the manifestation of auto-aggressive behavior decreased by 98%. Also, the feeling of happiness, relaxation and the level of participation in the class increased significantly after the treatment in all respondents.	Not specified	Not specified

Citation	Participant characteristics	Assessment	Intervention/procedure	The purpose of the study	Results	There was improvement in which behaviour	The intervention did not improve the following behaviour
Wenix et al. (2019)	Sample type; convenient. Total:108 participants; Gender:88 male and 15 Dg. autism The participants were divided into group A and B. 43 male patients and 7 female patients with an average age of 6.17±2.44 were included in group A. 45 male patients and 8 female patients with an average age of 6.18±2.94 were included in group	CARS scale was used to measure interpersonal relationships, emotional responses, adaptation to environmental changes, visual responses, anxiety responses, non-verbal communication, and so on. Autistic Behavior Check List (ABC List) (Lu et al. 2004) was used to determine if a child had autism.	Participants were randomly divided into group A (SIT + routine treatment group) and group B (routine treatment group), each group had 54 members. Evaluation was carried out before and after the experiment, and the scales were filled in under the guidance of professionals. SIT method uses games such as slides, tossing, leaping, balance beam, and sling to train children's balance, communication, and brain integration functions.	The aim was to examine the joint effect of SIT and exercise intervention on the behaviors and quality of life of children with autism.	Results were positive but not conclusive. For group A, the marked effective rate was 55.56%, the effective rate was 30.56% and the total effective rate was 86.11%. For group B, the marked effective rate was 17.95%, the effective rate was 46.15%, and the total effective rate was 64.10%. Significant differences in the CARS scores of the two groups before and after the treatment (P<0.05). Moreover, statistically significant differences were observed in the ABC scores of the two groups before and after the treatment (P<0.05).	The sensory, language, communication, self-care, and physical exercise ability of the experiment group significantly improved after the intervention period. The difference with the control group after the intervention is statistically significant (P<0.01). ABC score of the experiment group has exhibited significantly lower score than before the intervention. However, a significant decline was observed in the ABC score of the control group. Further differential analysis suggests that the decline in the ABC score of the control group is significantly lower than that of the experiment group.	Not specified

Intervention procedure:

Five of the ten studies presented in this paper focused on examining the effects of sensory integration therapy on cognition, verbal and sensorimotor abilities (Iwanaga et al., 2014), various aspects of occupational performance (Kashefimehr, et al., 2017), on the sustained focus (Thompson, 2011), behavior and quality of life of children with ASD (Wenix et al., 2019; Pfeiffer et al., 2011). Three of these studies included 10 key therapeutic strategies identified by Parham et al. (2007) (Iwanaga et al., 2014; Kashefimehr, et al., 2017; Pfeiffer et al., 2011), while the authors of the remaining two studies did not specify the sensory integration methods they applied (Thompson, 2011; Wenix et al., 2019).

Three studies were conducted to determine the effectiveness of auditory integration training in children with ASD (Al-Ayadhi et al., 2013) and the effects of this training on the behavior and social and emotional development of children with ASD (Al-Ayadhi et al., 2018). One of these studies focused on the impact of auditory integration training on behaviors directly related to sensory modulation problems in children with ASD (Brockett, et al., 2014).

One study involved alternative seating on therapy ball chairs in order to improve classroom participation, more specifically on in-seat behavior and engagement and social validity (Bagatell et al., 2010).

Finally, deep pressure therapy was used in one study to examine the effects of this therapy on the responsiveness of children with ASD and deep ID (Bestbier & Williams, 2017).

Eight studies conducted pre- and post-intervention evaluation (Al-Ayadhi et al., 2013; Al-Ayadhi et al., 2018; Bagatell et al., 2010; Bestbier & Williams, 2017; Iwanaga et al., 2014; Kashefimehr, et al., 2017; Pfeiffer et al., 2011; Wenix et al., 2019).

Results/ improvements in behavior:

The results of the presented studies, focused on examining the effects of sensory integration therapy, indicate a significant positive impact of this type of intervention. After SI therapy progress has been noted in various domains: motor skills (Kashefimehr et al., 2017) - fine and gross motor skills, oral motor and visual-motor abilities (Iwanaga et al., 2014; Pfeiffer et al., 2011); sensory processing (Pfeiffer et al., 2011) nonverbal memory, sequencing, visualization, solving complex problems that require the engagement of certain cognitive and sensory-motor abilities (Iwanaga et al., 2014), adaptive behavior, social functioning (Pfeiffer et al., 2011) communication and interaction skills, environment of occupational performance (Kashefimehr et al., 2017), attention (Thompson, 2011).

Results show increase in the ability to maintain attention in learning conditions by 14%, and 98% decrease in auto-aggressive behavior in children with ASD after SIT (Thompson, 2011). Also, there is a noticeable difference in pre- and post-treatment scores on CARS and ABC which indicates a decline in autism specific

behavior (Wenix et al., 2019). Positive changes in the sensory profile of children with ASD after SIT are also noticeable (Kashefimehr et al., 2017). On the other hand, no significant improvement was registered in verbal abilities (Iwanaga et al., 2014) and in the emotional domain - emotional reactions and emotional/social responses (Kashefimehr et al., 2017).

In the case of auditory integration training, pre- and post-evaluation results indicate improvement in social awareness, social cognition, and social communication (Al-Ayadhi et al., 2013), as well as improved scores on CARS, SRS, SSP, and ABC which indicate decline in condition severity and improvement in adaptive behavior after AIT (Al-Ayadhi et al., 2018; Brockett, et al., 2014). Changes in the sensory profile are reflected in the following domains: tactile sensitivity, taste/smell sensitivity, movement sensitivity, under-responsively, auditory filtering, low energy/weak, and visual/auditory sensitivity (Brockett, et al., 2014). On the other hand, positive behavioral changes are registered in the following domains: irritability, lethargy, stereotypy, hyperactivity, inappropriate speech. The results showed that most changes occurred within one month of intervention and maintained at three and six months (Al-Ayadhi et al., 2013; Al-Ayadhi et al., 2018; Brockett, et al., 2014). No improvement was registered in the domain of social motivation and stereotypical behavior, as well as in sensory and cognitive domain (Al-Ayadhi et al., 2013).

One study used therapeutic ball chairs to examine the effects of an alternative form of sitting on participation of student with ASD. The results of this study indicate that children with vestibular–proprioceptive seeking behaviors have benefited the most from this type of sitting. Significant progress is noticed in self-regulation of sitting behavior and participation in learning activities (Bagatell et al., 2010).

The use of deep pressure techniques (brushing, massage, and squeezing) has been shown to increase calmness (75%), engagement with activities (62.5%), responsiveness to instructions or other stimuli in the environment (62.5%), happiness (50%) and communicativeness (62.5%) in students with ASD and severe ID (Brockett, et al., 2014). However, the results of this research are mixed, maybe due to the fact that all participants received a different number of interventions on a weekly basis.

Based on the ten reviewed studies we can conclude that in people with ASD the most common difficulties are sensory processing of auditory stimuli and that sensory profiles are extremely heterogeneous. Because of this heterogeneous of sensory profiles and the lack of same methods used for SIT interventions we cannot conclude that this form of therapy is scientifically based.

CONCLUSIONS

The results of the analyzed studies indicate a remarkable heterogeneity profile of sensory function in children with ASD, which affect the applicability of different forms of treatment. Treatments based on the theory of SI are aimed at reducing or eliminating the difficulties of SI, which stimulates the cognitive and social development of the child with ASD, and thus affects the educational process and educational inclusion. Most of the research presented in this paper focuses on the influence of different forms of treatment on different domains of behavior of a child with ASD. Based on the results of these studies, we can conclude that treatments based on SI theory can reduce stereotypical, aggressive, auto-aggressive, irritable and hyperactive behavior, as well as improve self-regulation of behavior. The significance of these changes in the school environment is reflected in the increased possibility of active participation of children with ASD and the reduction of social distance of peers and other persons towards children with ASD, which supports the process of educational and social inclusion.

All research presented in this paper focuses on the effects of SI treatment on the functioning of children with ASD. The obtained findings indicate a positive influence of SIT, AIT and DPT on certain domains of functioning of children with ASD. The variability of the effects of these treatments in children with different sensory disorders indicates the need to create individualized treatment programs and combine different methods and techniques to encourage SI to provide adequate treatment tailored to the specific difficulties and abilities of each individual child. By hindering the daily functioning of a child with ASD, SI difficulties limit the possibility of participation of students with ASD in school activities, can lead to the creation and increase of social distance towards these students, hinder the process of adopting materials and, thus, require significant adjustments of curriculum and methods. Reducing or eliminating sensory difficulties has a positive impact on cognitive and social development, as well as on student's behavior, which conditions the better functioning of the individual with ASD both in the school environment and in the community. Therefore, it is necessary to conduct a more detailed analysis of sensory profiles of students with ASD, creating adequate instruments for assessment and monitoring, as well as examining the effectiveness of different SI treatments depending on the sensory difficulties of students with ASD. Ethnological aspects, typical for the environment of the child, can be included in therapeutically processes, such as movement, dance and music background in sensor-motor performance of the child.

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LEADING DISEASES IN DENTAL PROTECTION OF CHILDREN AND YOUTH IN HERZEGOVINA-NERETVA CANTON IN 2008 AND 2013

Original scientific paper

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ABSTRACT

The purpose of this paper is to detect the leading diseases diagnosed in dental care, for the population 0-6 years and 07-18 years of age for the Herzegovina-Neretva Canton in 2008 and 2013, to compare the results for those two years, to determine trends, individual diseases, and comparing the obtained results with the results for the territory of the Federation of B&H. During the preparation of this paper, the data collected and published in its reports by the Institute of Public Health of the Federation of Bosnia and Herzegovina were used. Dental caries / K02 / takes the first place on the list of diseases in the field of dental activity, in all age groups. Diseases of the pulp and periapical tissue / K04 /, which most often occur as a result of caries, take second place on the list of diseases in all age groups. It is necessary to work on increasing the number of public healthcare of specialist teams of preventive and pediatric dentistry in the area of HNK, as well as increasing the number of dental care points, where children and youth would receive the service. Further work is needed to improve the state of oral health and the population through.

Keywords: Caries, pulp, periapical tissue, oral health

INTRODUCTION

Health and well-being is the aspiration and need of all people and one of the greatest challenges of the 21st century. The answer to how to preserve it, lies in recognizing the causes that affect health disorders. However, the economic and social crisis, demographic and epidemiological changes, as well as public health threats from the environment represent a major challenge to preserve and improve the health of the population as stated on the website of the FB&H Institute of Public Health in the paper (Institute of Public Health of FB&H, 2013, p. 103).

Oral health is an important component of overall health, according to Smajkic et al. (2013, p. 256).

Before discussing “oral health”, it is important to define what health is. However, this is not easy at all and there have been many such attempts. One of the most frequently cited definitions is the one formulated by the World Health Organization in 1958: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”

According to Koch and Poulsen (2005, pp. 21-22; 31), the World Health Organization has defined oral health as a condition of healthy and properly functioning dental and other oral structures, with the absence of dental fear and anxiety.

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In his paper, Ivankovic (2004, pp. 55-56) says that Caries dentis, dental caries and its consequences are the most widespread diseases of modern civilization. According to epidemiological research by many authors in the world, which includes research in this area, dental caries has been found in 97-100% of the population, so it is rightly considered one of the most widespread diseases of modern civilization. The WHO has published in its publications a large number of data on the prevalence of caries and its programs for its remediation, which have been followed by many countries with their national programs.

According to Stojanovic and Krunic (2006, p. 229) caries is one of the most common oral diseases, not only in children and adolescents, but also in all age groups. In the paper of Markovic et al. (2013, pp.108-116) explain that the World Health Organization (WHO) provides a specific methodology for collecting epidemiological data on oral health parameters, through basic research, with a clear goal to provide a systematic approach to collecting and reporting on the state of oral diseases, to ensure that these data are comparable to other national surveys.

Zukanovic and Ganibegovic (2007, pp. 193-204) claim that in all developed countries, the prevalence of caries in all age groups has significantly decreased in recent years. Dental care, based on a well-organized and guided health policy, has enabled the application of massive individual preventive measures, which in many countries has resulted in a large reduction in the prevalence of oral diseases. And the oral health of all age groups in Bosnia and Herzegovina (B&H) is among the worst in Europe.

There is still no prevention program to be implemented as part of the official health policy in the country. The main reasons for the current situation are the lack of any national prevention program, curatively oriented dental policy, poor socio-economic condition of the population and changes in living conditions during and after the war. Porovic et al. (2014, pp.97-101) state that apparently dental caries is a major health problem today. Complications of caries, such as pain and others, have an impact on mental development, general health and quality of life.

AIMS

The purpose of this paper is to detect the leading diseases diagnosed in dental care, for the population 0-6 years and 07-18 years of age for the Herzegovina-Neretva Canton in 2008 and 2013, to compare the results for those two years, to determine trends, individual diseases, and comparing the obtained results with the results for the territory of the Federation of B&H.

METHODS

During the preparation of this paper, the data collected and published in its reports by the Institute of Public Health of the Federation of Bosnia and Herzegovina (public healthcare sector) were used,

- Health Statistical Yearbooks of the Federation of Bosnia and Herzegovina for 2008 and 2013 (11; 26; 59; 60)
- Health status of the population and health care in 2008 and 2013 (36; 47; 89)

RESULTS

Estimated total population on 30.06. in 2008, the Federation of Bosnia and Herzegovina (FB&H) had a total population of 2,327,195, and the Herzegovina-Neretva Canton (HNK) had a total population of 226,632, according to the Institute of Public Health of the Federation of B&H (11; 26; 59; 60), which accounted for 9.74% of the FB&H.

Estimated total population on 30.06. in 2013, there were a total of 2,337,200 inhabitants in the FB&H, and in the Herzegovina-Neretva Canton (HNK) there were a total of 224,388 inhabitants according to the data of the Institute of Public Health of the Federation of B&H (Zdravstveno statisticki godisnjak, 2014, pp. 36; 47; 89), which was 9.6 % FB&H.

Table 1. Estimation of the total population in 2008 and 2013 in FB&H and HNK in the total number and by age groups

Year	FB&H				HNK			
	Total	0-14	15-64	65+	Total	0-14	15-64	65+
2008	2.327.195	419.852	1579.720	327.623	226.632	37.473	150.802	38.357
2013	2.337.200	400.110	1.605.813	331.277	224.388	35.935	150.146	38.307

In 2008, there were a total of 476 doctors of dentistry in public health care sector (of which 137 specialists) employed in the public health care of the FB&H, which was a rate of 2.0 dentists per 10,000 inhabitants. Dental care was performed in FB&H at 226 points and 438 dental chairs. In the same year, the number of dentists employed in the health care of the HNK was 56 (20

specialists), which was a rate of 2.5 dentists per 10,000 inhabitants. Dental care at HNK was performed at 31 points, ie 38 dental chairs, according to the data of the Institute of Public Health of the Federation of B&H (Zdravstveno statisticki godisnjak, 2009, pp. 11; 26; 59; 60).

On the other hand, in 2013, the number of dentists employed in the FB&H public health care system was 576 (of that number, 208 specialists), which is a rate of 2.5 dentists per 10,000 inhabitants. Public dental care was performed in FB&H at 226 points and 438 dental chairs. The number of dentists employed in the public health care of HNK was 53 (of which 18

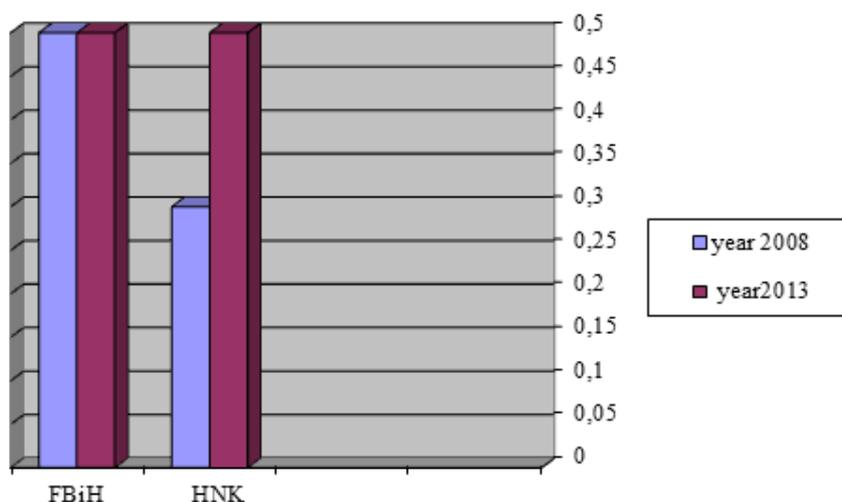
specialists), which is the rate of 2.4 dentists per 10,000 inhabitants. Public dental care at HNK was performed at 33 points, ie 38 dental chairs, according to the data of the Institute of Public Health of the Federation of B&H (Zdravstveno statisticki godisnjak, 2009, pp. 11; 26; 59; 60).

Table 2. Dentists employed in health care, number of points and dental chairs in FB&H and HNK in 2008 and 2013

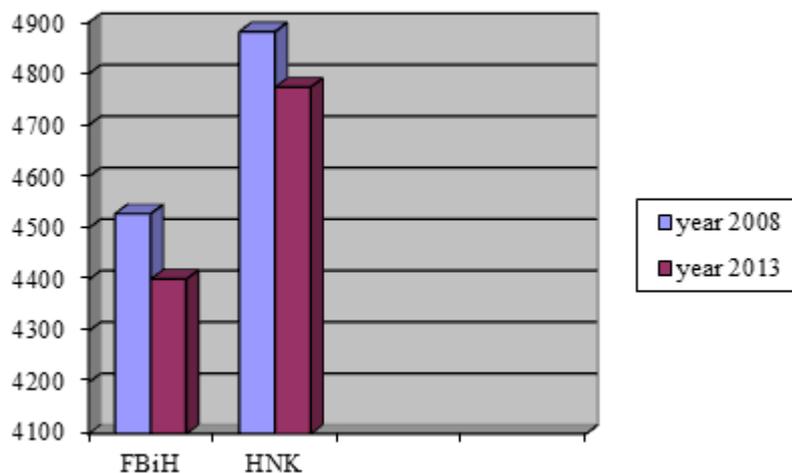
Year	FB&H					HNK				
	Point number	Chair number	No. Of dentists total	Dentist specialists	Dentists per 10.000 inhabitants	Point number	Chair number	No. of dentists total	Dentist specialists	Dentists per 10.000 inhabitants
2008	226	438	476	137	2.0	31	38	56	20	2.5
2013	226	438	576	208	2.5	33	38	53	18	2.4

The average number of examinations in the dental service in the FB&H was 0.5 per capita, and in the area of HNK this number was 0.3 per capita. In the same year, in FB&H there were 4528 inhabitants per one public dentist, and in HNK there were a total of 4882 inhabitants per one public dentist, according to the data

of the Institute of Public Health of the Federation of B&H (Zdravstveno statisticki godisnjak, 2014, pp. 36; 47; 89). In 2013, in both the FB&H and the HNK, the average number of dental visits per capita was 0.5. The number of inhabitants per one public dentist in 2013 in FB&H was 4401, and in HNK 4774.



Graph 1. Average number of examinations per capita in dental activity in FB&H and HNK, for 2008 and 2013.



Graph 2. Number of inhabitants per one dentist in FB&H and HNK for 2008 and 2013

According to the data of the Institute of Public Health of the Federation of B&H (Zdravstveno statisticki godisnjak, 2009, 11; 26; 59; 60) diseases, conditions and injuries identified in the dental activity for the

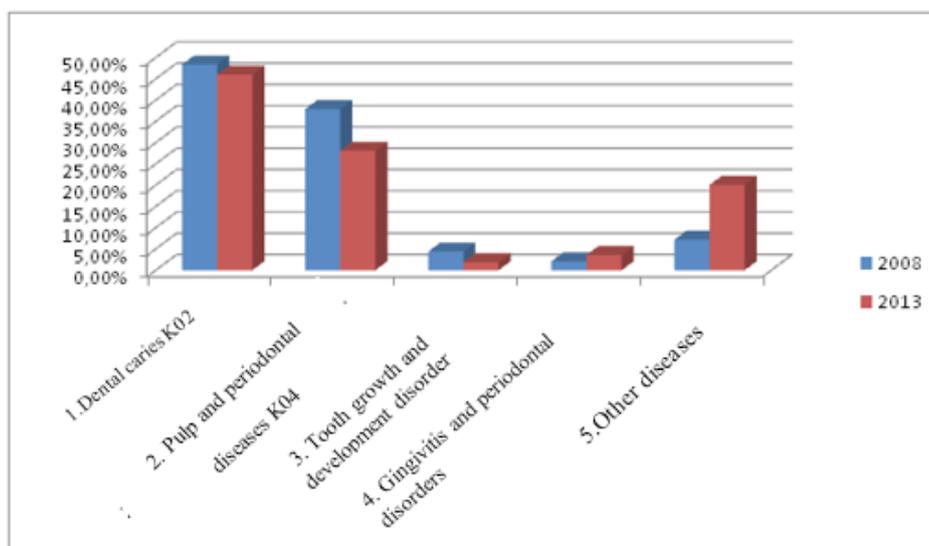
population 0-6 years and 07-18 years of age in the HNK and FB&H in 2008 are shown in table No.3, and in 2013 they are shown in table No. 4.

Table 3. Diseases diagnosed in the dental activity in the areas of HNK and FB&H in 2008

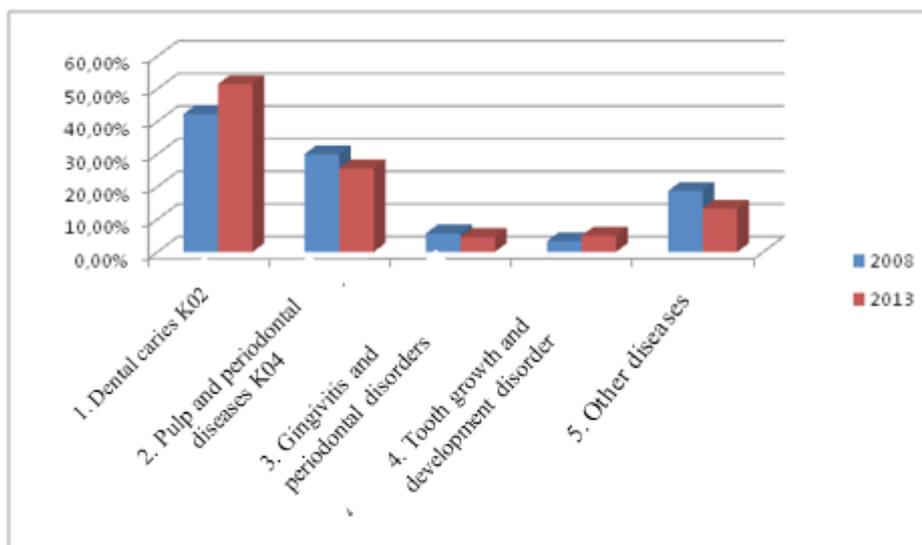
Diseases, conditions and injuries 10 MKB	HNK						FB&H					
	0-6 years			07-18 years			0-6 years			07-18 years		
	Total	Structure index %	Rate per 10,000 inhabitants	Total	Structure index %	Rate per 10,000 inhabitants	Total	Structure index %	Rate per 10,000 inhabitants	Total	Structure index %	Rate per 10,000 inhabitants
Malignant neoplasms of the lips and oral cavity (C00-C08)	0	0	0	0	0	0	0	0	0	3	0	0
Malignant neoplasms of the lips and oral cavity (K00)	82	6	45	743	4.4	167	1.379	3.3	74	8.456	2.6	185
Malignant neoplasms of the lips and oral cavity (K01)	3	0.2	2	14	0,1	3	613	1.5	33	4773	1.5	105
Dental caries (K02)	700	50.4	386	8.258	48.4	1.860	17.564	42.3	943	140.521	42,8	3.081
Malignant neoplasms of the lips and oral cavity (K03)	12	0.9	7	467	2.7	105	2.486	6	134	18.642	5.7	409
Dental pulp and periapical tissue diseases (K04)	384	27,7	211	6.465	37.9	1.455	12.447	30	669	93.509	28.6	2.050
Gingivitis and periodontal diseases (K05)	110	7.9	60	357	2.1	80	2.369	5.7	127	12.523	3.8	275
Other disorders of the gingiva and alveolar arch (K06)	0	0	0	144	0.8	32	174	0.4	9	1.476	0.4	32
Dentofacial anomalies / including malocclusion (K07)	2	0.1	1	183	1.1	41	1.124	2.7	60	32.167	9.8	705
Other disorders of teeth and supporting structures (K08)	3	0.2	2	203	1.2	46	1.106	2.7	59	7.221	2.2	158
Oral cysts not elsewhere classified (K09)	0	0	0	0	0	0	146	0.4	8	347	0.1	8
Other diseases of the jaw (K10)	70	5	39	153	0.9	34	1.059	2.6	57	6.511	2	143
Diseases of the salivary glands (K11)	0	0	0	1	0	0	22	0	1	76	0	2
Stomatitis and related lesions (K12)	21	1.5	11	76	0.4	17	864	2.1	46	1.462	0.4	32
Other diseases of lips and mucous membranes of oral cavity (K13)	0	0	0	7	0	2	102	0.2	5	486	0.1	11
Diseases of the tongue (K14)	0	0	0	2	0	0	21	0	1	81	0	2
Face and oral cavity injuries (S00-S09, T00-T04, T20, T90)	1	0.1	1	1	0	0	41	0.1	2	107	0	2
TOTAL	1388	100	765	17.074	100	3.842	41.517	100	2.229	328.361	100	7.199

Table 4. Diseases diagnosed in the dental activity in the areas of HNK and FB&H in 2013

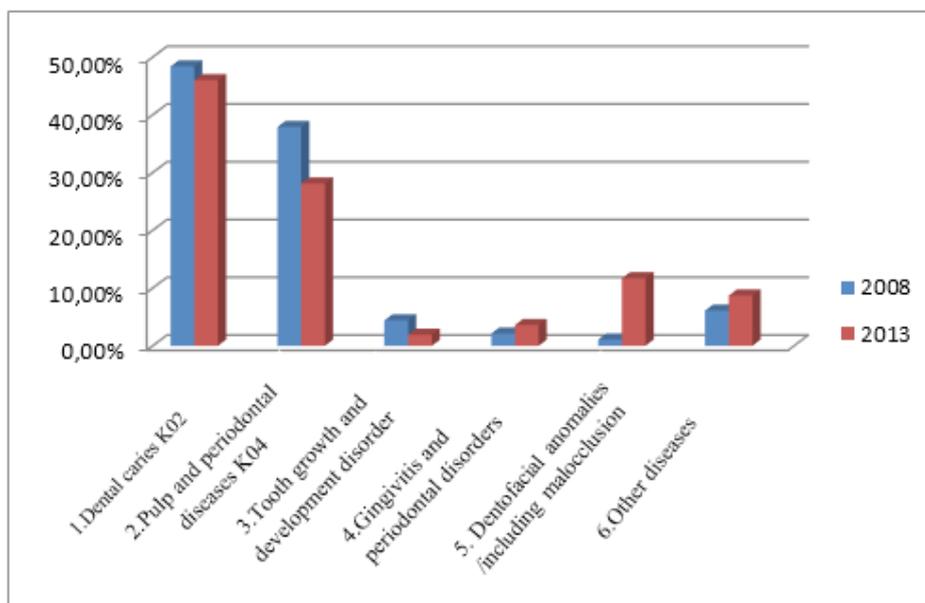
Diseases, conditions and injuries 10 MKB	HNK						FB&H					
	0-6 years			07-18 years			0-6 years			07-18 years		
	Total	Structure index %	Rate per 10,000 inhabitants	Total	Structure index %	Rate per 10,000 inhabitants	Total	Structure index %	Rate per 10,000 inhabitants	Total	Structure index %	Rate per 10,000 inhabitants
Malignant neoplasms of the lips and oral cavity (C00-C08)	0	0	0	0	0	0	0	0	0	3	0	0
Malignant neoplasms of the lips and oral cavity (K00)	22	1.9	12	403	1.9	92	1.810	5	91	9.762	3.3	213
Malignant neoplasms of the lips and oral cavity (K01)	12	1	6	77	0.4	18	532	1.5	27	3.752	1.3	213
Dental caries (K02)	476	40.1	250	9.843	46	2.238	18.546	51.5	934	131.514	43,9	82
Malignant neoplasms of the lips and oral cavity (K03)	9	0,8	5	1.258	6	292	1.701	4.7	86	13.620	4.5	2.871
Dental pulp and periapical tissue diseases (K04)	580	48.9	304	6.015	28.1	1.368	9.236	25.6	465	76.119	25.4	297
Gingivitis and periodontal diseases (K05)	17	1.4	9	763	3.6	173	1.644	4.6	83	14.362	4.8	1.662
Other disorders of the gingiva and alveolar arch (K06)	4	0.3	2	52	0.2	12	9	0.3	5	1.540	0.5	34
Dentofacial anomalies / including malocclusion (K07)	8	0.7	4	2.505	11.7	570	821	2.3	41	38.505	12.8	841
Other disorders of teeth and supporting structures (K08)	3	0.3	2	209	1	48	344	1	17	4.909	1.6	107
Oral cysts not elsewhere classified (K09)	6	0.5	3	4	0	1	9	0	0	269	0.1	6
Other diseases of the jaw (K10)	6	0.5	3	24	0.1	5	838	2.3	42	3.160	1.2	79
Diseases of the salivary glands (K11)	0	0	0	2	0	0	10	0	1	59	0	1
Stomatitis and related lesions (K12)	1	0.1	0	86	0.4	20	269	0.7	14	995	0.3	22
Other diseases of lips and mucous membranes of oral cavity (K13)	0	0	0	22	0.1	5	80	0.2	4	456	0.2	10
Diseases of the tongue (K14)	1	0.1	1	4	0	1	8	0	0	36	0	1
Face and oral cavity injuries (S00-S09, T00-T04, T20, T90)	42	3.5	22	88	0.4	20	99	0.3	5	248	0.1	5
TOTAL	1.187	100	21.382	21.382	100	4.862	36.038	100	1.814	299.756	100	6.544



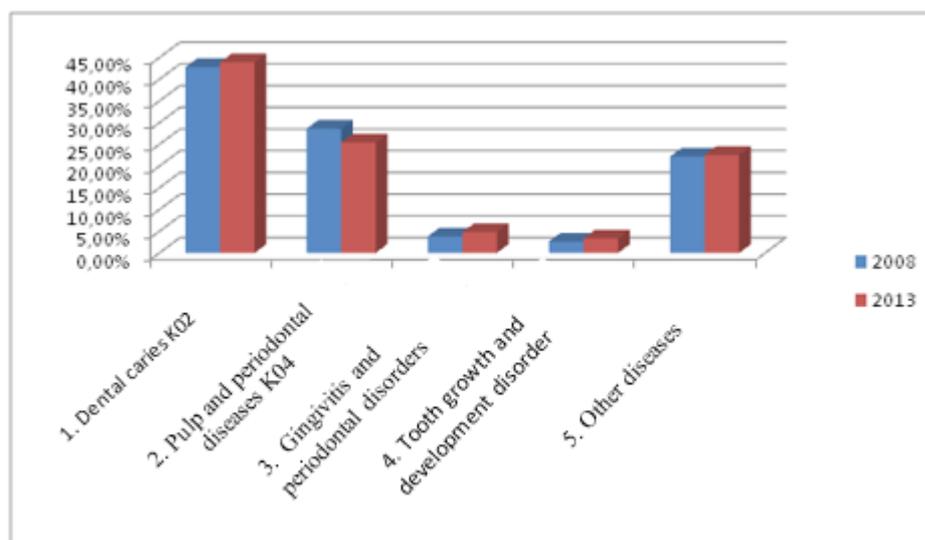
Graph 3. Leading diseases in dental care at HNK in children aged 0-6 in 2008 and 2013



Graph 4. Leading diseases in dental care in FB&H in children aged 0-6 in 2008 and 2013



Graph 5. Leading diseases in dental care at HNK among young people aged 7-18 in 2008 and 2013



Graph 6. Leading diseases in dental care in FB&H among youth aged 7-18 in 2008 and 2013

DISCUSSION

Dental caries / K02 / takes the first place on the list of diseases in the field of dental activity, in all age groups. In 2008, in the area of HNK, the total percentage of caries in 2008 in children aged 0-6 years, who were examined in dental care points, was 50.4%. This percentage is significantly higher than the percentage of caries in the entire FB&H, for the same target group, which was 42.3%. In children aged 7-18, in the same year, the percentage of caries in the HNK was slightly lower and amounted to 48.4%, which is again higher than in the FB&H, where the percentage was 42.8%.

In 2013, in HNK, for children aged 0-6, the percentage of caries decreased significantly compared to 2008, and amounted to 40.1%, however, in the FB&H we have a significant increase in caries in which it amounts to 51.5%. In children aged 7-18 in the area of HNK, we have a slight decrease compared to 2008, and the percentage of caries is 46%. In the FB&H we have a percentage of 43.9% percent of caries, which is less than in the HNK.

Diseases of the pulp and periapical tissue / K04 /, which most often occur as a result of caries, take second place on the list of diseases in all age groups.

In the area of HNK, in 2008, for the age group 0-6, we had a percentage of pulpal diseases of 27.7%. However, already in 2013, we had a significant increase in the percentage of pulp diseases, which amounted to 48.9%. In 2008, the percentage of pulpitis in HNK was lower compared to FB&H (30%). In 2013, we have an increase in the number of pulpitis compared to FB&H (25.6%), and at the same time there is a visible trend of decreasing pulpitis in FB&H, compared to 2008.

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ADDITIONAL EXTRACURRICULAR TEACHING OF MATHEMATICS

Original scientific paper

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ABSTRACT

Mathematics as a school subject in primary and secondary school is a significant problem for quite a number of students. Additional classes that are organized and conducted within schools reduce this problem, but not significantly. In supplementary classes, the same is done with large groups, but not individually, and the same teachers teach in the same way that did not give satisfactory results, and similar. For that reason, many resort to the so-called “instructions”, in other words to the extracurricular supplementary lessons of mathematics. The aim of the research is to examine, determine, analyze and present the representation of extracurricular supplementary teaching in mathematics in secondary (high school) education depending on gender, grade, socio-economic status of the family and grade point average in the past school year.

Keywords: *mathematics, teaching, supplementary, extracurricular, instruction, failure*

INTRODUCTION

“Mathematics is a symbol of our intellectual strength and a guarantee that the human mind will always fight for lofty goals” - Danilo Blanusa. Today, mathematics has developed greatly and has applications in many branches, both natural and social sciences. Mathematics emerges wherever questions related to size, structure, space, or change arise. It is taught in primary and secondary schools as a compulsory subject. Also, a large part of the faculty has compulsory and elective mathematics courses. What is characteristic of mathematics as a subject is that, as expected, it is at the top of the list of subjects with the largest number of users of private instruction. The advantage of individual instructions is that the lecturer devotes his attention and time to only one student and his needs. Thus, greater efficiency is achieved than with group instructions. In addition to the greater attention that the student receives, there is also greater freedom about arranging appointments and the duration of appointments.

As previously mentioned, the topic of this final paper is extracurricular supplementary teaching of mathematics in high school. Through this paper, we will show the prevalence of private instruction in secondary schools, what are the reasons for using the instruction and how they are implemented.

Theoretical part of the paper

“A large part of the settings and goals of modern mathematics teaching can be achieved by appropriate choice of teaching forms and teaching methods and their more frequent change. One of the characteristics of a creative mathematics teacher is mastering this skill. A creative teacher, by choosing suitable problems and applying different methods, can train students for work that is very close to research work.

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Students should be gradually and appropriately taught to analyze, synthesize, concretize, induce, deduce, generalize, specialize, and observe analogies, whether or not they later take mathematics more seriously. The mathematical way of thinking is valuable and applicable in many other industries.¹ The difficulty of mathematical content and prior knowledge of students depends on which forms of work and teaching methods the problem will be addressed later. There are two systems for teaching mathematics, and especially for developing students' ability to solve problems: problem-based teaching and heuristic teaching (Resic, 2016, p.136). There are also the following types of teaching: differentiated teaching, programmed teaching, elective, optional and additional teaching, methodology in working with gifted students, worksheets, teaching individual areas of geometry. In addition to these divisions, extracurricular supplementary classes have often been represented recently.

School supplementary classes in mathematics

Supplementary teaching is a means of pedagogical intervention in situations in which regular teaching cannot achieve satisfactory results for some students. It is organized for students who find it difficult to master parts of the prescribed program in regular classes, so they need additional help. The aim of supplementary classes is to compensate for losses in knowledge or skills and thus enable students to successfully learn mathematics. According to the Law on Upbringing and Education in Primary and Secondary School, the school is obliged to organize additional classes for students who need learning assistance. Additional classes are organized for a certain period of time when such a form of assistance to students is needed. Prema Pravilniku o normi rada nastavnika u srednjoskolskoj ustanovi ukupan broj sati dodatne i dopunske nastave ne može biti veći od broja razrednih odjeljenja u srednjoskolskoj ustanovi, s tim da jedan nastavnik može izvoditi najviše 4 sata sedmično dopunske ili dodatne nastave.² Relatively small schools, with the aim of their own advancement, have a great interest in participating in cantonal or state competitions, and in accordance with that, they assign hours of additional classes to teachers, ie students, depriving them of additional classes. When everything is taken into account, it is clear that the school can organize only one hour a week of additional classes in mathematics. One hour a week is not so bad if it were not for a class in which students from, for example, first, second and third grade car mechanics, some students from the mechanical engineering class, and nurses / technicians come to additional classes in mathematics. This is a real situation that can happen in school, and it really happens, and it is clear that

such structured supplementary classes can be very difficult to perform and, unfortunately, have no effect.³ The question is when and how much should students use this type of teaching:

- It is organized as needed, and how long it will take and which students will be involved varies throughout the year;
- The student may be included in supplementary classes once, over a longer period of time or occasionally;
- The regular teaching program is also a supplementary program.

Each hour of additional school classes must be organized as much as possible, which means that for each student (or group of students) should be determined goals and tasks, content in stages, choose appropriate methods and forms of work, teaching aids and the like. The main form of work in supplementary teaching is individual work.

What we need to take into account when organizing extracurricular supplementary classes is the following:

- Identification of students who need help and diagnosis (closer examination of the student's difficulties and search for the cause of their occurrence);
- Identifying mathematical content that the student has not mastered;
- Development of a program for each student involved in additional classes in writing;
- Monitoring and controlling the student's further progress in supplementary and regular classes.⁴

Reasons for the failure of supplementary teaching in mathematics

Perhaps the previous example best illustrates the reasons for the failure of school supplementary classes in mathematics, but we will try to single out some more. These are certainly an insufficient number of hours in which classes are realized (1 hour per week), for all students of one teacher, so students from several different classes can be in the classroom at the same time. The problem is also that additional classes must be organized in the seventh hour in order to be available to a larger number of students. It is a term when students are already quite tired and do not have the strength or will to learn content that is already difficult and uninteresting for them. Additional classes should not be taught by the same teacher who teaches regular classes. Namely, it often happens that teachers turn additional classes into a mechanical extension of regular classes, and the teacher explains mathematical contents to the student on the same examples and in the same way as he did in regular classes. Supplementary teaching could be more effective if, for example, two mathematics teachers from the same school were "replaced" by supplementary.

¹<https://element.hr/wp-content/uploads/2020/06/unutra-13501.pdf> (Accessed 05.01.2021 00:22)

²<http://www.propisi.hr/print.php?id=8361> (Accessed 05.01.2021 00:51)

³<https://hrcak.srce.hr/file/279558> (Accessed 05.01.2021 01:09)

⁴<http://evropskiuniverzitet-brcko.com/02-ID/023-Mon/Osnovi-metodike-nastave.pdf> (Accessed 05.01.2021 01:22)

This idea would be quite complex organizationally in some schools, but with more hours of such teaching it could significantly reduce the amount of private instruction.⁵ Some of the reasons are more:

- Short duration of the hour (45 minutes), and relatively long time interval between hours (one week);
- Stabilized and accumulated educational deficit in mathematics is very resilient, and can only be eliminated by long-term and permanent influences;
- Improper organization of additional classes due to didactic, methodological and psychological unpreparedness of teachers;
- When students are identified for additional classes, the cause of the difficulties is not sought;
- The student's difficulties are sometimes caused by some psychological problems, for which the teachers are not educated enough;
- When the need for additional classes ceases, the further progress of students in regular classes is not monitored enough until the problems accumulate more seriously again.⁶

After-school remedial teaching of mathematics

Mathematics as a school subject in primary and secondary schools is a significant problem for quite a number of students. Supplementary classes that are organized and conducted within regular schools reduce this problem, but not significantly. That is why many students and parents resort to the so-called. instructions, i.e. extracurricular supplementary teaching of mathematics. We are witnessing a growing interest and demand for private tuition, especially since the entrance exam became a ticket to higher education institutions.⁷ It would be wrong to view the phenomenon of instruction solely from the perspective of something that is only good or only bad. The effects of using instructions are most often both positive and negative. Private instruction or instruction can help students with lower educational attainment to master certain teaching contents and achieve better results in the exams they take, and provide those with better achievement with the possibility of further development of their own abilities and achievement of individual educational goals. In case of illness or some other justified reasons for absenteeism, the instructions help the student to master the missed material. On the other hand, attending instruction can lead to excessive reliance of students on the help of instructors and, consequently, less interest in schooling, as well as more frequent absences. However, instruction often causes feelings of incompetence, helplessness, and makes it impossible to acquire self-directed skills.⁸ Success in school requires students to successfully learn a range of subjects.

⁵<https://hrcak.srce.hr/file/279558> (Accessed 05.01.2021 01:34)

⁶ https://marul.ffst.hr/~irenavz/sadrzaji%20predavanja_files/METODIKA%201-teorijske%20osnove/A10.%20PREDAVAN-JE-DOPUNSKA/DOPUNSKA%20NASTAVA.ppt (Accessed 05.01.2021 01:46)

⁷<https://hrcak.srce.hr/file/279558> (Accessed 05.01.2021 01:46)

⁸<https://hrcak.srce.hr/file/279558> (Accessed 05.01.2021 01:52)

⁹http://darhiv.ffzg.unizg.hr/id/eprint/10956/1/Mihalic_Vlatka.pdf (Accessed 05.01.2021 02:03)

¹⁰https://www.idi.hr/wp-content/uploads/2014/03/Privatne_instrukcije_2011_Ristic_Dedic_Jokic.pdf (Accessed 05.01.2021 02:03)

Few, however, manage to excel in all subjects. Math is still an absolute favorite subject when it comes to seeking instruction. “Supplementary classes are organized and performed for students who find it difficult to progress in mastering the teaching content through regular classes” (Selimovic, Tomic, 2011, p. 324).

The emergence of private instructions

Private instruction is defined as additional instruction in school subjects. It is teaching outside of regular classes, and it refers to the subjects and contents that the student learns within the official education system. The term private instruction includes private lessons given by an individual instructor to one or a group of students, but also organized courses such as preparation for the state matura or college enrollment. Private instruction does not apply to extracurricular activities such as coaching a sport, learning an additional foreign language, attending music or dance school, etc.⁹ For an increasing number of students and their parents, participation in the teaching and learning process in the formal education system is not enough to satisfy their own desires or meet the minimum requirements that the system places on them. As a result, a significant number of students and their parents opt for additional tuition services outside the official system. At the beginning of the 21st century, the emergence of private instruction was declared a “world megatrend” in education.¹⁰ The emergence of private instruction is very complex, and the effects of using instruction are usually both positive and negative. Therefore, it is wrong to approach the analysis and consideration of this phenomenon from the position of exclusivity. Private instruction allows students with lower educational attainment to stay in the educational race, and those with better educational attainment to further develop their own abilities and achieve individual educational goals. On the other hand, attending instruction can cause students to rely excessively on the help of instructors, but also a lack of interest in schooling, as well as more frequent absences. At the same time, the consequence of private instructions can be the difficulty of teaching in the official education system. The increase in the use of private instruction can be understood in the context of a number of problems related to the effectiveness of the formal education system, the decline in the quality of teaching in schools, the (in)adequacy of the school achievement evaluation system and student overload. The use of private instruction is gaining momentum in countries where the school system fails to respond to the needs of modern society as well as to the individual needs of students, especially the needs of students with disabilities or students with special needs.

Namely, curricula are too extensive, focused on content or factual knowledge, and not on outcomes and competencies; teaching methods are often targeted at teachers rather than students, and content is fragmented, too extensive, and unrelated to personal experiences. All of this burdens students and does not prepare them appropriately for the challenges of professional and personal life. It is therefore not surprising that many students, through private tuition, seek a way out of overcoming the shortcomings of the education system.¹¹ Private tuition, instruction, learning assistance is usually understood as support for fulfilling school obligations. Private tuition is defined as additional tuition instruction provided by a private tutor for a fee, and is present at all levels of education. The curriculum for primary school prescribes compulsory subjects within which certain topics, key concepts and educational achievements are determined. Students do not learn all the knowledge of science in any subject, but only the choice determined by the Curriculum for primary school. The importance of educational strategies in teaching and social forms of work in the articulation of teaching are an important prerequisite for student success in the educational process. Grading is defined as joining a certain grade for the achieved results of students, ie classifying students into certain categories according to learning achievements and agreed criteria. Dissatisfaction with the assessment is one of the key reasons for using private instruction. The reasons for going to instruction are the need to supplement knowledge, preparation for high school and incomprehensibility of teaching topics. Most students would not omit any topic from the Curriculum, but there is a statistically significant number of students who would omit some topics in the subjects. Extracurricular supplementary teaching of mathematics is a means of pedagogical intervention in situations in which the procedures of regular teaching cannot achieve satisfactory results for a part of the students. It is organized for students who have difficulty mastering parts of the prescribed program in regular classes, so they need additional help. Its goal is to compensate for losses in knowledge or skills, and thus enable students to successfully learn mathematics. At the secondary level, both basic types of private instruction appear - individual lessons and group preparatory courses for college enrollment - and different reasons for taking instruction can be analyzed, both those related to enriching knowledge and skills and those related to overcoming. "holes" in students' knowledge, correcting negative grades and the like. Users of private tuition have less and less confidence in the educational value systems that it should provide, so they "must" turn to additional educational services.¹²

Characteristics of private instruction service providers

Private instruction providers are teachers who work in the official education system, and the main way to reach an instructor is through the recommendations of acquaintances and friends. A significant number of providers are students and experts in the field (eg mathematics or physics engineers), but also teaching staff of higher education institutions. How widespread the instructions have actually become is shown by the appearance of the so-called Education Centers. As a rule, they offer two types of services, namely private lessons and group preparations for the state matura. In addition to the above, it should be mentioned that preparations for the state matura are sometimes carried out in the organization of public institutions, cities or cantons.¹³

Causes of widespread occurrence of instruction

Analyzing the motives for using learning aids, Fox (2008) singled out four most common reasons: improving grades, preparing for school papers and tests, "filling in gaps" in knowledge, and acquiring better learning strategies. The importance of assessment is important for the life of each individual child. The foundation of psychophysical health, which is self-esteem and self-confidence, in school children largely depends on school success. Children who fail at school rarely have the opportunity to experience success in another area of life and thus compensate for the feeling of failure. Poor grades are the most common source of stress in school-age children. Stress is an integral part of life, as is poor grades, but serious problems are possible when stress becomes chronic and when a child loses a sense of control over what is happening to him. Persistent exposure to stress can cause serious health and mental health problems. In addition, the possibility of continuing education depends on school success, and behind the same grades (numbers) sometimes lie completely different knowledge and work habits. The increase in the use of private instruction should be viewed in the context of a number of problems related to the effectiveness of the formal education system, comprehensive curricula, (too) large number of textbooks, declining quality of teaching in schools, (in) adequacy of school achievement evaluation learning, low motivation for teaching, often noticeable lack of peer or parental help, and many other.¹⁴

¹¹<https://hrcak.srce.hr/file/279558> (Accessed 05.01.2021 02:03)

¹²https://marul.ffst.hr/~irenavz/sadrzaji%20predavanja_files/METODIKA%201-teorijske%20osnove/A10.%20PREDAVAN-JE-DOPUNSKA/DOPUNSKA%20NASTAVA.ppt (Accessed 05.01.2021 02:03)

¹³https://www.idi.hr/wp-content/uploads/2014/03/Privatne_instrukcije_2011_Ristic_Dedic_Jokic.pdf (Accessed 05.01.2021 02:22)

¹⁴<https://hrcak.srce.hr/file/279558> (Accessed 05.01.2021 02:43)

AL FRAMEWORK

Subject of research

The subject of this research is to examine, determine, analyze and present the representation of extracurricular supplementary teaching in mathematics in secondary education.

Research goals

1. Through the historical development and methodology of teaching mathematics to show the position of mathematics as a science in society;
2. Analyze the circumstances in which today’s high school students find themselves and explore what leads to the emergence of math instruction and why they are increasingly in demand;
3. Investigate the level of attendance of extracurricular supplementary mathematics classes with regard to various factors.

Research tasks

1. To present the historical development of mathematics as a science;
2. Define the concept of mathematics teaching methodology;
3. List the forms and types of teaching mathematics;
4. Define extracurricular supplementary teaching of mathematics and the reason for its existence;
5. Show how to organize and prepare an hour of extracurricular supplementary mathematics classes;

6. List the shortcomings of extracurricular supplementary teaching of mathematics and present the measures we can take;
7. Do research on the prevalence of extracurricular supplementary mathematics teaching in secondary schools.

General hypotheses

- H1: There are differences in the attendance of extracurricular supplementary mathematics classes according to the gender of the students.
 H2: Extracurricular supplementary mathematics classes are attended by students with above-average socio-economic status in the family.
 H3: There are differences in the attendance of extracurricular supplementary classes with regard to the school success of students.
 H4: Students sometimes use extracurricular supplementary mathematics instruction due to the overload of the mathematics curriculum.
 H5: Students find that extracurricular math classes are always used to increase their grades.

Sample research

This research will cover the population of students from I to IV grade of high schools from the area of Central Bosnia, 300 students. The sample as a subset of a population is taken for the purpose of examining the characteristics of that population and it should be representative with its abundance, sexual and age diversity. The survey was conducted through personal engagement, with the help of principals, pedagogues and high school teachers.

Interpretation of research results

First hypothesis: There are differences in the attendance of extracurricular supplementary mathematics classes according to the gender of the students.

Table 1. Indicators for arithmetic mean, standard deviation and error

Gender	Mean	Std. Deviation	Std. Error Mean
Male	3.09	.561	.09
Female	3.07	.66	.10

Table 2. There are differences in the attendance of extracurricular supplementary mathematics classes according to the gender of students.

	Levene’s Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	3.48	.07	.16	78	.87	.02	.14	-.25	.29
Equal variances not assumed			.16	76.16	.87	.02	.14	-.25	.29

After the obtained tables in SPSS and already known parameters that must be taken into account for this first hypothesis, such as the size of Sig. which when, in the Levene section, with Test for Equality of Variances, greater than .05 the first row of the table should be used. Since this is the case in our example (.07), we read the results from the first row of the table obtained in SPSS. The value of $t = .16$ as well as its significance Sig. = .88, which is above the limit value of .05 indicates that there is no statistically significant difference in the attendance

of extracurricular supplementary mathematics classes with regard to the gender of students. The mean value of this difference in the Mean Difference field can also be loaded here and it is .02. At the end of the table you can also load the lower (Lower) and upper (Upper) limits of the interval which with a probability of 95% contains the actual values of this difference and which contains the calculated value of Mean Difference. From the above we conclude that the first hypothesis has not been confirmed.

Second hypothesis: Extracurricular supplementary mathematics classes are attended by students with above-average socio-economic status in the family.

Table 3. Indicators for arithmetic mean, standard deviation and error

In order to assess the socio-economic status of his/her family?	N	Mean	Std. Deviation	Std. Error Mean
Above average	10	3.06	.55	.18
Below average	53	3.05	.58	.08

Table 4. Extracurricular supplementary mathematics classes are attended by students with above-average socio-economic status in the family.

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig	t	Df	Sig (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	.31	.58	.06	61	.95	.01	.20	-.39	.41
Equal variances not assumed			.06	13.02	.95	.01	.19	-.40	.43

After the obtained tables in SPSS and already known parameters that must be taken into account for this first hypothesis, such as the size of Sig. which when, in the Levene section, with Test for Equality of Variances, greater than .05 the first row of the table should be used. Since this is the case in our example (.58), we read the results from the first row of the table obtained in SPSS. The value of $t = .06$ as well as its significance Sig. = .95, which is above the limit value of .05 indicates that there is no statistically significant difference in the attendance of extracurricular supplementary

mathematics classes with regard to the socio-economic status of the student's family. The mean value of this difference in the Mean Difference field can also be loaded here and it is .01. At the end of the table, you can also load the lower (Lower) and upper (Upper) limits of the interval, which with a probability of 95% contains the actual magnitudes of this difference and which contains the calculated value of Mean Difference. From the above, we conclude that the second hypothesis has not been confirmed.

Hypothesis three: There are differences in the attendance of extracurricular supplementary classes with regard to the school success of students.

Table 5. Indicators for arithmetic mean, standard deviation and error

	Mean	Std. Deviation	Std. Error Mean
Your grade point average this school year	2.00	1.04	.12
	3.08	.61	.07

Table 6. There are differences in the attendance of extracurricular supplementary classes with regard to the school success of students.

	Test value = 3					
	t	df	Sig (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Your grade point average this school year	-8.57	79	.00	-1.00	-1.23	-.77

The value of $t = -8.57$ as well as its significance $Sig. = .00$, which is below the limit value of $.05$ indicates that there is a statistically significant difference in the attendance of extracurricular supplementary mathematics classes with regard to student achievement. The mean value of this difference in the Mean Difference field can also be loaded here and it is -1.00 .

At the end of the table you can also load the lower (Lower) and upper (Upper) limits of the interval which with a probability of 95% contains the actual values of this difference and which contains the calculated value of Mean Difference. From the above, we conclude that the third hypothesis has been confirmed.

Hypothesis four: Students sometimes use extracurricular supplementary mathematics instruction due to the overload of the mathematics curriculum.

Table 7. Indicator of the total number of respondents and the arithmetic mean.

N	Valid	300
	Missing	0
	Mean	3.31

In the mentioned research, there are a total of 300 respondents and 0 missing respondents. The mean value is 3.31.

Table 8. Students sometimes use extracurricular supplementary teaching of mathematics due to the overload of the mathematics curriculum.

	Percent	Valid Percent	Cumulative Percent
Valid			
Never answers for me	13.8	13.8	13.8
Rarely answers for me	13.8	13.8	27.5
Sometimes answers for me	26.3	26.3	53.8
Often answers for me	20.0	20.0	73.8
Always answers for me	26.3	26.3	
Total			

The first column contains the categories of the variable using private instruction due to curriculum overload, never responding to me, rarely responding to me, sometimes responding to me, often responding to me, and always appropriate to me. In our case, the percentages, as found in the second Percent column, are 13.8% never, 13.8% rare, 26.3% sometimes, 20.0% frequent, and 26.3% always. The third column Valid Percent talks about the percentage of respondents in relation to the valid number of respondents 300 in this case. The last column of the Cumulative Percent gives the

cumulative percentages, ie it represents the sum of the percentages of the given students with the percentages of the previous students. Since the average value is 3.31, this means that students sometimes attend extracurricular supplementary mathematics classes due to the overload of the mathematics curriculum. Accordingly, we conclude that the fifth hypothesis is confirmed. We also have a graphical representation of the data, in a bar chart.

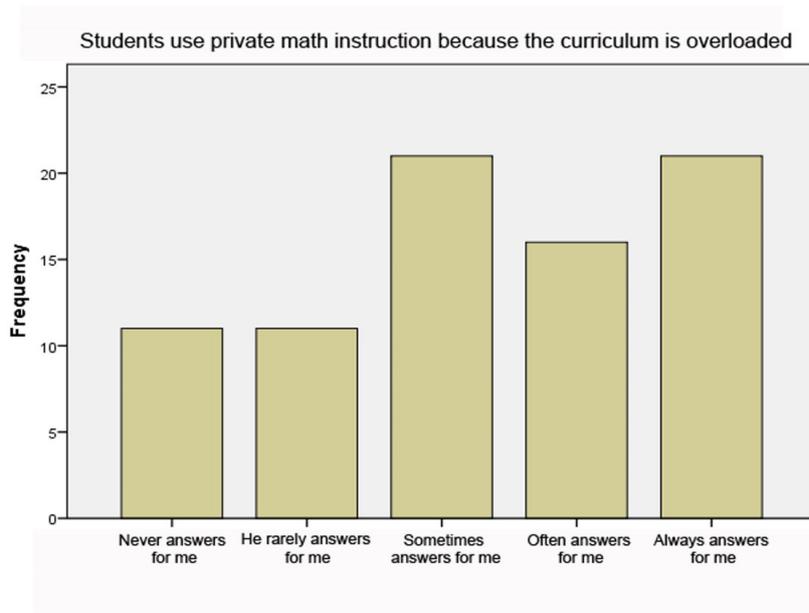


Figure 1. Graphic presentation of data on the use of extracurricular supplementary mathematics teaching due to curriculum overload

Hypothesis Five: Students believe that extracurricular mathematics instruction is always used to increase their grades.

Table 9. Indicator of the total number of respondents and the arithmetic mean.

N	Valid	300
	Missing	0
	Mean	4.10

In the mentioned research, there are a total of 80 respondents and 0 missing respondents. The mean value is 4.10.

Table 10. Students always use extracurricular supplementary mathematics instruction to increase their grades.

	Percent	Valid Percent	Cumulative Percent
Valid			
Never answers for me	2.5	2.5	2.5
Rarely answers for me			
Sometimes answers for me	7.5	7.5	10.0
Often answers for me	16.3	16.3	26.3
Always answers for me			
Total	25.0	25.0	51.2
	48.8	48.8	
	100	100	100

The first column contains the categories of the variable using private instruction due to curriculum overload, never answers for me, rarely answers for me, sometimes answers for me, often answers for me, and always answers for me. The second column of the Frequency table contains the designations of the categories for which the frequencies were determined and next to them the total sample size. In our case, the percentages, as found in the second Percent column, are 2.5% never, 7.5% rarely, 16.3% sometimes, 25.0% often, and 48.8% always. The third column Valid Percent talks about the percentage of

respondents in relation to the valid number of respondents 300 in this case. The last column of the Cumulative Percent gives the cumulative percentages, ie it represents the sum of the percentages of the given students with the percentages of the previous students. Since the mean is 4.1, this means that students often attend extracurricular supplementary mathematics classes to increase their grades. Accordingly, we conclude that the sixth hypothesis has not been confirmed. We also have a graphical representation of the data, in a bar chart.

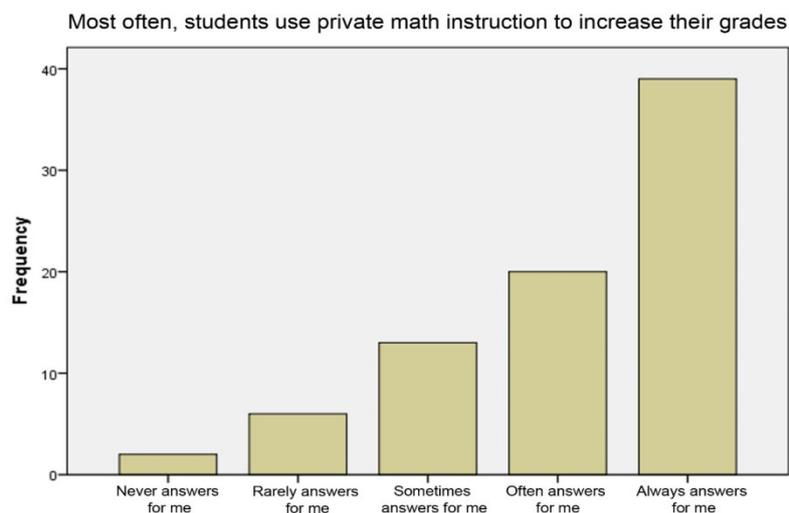


Figure 2. Graphic presentation of data on the use of extracurricular supplementary mathematics teaching due to the increase in grades.

DISCUSSION AND CONCLUSION

When it comes to mathematics, it is a subject that requires systematic and regular work, which students do not do. It is also a subject that is designed in such a way that if you do not adopt a part of the content at a satisfactory level, it is very likely that it will cause significant problems in the adoption of other content. The basic function of instruction at the high school level is to correct or increase one's grades. Students use instructions to correct units or correct poor grades and before the test itself. The fact of using instructions before the examination itself or in the case when "worst grade" have already been obtained, confirms the irregularity and unsystematic work of students and the need to quickly acquire some knowledge before the examination itself. Second and more important, the instructions are mostly used by students who perform less well in mathematics. The system, through the improvement of the model of additional classes and greater individualization and differentiation in regular classes, should provide these students with better support and help them acquire the basic knowledge and skills necessary to meet the minimum required for passing the grade. The analysis of the causes of the emergence of private instruction clearly indicates the insufficient development of learning competence as a key element underlying the demand for private instruction services. Students do not have the habit of regular learning, they are not independent in learning, the system does not teach them how to learn, and their teachers claim that they do not know how to learn. In an environment of such dominant learning patterns, as well as a general lack of motivational readiness of students to invest effort and dedicated learning, private instruction emerges as a mechanism that (from a student perspective) quickly and effectively "solves the

problem", helps prepare for the test, corrects negative grades, "Filling gaps in knowledge", etc. However, this often does not ensure the acquisition of lasting knowledge and skills in certain areas of learning, does not develop a positive motivational basis for independent learning and hard work, nor strengthens various key competencies of students needed as a basis for participation in lifelong learning. All of the above points to the need for systematic work on fostering the "learn how to learn" competence. The introduction of a program to encourage this competence could, in addition to the development of competence in students and teachers, also have positive effects on curbing the emergence of private instruction.

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