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Oral health, dental care and health behaviour in three different special needs patient groups

Ph.D. Thesis

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List of abbreviations

CP	cerebral palsy
df-T	decayed, filled deciduous teeth
DMF-T	decayed, missing, filled teeth
FIM	Functional Independence Measure
FSZOI	Department of Community Dentistry, Faculty of Dentistry, Semmelweis University (Hungarian acronym)
GMFCS	Gross Motor Function Classification System
ICD- 10	International Statistical Classification of Diseases and Related Health Problems- 10th revision
ICF	The International Classification of Functioning, Disability and Health
ICIDH	International Classification of Impairments, Disabilities and Handicaps
OORI	National Institute of Medical Rehabilitation (Hungarian acronym)
PAK	András Pető Faculty, Semmelweis University (Hungarian acronym)
PD	physical disability
PM&R	physical medicine and rehabilitation
RI	restorative index
WHO	World Health Organization

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1. Introduction

1.1 *Prevalence and demographic characteristics of disability*

More than 1 billion people are estimated to live with some form of disability as discussed in the World Health Organization's (WHO) world report. It is about 15% of the planet's population *(WHO 2011)* According to the national census of 2011, the total number of people living with disabilities in Hungary was around 500,000 almost half of them with physical disability (PD). The number of children (aged 0-19 years) living with disability can be around 35,100 and movement deficiencies are around 7,000. Table 1. shows that people with PD form the largest group in terms of the type of disability. The following large groups are people with vision impairment and deaf or hard of hearing. It is visible that their number increases with age. *(Központi Statisztikai Hivatal 2011)* Based on data from the 2016 microcensus the number of people living with disability reduced by 80.000 people. It can be explain by the transformation of social benefits system related to a medical condition. All of these in the register of the Central Administration of National Pension Insurance from 2011 to 2012 the number of recipients of health-related benefits decreased by 70,000. *(Központi Statisztikai Hivatal 2016)* The number of ageing people is increasing in the world, as well as their lifespan. An ageing population gives rise to a higher risk of disability. In the future, more and more elders will have suffered from disabilities as a result of non-communicable diseases, like diabetes, cancer, chronic respiratory and heart disease. *(Prynn et al. 2019)*

Table 1. *People living with disability by age and the type of disability (Központi Statisztikai Hivatal 2011)*

Type of disability/age groups	–14	15–19	20–29	30–39	40–49	50–59	60–69	70–79	80–	Summary
Physical disability	4 573	2 391	5 256	9 573	16 861	50 416	56 430	51 059	35 647	**232 206**
Vision impairment	2 344	1 717	3 238	4 377	5 811	12 555	12 695	14 593	16 100	73 430
Blindness	247	186	457	699	780	1 358	1 635	1 724	1 968	9 054
Mental disability	6 094	4 083	7 307	7 719	6 076	5 182	3 050	1 854	1 414	42 779
Autism	2 598	735	1 071	364	165	88	46	32	21	5 120
Mental handicap	1 648	1 059	2 804	5 216	7 392	12 770	6 897	4 517	3 962	46 265

Hard of hearing	1 596	865	1 864	2 827	3 831	8 005	10 959	14 055	19 012	63 014
Deafness	378	264	645	1 025	1 190	1 544	1 366	1 141	1 018	8 571
Deafblindness (visually and hearing impairment)	124	61	141	172	245	592	603	583	741	3 262
Speech disorder	2 151	760	1 422	1 746	1 767	2 559	2 057	1 320	746	14 528
Speech impairment	1 962	598	1 114	1 070	1 076	1 614	1 637	1 123	719	10 913
Severe visceral impairment	2 160	764	1 546	2 618	4 224	11 887	10 379	8 224	4 846	46 648
Other	260	105	146	205	267	519	364	261	150	2 277
Unknown	2 329	999	1 687	2 803	3 961	8 804	7 756	5 507	3 274	37 120
People with disability	23 190	11 931	23 059	33 817	45 102	98 384	98 744	88 033	68 318	**490 578**

1.2 *Defining disability*

In 1980, the WHO published International Classification of Impairments, Disabilities and Handicaps (ICIDH) describing the process of disability (Figure 1). According to this, developmental disorders, injuries, diseases, as well as environmental factors, societal expectations and attitudes can lead to impairments, disabilities and handicaps, all in one direction, putting the individual in an ever-worsening situation. This process has been called a disability process. It examines people not only as a biological being (the disorders of which are impairments), but also as a person (the functional disorders of this level are disabilities) and as a social being (the permanent disadvantage that develops here is handicap). It classifies disturbances and problems into these three "dimensions". *(WHO 1980)* Several studies have been conducted on the possible areas of application e.g. conceptual development in interdisciplinary fields related to disability; medical and rehabilitation monitoring systems; survey research; database development; clinical diagnosis and rehabilitation assessment; and program evaluation. There has been some criticism of the classification from professionals and people living with disabilities in 1994 when ICIDH had been translated into 13 languages. (*AIHW 2002)*

Figure 1. *Process of disability (WHO 1980)*

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After 7 years of revisions new version, The International Classification of Functioning, Disability and Health (ICF) was published in 2001. The development involved not only medical professionals, but also special education teachers, psychologists, and representatives of international organizations of people with disabilities and the social sciences. Under the new interpretation, functions can be impaired, activity may become limited, and participation in social life can be restricted. Together, these disorders are collectively referred to as disability by the WHO.

This framework describes disability as a life experience that anyone can gain at any time if there is a problem with their functioning. The model mentions interactions between different factors rather than describing a disability process (Figure 2). In this new classification, environmental and personal factors appear as influencing factors of functioning and disability. *(WHO 2001)*

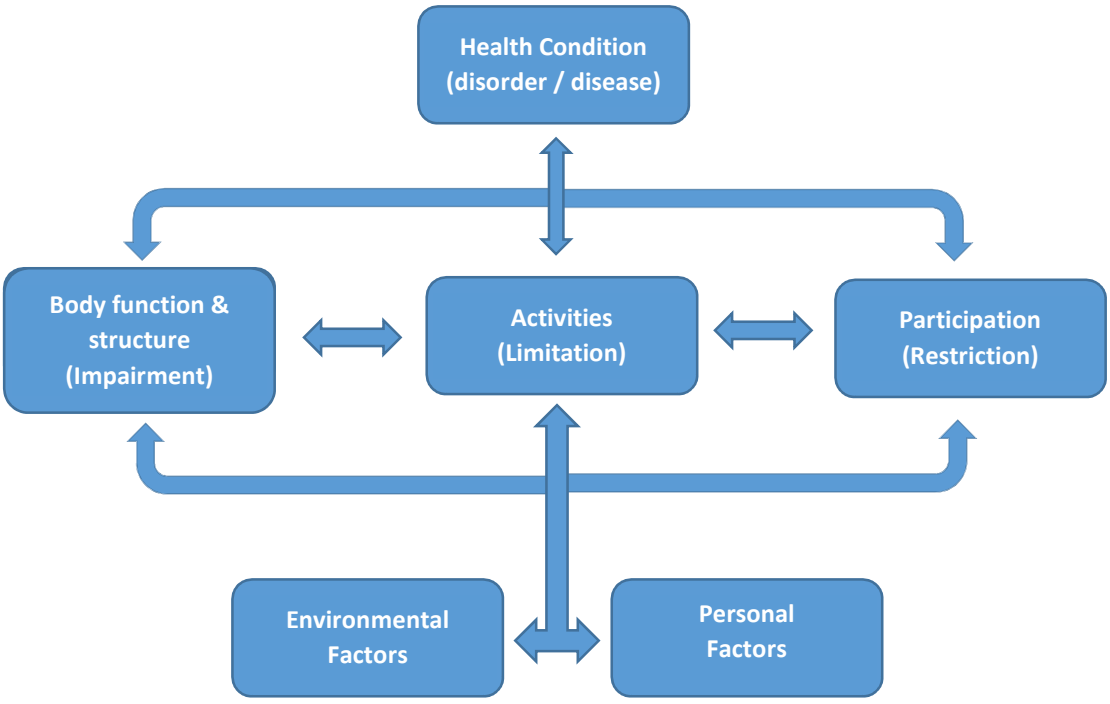

Figure 2. *Factors influencing disability (WHO 2001)*

The rights of people living with disabilities for receiving care are set out by legal acts in Hungary. Hence there are no regularly collected data on indicators of access to care or whether these legal requirements are actually met. According to the Act No. 26 of 1998 on assuring equal opportunity for persons with disabilities, the particular disability must

be taken into account when providing care to improve or prevent the deterioration of one's health. The act also describes a holistic approach towards the care of persons with disabilities and regulates the provision of special training of carers. *(Fot. 1998)* The Hungarian Central Statistical Office reports some data based on the regular censuses of the general population from time to time yet these reports contain information on the demographics of the disabled, and describe access to social care in broad terms. *(Központi Statisztikai Hivatal 2011, 2016)* The Hungary healthcare system is not dedicated guidance or clinical pathways for the management of complex dental care for those with disabilities This lower level regulation is responsible for that in practice, the community-based dental care system take care of the oral health of patients with special needs. It has been possible since 2013 of one-day dental care under general anesthesia to conclude contracts with key dental institutions, for which it also provides funding. This step contributed greatly the dental treatment of intellectual disabled patients. *(Korm. rendelet, 1999)* However, in our opinion, the first step would be dental prevention and proper education of caregivers and family members, regardless of any type of disability.

1.3 *Physical Medicine and Rehabilitation*

Rehabilitation is an organized assistance provided by society to a person with disability due to temporary or permanent impairment of health, physical or mental well-being in order to regain a place in society using the restored or remaining abilities. *(Eütv. 1997)* Rehabilitation is one of the main health strategies of the health system (Preventive, Curative, Rehabilitative, Palliative care). In the 19th and 20th centuries Preventive and Curative strategies were the guiding principles. Thanks to their success, epidemiological explosion has emerged by the 21st century, such as aging population and major changes in the main causes of death. Thus, the challenge of this century is not only to prevent and cure, but also to maintain the health of elderly with many chronic illnesses and disabilities. The aim is to optimize health capacity and enhance facilitating environment. Obviously rehabilitation is the key strategy for 21st century. (*European Physical and Rehabilitation Medicine Bodies Alliance, 2018)*

Rehabilitation is needed when a person is experiencing limitations in their daily lives due to their age or health condition (chronic illnesses, developmental disorders, injuries). Limitation may be difficulty in moving, communicating, thinking, seeing, hearing. The

patient's willingness to cooperate and his mental capacity, as well as physical activity for movement therapy and the use of assistive devices, are essential for successful rehabilitation. The lifestyle before the trauma or illness can also be an important factor in the implementation of rehabilitation. *(Vekerdy-Nagy, 2017)* The aim of Physical Medicine and Rehabilitation (PM&R) is to enhance and restore functional ability and quality of life to those with disability. Rehabilitation has some features that are unique in areas of medicine. Other medical specialties focus on a medical cure, rehabilitation is a teamwork, containing functional diagnostics, complex human approach, maximizing the independence in activities of daily living and improving quality of life of patients'. *(Gutenbrunner et al, 2011, Vekerdy-Nagy, 2010)*

Components of PM&R programme:

- Rehabilitation team - the most common members are a rehabilitation specialist, a nurse, a physiotherapist, a psychologist, a social worker and a rehabilitation occupational therapist. Their joint work will be successful if everyone knows their own role and is able to make independent decisions within their field.
- Examinations – of pain, the joint range of motion and muscle strength through functional tests that are close to everyday life situations (walking, standing up, stair climbing). Measuring the activity of daily living with functional test like Functional Independence Measure (FIM) (independence for self-care and self-sufficiency) and Barthel index (performance in activities of daily living). The team collect data about the patient's physical capacity, the mental status, the cooperation willingness and their quality of life.
- Diagnosing – and defining achievable goals, creating a personalized plan for rehabilitation: its starting point is the set of functional disorders in addition the patient's underlying diseases. Choosing assistive devices if necessary.
- Evaluation - of results and repeating the examinations. Making revision on the plan if necessary.
- Adaptation - to the home environment, continuing. This is one of the biggest challenges in rehabilitation, as the continuity of the patient's treatment is interrupted. It is important that the patient adheres to the recommendations set by the rehabilitation team. The attitudes of relatives can also contribute to achieving

long-term goals. To educate them is a key. Subsequent monitoring and follow-up are required. *(Vekerdy-Nagy, 2010, Vekerdy-Nagy, 2017)*

1.4 *Home of Medical Rehabilitation in Hungary*

The National Institute of Medical Rehabilitation (OORI) is the largest rehabilitation centre in Hungary. Patients come from any part of the country by referral. Rehabilitation care is provided in 422 beds in 9 departments for all ages. The names of the departments reflect that the institute covers the full spectrum of physical medicine and rehabilitation treatments.

- Department of Orthopaedic Surgery
- Surgical and Rehabilitation Department of Amputations
- Rehabilitation Department of Traumatic Injuries
- Rehabilitation Department of Spinal Cord Injuries
- Rehabilitation Department of Hemiplegics
- Rehabilitation Department of Brain Injuries
- Department of Septic Locomotor Rehabilitation
- Rehabilitation Ward of patients with different disabilities
- Department of Psychosomatic and Psychotherapeutic Rehabilitation

In 2019 (this year is a good reference, later with the onset of the pandemic, serious changes have taken place in the health care system) 3308 patients was hospitalized. Out of them 2641 inpatients take part in the rehabilitation programme, the other received active care (surgical). In 2019 The Department of Rehabilitation Medicine has been set up at Semmelweis University. It is an independent organizational unit at the basis of OORI. *(NEAK, 2019, OORI webpage)*

Afterwards in 2021 structural changes have taken place: the institute was merged with National Institute of Rheumatology and Physiotherapy into Institute of Locomotor Diseases and Disabilities. *(OMINT webpage)* These changes did not affect our dental program.

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1.5 *Conductive Education*

Most children with cerebral palsy (CP) will go through traditional medical therapies and conventional educational programs. These programs are designed to provide children public education. Providing supports to maximize their ability to learn and interact with their peers in an educational environment. (*Wimalasundera et al, 2016)* But there is another educational approach to support learning, this is conductive education.

Conductive education is a comprehensive method of learning for children and adults with locomotor disabilities caused by CP. Conductive education using specialized learning strategies for motor dysfunction to attain "orthofunction". This program is not medically based but task oriented. Conductive education was founded by and named after Professor András Pető, Hungarian physician. This method is based on educational intervention which integrated education and rehabilitation goals into this program. Conductive education provides structured program to functional mobility, self-care skills, cognitive and social skill development. Enhance independence, self-efficacy and communication in the child. *(Bourke-Taylor et al, 2007)*

Six components of conductive education:

- Conductors – are the persons who facilitate conductive education, their goal is to achieve an orthofunctioning personality. Conductors work with the student group, they are monitoring education.
- Group Dynamic – group activities are segmented intentional activities where children learn how to complete tasks within their skill levels. Interactions with others in real-life settings provides encouragement, social skill development, behaviour modification and friendship.
- Facilitation – is the basis of conductive education. The goal of it is to enable a child to complete tasks independently. Facilitation can be verbal and hands-on assisted.
- Daily Routine – is important in conductive education. The daily routine breaks into sequence of actions and become habit-forming.
- Rhythmic Intention – an alternative way of learning with the rhythm of action poured into words using language and music to regulate their movements.

- Task Series – help children gain control of their movement and improve their cognitive functioning. These series are transferable into many situations they will encounter throughout life. They learn to plan out the process to perform a task based on skills already developed. *(Kállay et al, 2018)*

1.6 *Home of Conductive Education in Hungary*

The András Pető Institute is a unique centre of conductive education. It provides conductive education for children and adults, in addition perform training for conductors. The three departments are adjusted for age and located in two bases in Budapest.

- Practice Kindergarten
- Conductive Practice School and Dorm
- Rehabilitation and Adult Care Department.

The institute is international, it receives patients from all over the world for high intensity short interval conductive education. In 2017 the institute was integrated into Semmelweis University as András Pető Faculty (PAK). *(PAK webpage)*

1.7 *Effect of disability on oral health*

It is expected that disability is an increased risk of oral disease and neglected oral care. Loss of function have a negative impact of one's general and oral hygiene caused by impaired mobility, lost autonomy or dependence on a caregiver. *(Pakpour et al, 2016)* The mean obstacles are fear, dependency, access to care and lack of training of the dental professional with special needs patients. Therefore, people with disability experience more frequent oral health problems than their nondisabled peers. Oral health and general health are in tight connection because numerous diseases and conditions can manifest in the mouth. The reverse is also true, oral health has a direct impact on general health. This is especially important as better oral hygiene leads to a better quality of life. *(Davies et al, 2000, Sharma et al, 2016)*

Due to impaired mobility or low manual dexterity, tooth cleansing is more difficult for the people with disability. Previous studies have indicated that these patients cannot perform the recommended frequency of tooth brushing. *(Miniham et al, 2014, Pradhan et al, 2019b)* An additional problem can be because of inability to chew properly due to

paralysis of the facial muscles or problems with movement of the tongue and dysphagia, food cannot leave the oral cavity completely. Food remains in their mouths for a longer period of time, this can set off a cascade leading to tooth decay, gingivitis, periodontitis and mouth infections. *(Németh et al, 2018, Orsós et al, 2019)*

Another serious factors are chronic pain conditions. People with disability often experience pain soon after onset the impairment. They are frequently prescribed painkillers to manage this chronic pain, which can conceal symptoms arising from oral diseases as well. *(Dudgeon et al, 2006, Ehde et al, 2003)* Consequently, this group of patients may only consult a dentist at the point of having unbearable pain, usually when restorative dental treatment is unlikely to be possible. *(Orsós et al, 2021b)*

People with disability experience a range of obstacles to access health care.

Attitudinal barriers:

- People with disability often report experiences of stigma and discrimination by health care providers and receive poor quality services.
- Many health care providers have limited knowledge of the rights of people with disability and their health needs.
- Health professionals do not have the adequate training for treating patients with special needs.
- Many health care services do not have guidelines how to treat this group of patients, longer treatment times, health care education, prevention. *(WHO 2021)*

These obstacles are also in dental care system. There is no specialization in Hungary for special needs patients dental care. Mostly these disabled patients visit dentist who has no professional experience with special needs patients. It requires adaptation from the dentist also, because it is often not possible to use the dental chair. A pilot study surveyed CP children in which Gross Motor Function Classification System (GMFCS) groups can only be examined and treated in a wheelchair. *(S. Hesz et al, 2021)* When they still manage to treat them, they receive reduced oral health care often on a lower quality and the type of dental care may be determined more by the disability than the oral condition. People with special needs require special oral care, whereas people with special needs would require a holistic approach to their oral care. *(Desai et al, 2001, Pradhan et al, 2009a)* The mean

objective of this study is to educate the general public of the dental care needs of people with disabilities and also highlight the difficulties in accessing proper dental care.

At present, there is not enough data in the literature to allow a meta-analysis or systematic review on this topic. That is why our research is important and fills in the gaps in knowledge.

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2. Objectives

During my doctoral work, my aims were the following in three cross-sectional study:

I-II.

Creating a database on dental care, health behaviour and nutritional habits of ***inpatients undergoing Physical Medicine and Rehabilitation and physically disabled inpatients undergoing Physical Medicine and Rehabilitation.***

1: Assessing DMF-T (decayed, missing, filled teeth) scores in this two special needs patients groups.

2: Determining the dental care with restorative index (RI).

3: Investigating the effect of dental care, health behaviour, nutritional habits, age and gender on DMF-T scores.

III.

Creating a database on dental care, health behaviour and nutritional habits of ***children with cerebral palsy during Conductive Education.***

1: Assessing DMF-T/df-t (decayed, filled deciduous teeth) scores in this special needs patients group.

2: Determining the dental care with RI.

3: Investigating the effect of dental care, health behaviour, nutritional habits, age, gender, GMFCS on DMF-T/df-t and the toothbrushing performance on gingivitis and on DMF-T/df-t scores.

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3. Methods

3.1 *Oral health, dental care and health behaviour of inpatients undergoing Physical Medicine and Rehabilitation*

In 2015 a co-operation was established between the Department of Community Dentistry (FSZOI) and OORI which resulted the opening of a dental office in OORI for inpatients undergoing rehabilitation. The study was conducted at that place. It was prior approved by the Medical Research Council, Hungary (ETT TUKEB IV/1433-1/2020/EKU). The procedures included in the study were thoroughly explained to the participants, thereafter they signed consent. Parents and legal guardians gave the consent for patients under 18. Personal information of the participants such as their name, address and social security number were excluded from the analysis.

Patients

In the dental office of OORI 608 inpatients (in the rehabilitation program) were examined.

Data collection

Prior to assessing the patients in the sample, the examiner dentists achieved a Kappa score of 0.81 during calibration. The examiners used plane mouth mirror, a blunt dental probe and artificial light. Regarding to DMF-T score decayed, missing, filled or sound teeth were recorded. Caries lesion or filled tooth with decay recorded as decayed (D) teeth. If the teeth were missing of any reason counted as missing (M) teeth. Any type or material of filling in the teeth without caries lesion recorded as filled (F) teeth. Teeth (T) without dental caries or restoration were coded as sound.

RI formula (RI=F/(D+F)*100) was calculated from the dental status of the examined population.

The dental examination and questionnaire were based on the recommendations of Oral health surveys: basic methods - 5th edition, WHO. It asked on oral hygiene (frequency of tooth-brushing, mouthwash usage), health behaviour (eating habits, alcohol and tobacco consumption) and dental care (last visit to a dentist). (Appendix 1.) Sociodemographic data such as age, gender, permanent address, employment status and educational level of

patients were assessed. The education level was categorized into three groups: primary (completed primary or elementary school), secondary (high school or vocational school), tertiary (college or university).

FIM scores were collected which is a functional test for patients in rehabilitation program, it measures the patients' functional status and activities of daily living such as self-care, eating, grooming, bathing, dressing, toileting, swallowing, sphincter control, mobility, transfer and locomotion. It shows the dependency at the start and at the end of the rehabilitation and the improvement of the patient. Possible FIM scores range from 18 to 126.

Statistical analysis

Prior to start the study a collaboration was established between the dental research group and the scientists of Wigner Research Centre for Physics, Budapest. They developed a special application and software on tablets for the data collection which upload immediately data to the Cloud area allocated to the Hungarian Academy of Science. R software was used for statistical analysis (9205 NW 101st St, Miami, Florida, United States).

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3.2 *Oral health, dental care and health behaviour of physically disabled inpatients undergoing Physical Medicine and Rehabilitation*

The methodology is described in 3.1, with exception:

Patients

Patients with PD were identified through medical records by using International Statistical Classification of Diseases and Related Health Problems- 10th revision (ICD-10) codes that include mobility impairment. A total of 110 PD inpatients of OORI gone through dental screening.

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3.3 *Oral health, dental care and health behaviour of children with cerebral palsy during Conductive Education*

The study was conducted in the dental office of PAK. The study was approved by the Medical Research Council, Hungary (ETT TUKEB IV/1433-1/2020/EKU). Parents and legal guardians gave the consent for patients, participants over 14 provided their own consent also (the age of limited legal capacity in Hungary is 14). Personal data were omitted from the dataset before the analysis.

Patients

The dental screening was carried out on 199 children. Out of them 149 children with CP at PAK (Practice Kindergarten, Conductive Practice School and Dorm) and 50 children at a school centre as a healthy control group. Children with CP and motor dysfunction are categorized into different levels using GMFCS. It helps to describe the child's motor function and suggest equipment or mobility-aids may need in the future, e.g. crutches, walking frames or wheelchairs. The examined children were categorized into seven groups:

0 - without motor dysfunction, normal education method
1 - without motor dysfunction, conductive education method
2 - GMFCS I.
3 - GMFCS II.
4 - GMFCS III.
5 - GMFCS IV.
6 - GMFCS V.

Data collection

The clinical examination and the questionnaire were recorded by a dentist, the method of the dental screening were in accordance the recommendation of Oral health surveys: basic methods - 5th edition, WHO. As 49.3% of the children had mixed dentition, both df-t (for deciduous dentition) and DMF-T index (for permanent dentition) were assessed. The missing teeth (m) component were not included in the deciduous dentition. Gingivitis was measured with Gingival Bleeding Scores.

The dental care was measured with RI (RI=F/(D+F)*100).

Medical history, GMFCS classification and clinical data on CP were obtained from medical records. The questionnaire asked on oral hygiene practices (frequency of tooth-brushing, mouthwash usage), toothbrushing performance (independent or helped), health behaviour (eating habits, bad oral habits) and dental care (last visit to a dentist). (Appendix 2.) Sociodemographic data such as age, gender of the children and employment status, educational level of parents were assessed. In the case of dysphagia, aphasia or severe mental disability parents, legal caregivers (guardians) and conductive education teachers helped us.

Statistical analysis

For data collection the application and software were performed as in the two previous study (3.1, 3.2). R software was used for statistical analysis (9205 NW 101st St, Miami, Florida, United States).

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4. Results

4.1 *Oral health, dental care and health behaviour of inpatients undergoing Physical Medicine and Rehabilitation*

The distribution of the examined patients among the 9 department OORI are summarized in Table 2. The gender distribution is balanced, 51% of the population was male, 49% female. The mean age was 59. In terms of education and occupational status, 60% of patients had completed secondary education, and nearly two-thirds had an active occupation (76%). The distribution of permanent address is the follow, 43% live in the capital. The mean FIM, recorded at the start of the rehabilitation, was 88.09±6.81. The mean DMF-T score of the PD population was 19.36±7.46. The RI was 67,4%.

Table 2. *Distribution of the examined patients divided into departments at OORI (Orsós et al, 2018)*

Department	*n=608*
Department of Orthopaedic Surgery	**72**
Surgical and Rehabilitation Department of Amputations	**9**
Rehabilitation Department of Traumatic Injuries	**60**
Rehabilitation Department of Spinal Cord Injuries	**87**
Rehabilitation Department of Hemiplegics	**91**
Rehabilitation Department of Brain Injuries	**87**
Department of Septic Locomotor Rehabilitation	**88**
Rehabilitation Ward of patients with different disabilities	**101**
Department of Psychosomatic and Psychotherapeutic Rehabilitation	**13**

Table 3. *Mean DMF-T; D-T; M-T and F-T by age groups (Orsós et al, 2018, Moldvai et al. 2019)*

n=600	**Age**	**DMF-T**	**D-T**	**M-T**	**F-T**
10	**-19**	7,30±4,47	4,90±4,12	0,50±1,27	1,90±1,60
64	**20-34**	11,75±6,68	6,45±4,92	1,41±1,87	3,89±3,85
52	**35-44**	13,96±6,71	4,98±4,39	3,83±4,85	5,19±4,21
210	**45-64**	18,63±6,60	2,63±3,15	9,82±8,11	6,25±5,10
139	**65-74**	22,09±6,09	1,86±2,83	14,49±8,49	5,80±5,61
125	**75-**	24,66±4,62	0,98±2,44	17,31±8,90	6,08±6,10

The association of DMF-T; D-T; M-T and F-T with age groups are summarized in Table 3. The relation between D-T; M-T; F-T index and oral health behaviours are summarized in Table 4. Seventy percent of the patients did not perceive tooth pain in the past 12 months, this contradict to their high DMF-T. The last dental screening in the case of 34% of patients exceeds 24 months.

Table 4. *Relation between D-T; M-T; F-T index and oral health behaviours. Data are mean (SD) or n (Orsós et al, 2018, Moldvai et al. 2019)*

Variables	n (%)	D-T	M-T	F-T
Toothache in the past 12 months (n=596)				
Reported	172 (28.91%)	4.27 (4.47)	8.25 (7.61)	5.97 (4.99)
Not Reported	413 (69.41%)	2.18 (3.19)	11.84 (9.61)	5.62 (5.40)
Last dental visit (n=598)				
≤6 months ago	173 (28.93%)	2.03 (2.89)	10.10 (8.37)	7.53 (5.41)
6-12 months ago	134 (22.41%)	2.75 (3.65)	8.30 (7.84)	7.16 (5.34)
12-24 months ago	89 (14.88%)	2.88 (4.21)	10.48 (9.14)	4.63 (4.55)
≥24 months ago	202 (33.78%)	3.20 (3.93)	13.61 (10.28)	3.72 (4.61)
Self-reported frequency of tooth brushing (n = 598)				
Twice or more per day	345 (57.69%)	2.13 (3.22)	9.74 (8.41)	6.97 (5.33)
Daily	185 (30.94%)	3.34 (3.82)	11.57 (10.00)	4.45 (4.73)
Less than daily	68 (11.37%)	4.72 (4.85)	13.06 (9.68)	3.13 (4.55)
Device used for tooth cleansing(n = 606)				
Toothbrush (electric)	114 (18.81%)	3.05 (3.79)	6.17 (6.94)	7.01 (5.34)
Toothbrush (manual)	531 (87.62%)	2.74 (3.62)	10.64 (8.90)	5.91 (5.26)
Toothbrush (manual or electric) and mouthwash	300 (49.50%)	2.77 (3.77)	10.02 (8.50)	6.40 (5.21)
Toothbrush (manual or electric), mouthwash and dental floss or shiwak or other	51 (8.42%)	1.78 (2.26)	6.55 (6.24)	8.63 (5.41)

In terms of frequency of toothbrushing 58% of the patients brush their tooth twice or more per day and 11% less than daily. The DMF-T score increases as the frequency of brushing decreases. Most of the examined patients (88%) use manual toothbrush and the half of them (50%) combined toothbrush (manual or electric) with mouthwash.

The data on self-reported smoking, drinking and eating habits are presented in Table 5. There is no significant different in DMF-T score between self- reported smokers and no

smokers. As for nutritional habits, the five time per day consumption of products with high carbohydrate content increased the most the DMF-T score. (*Orsós et al, 2018, Moldvai et al, 2019)*

Table 5. *Relation between D-T; M-T; F-T index and self-reported smoking, drinking and eating habits (data reported as frequency, mean (SD)) (Orsós et al, 2018, Moldvai et al. 2019)*

Characteristic	n (%)	D-T	M-T	F-T
Smoking[1] (n=606)				
Yes	118 (19.47%)	4.97 (5.15)	9.86 (9.68)	4.05 (4.40)
No	448 (80.52%)	2.23 (3.05)	11.13 (9.16)	6.09 (5.40)
Alcohol consumption[2] (n=570)				
Any other reply	99 (17.37%)	3.04 (3.96)	9.67 (9.16)	5.21 (4.99)
Not in the past 30 days	471 (82.63%)	2.72 (3.63)	11.24 (9.37)	5.65 (5.31)
Daily consumption of sugar containing food and drink (n=608) [3]				
≥6	40 (6.58%)	2.25 (3.48)	12.35 (10.28)	4.53 (4.64)
5	64 (10.53%)	2.92 (3.94)	12.55 (9.45)	5.28 (5.29)
4	122 (20.06%)	2.75 (3.71)	11.66 (9.09)	5.64 (5.33)
3	159 (26.15%)	2.67 (3.70)	11.67 (9.60)	5.55 (5.42)
≤2	223 (36.68%)	2.90 (3.72)	9.12 (8.66)	6.15 (5.24)

[1]Subcategories of smoking are defined by aggregating the number of patients who reported either the permanent or occasional consumption of any tobacco product (cigarettes, cigars, pipe, snuff or any other kind)

[2]Subcategories of alcohol consumption are created by aggregating the number of patients who reported to regularly consume any amount of alcohol in the past 30 days.

[3]Subcategories of high risk food types are fresh fruit, pies and buns, jam and honey, chewing gum containing sugar, sugar or any kind of sweetener, lemonade or other soft drinks, tea served with sugar and coffee served with sugar.

4.2 *Oral health, dental care and health behaviour of physically disabled inpatients undergoing Physical Medicine and Rehabilitation*

The majority of patients (n=110) with PD were males (66 males, 44 females). The mean age was 53.68 years. In terms of education status two-thirds (65%) of patients with PD had completed secondary education. Nearly the same proportion had an active occupation (67%). The distribution within the country (36%) of the patient live in the capital. The mean FIM, recorded at the start of the rehabilitation, was 85.68±7.46. The mean DMF-T score of the PD population was 18.90±7.85. The restorative index was 52,3%. The association of DMF-T; D-T; M-T and F-T with age groups are summarized in Table 6.

Table 6. *Mean DMF-T; D-T; M-T and F-T by age groups (Orsós et al, 2021b)*

n=106	**Age**	**DMF-T**	**D-T**	**M-T**	**F-T**
2	**-19**	7,00±0,00	3,00±1,41	2,00±2,83	2,00±1,41
19	**20-34**	10,47±6,10	6,21±4,89	0,95±1,22	3,32±3,65
12	**35-44**	17,42±5,16	6,67±3,98	5,08±4,96	5,67±4,19
37	**45-64**	19,22±7,06	2,95±2,95	9,97±8,57	6,19±5,67
21	**65-74**	23,67±5,75	2,14±4,04	17,71±8,98	3,81±4,91
15	**75-**	24,87±5,25	2,47±5,11	17,67±9,93	4,73±5,30

The relation between D-T; M-T; F-T index and oral health behaviour are summarized in Table 7. Seventy-five percent of patients had not experienced dental pain in the past 12 months, in contrast their DMF-T scores are higher than the mean scores. Only 18 (17 %) patients with PD had received a full mouth examination in the recommended last 6 months. Fourteen patients had their last dental visit 12- 24 months and forty-six patients had it 24 months or later, together it is a significant proportion (58%). It is visible that the D-T and F-T scores are in correlation with the time elapsed since the last dental examination. As the time interval increased, so does D-T scores, while F-T scores decreased. Sixteen (15 %) patients reported brushing their teeth less than daily, 43 (41%) daily and 46 (44%) twice or more per day. Those who do not brush their teeth twice a day have worse values, their DMF-T are nearly 20. On the questions concerning devices used for tooth cleansing 17 (16%) patients reported using electric toothbrush, 93 (85%) manual toothbrush. Fifty-three (49%) patients used mouthwash in addition to toothbrush (manual

or electric). Of the 17 patients who wore complete denture, 8 (47%) reported using a denture cleanser.

Table 7. *Relation between D-T; M-T; F-T index and oral health behaviours of patients with PD. Data are mean (SD) or n (Orsós et al, 2021b)*

Variables	n (%)	D-T	M-T	F-T
Toothache in the past 12 months (n=105)				
Reported	30 (28.57%)	5.07 (4.82)	6.77 (7.58)	4.90 (4.93)
Not Reported	75 (71.43%)	3.23 (4.00)	11.76 (10.27)	4.77 (5.06)
Last dental visit (n = 104)				
≤6 months ago	18 (17.31%)	2.17 (2.90)	10.5 (8.71)	7.94 (5.95)
6-12 months ago	26 (25%)	3.08 (2.88)	5.92 (6.89)	7.42 (5.40)
12-24 months ago	14 (13.46%)	5.43 (6.72)	9.07 (10.56)	2.79 (3.42)
≥24 months ago	46 (44.23%)	4.20 (4.39)	13.28 (10.63)	2.74 (3.24)
Self-reported frequency of tooth brushing (n = 105)				
Twice or more per day	46 (43.81%)	3.43 (4.43)	8.50 (9.32)	5.70 (5.45)
Daily	43 (40.95%)	3.35 (3.75)	11.35 (10.27)	4.93 (4.80)
Less than daily	16 (15.24%)	5.81 (4.94)	11.38 (8.84)	2.56 (3.42)
Device used for tooth cleansing (n = 109)				
Toothbrush (electric)	17 (15.60%)	3.76 (4.10)	6.35 (8.18)	6.82 (5.58)
Toothbrush (manual)	93 (85.32%)	3.78 (4.22)	9.34 (9.28)	5.08 (4.95)
Toothbrush (manual or electric) and mouthwash	53 (48.62%)	3.92 (4.41)	7.53 (8.30)	5.98 (5.17)
Toothbrush (manual or electric), mouthwash and dental floss or shiwak or other	10 (9.17%)	1.30 (1.34)	7.70 (8.39)	8.70 (6.43)

In terms of frequency of visiting a dentist, patients who had their last dental visit within six months had the highest FIM values (97). The frequency of toothbrushing is daily or less than daily in patients with the lowest FIM values (72). Manual toothbrush user patients have 108.47 FIM value. Patients with somewhat lower FIM values (98.78) reporting the use of mouthwash with electric or manual toothbrush.

The data on self-reported smoking, drinking and eating habits are presented in Table 8. Quarter of the examined patients have reported the use of some kind of tobacco product (23%) and the consumption of alcohol in the past 30 days (25%). It is visible that the dental health status is more favourable for those who don't smoke or don't consume alcohol in the past 30 days. In terms of nutrition habits there was a correlation between

the daily consumption of alimentary products with high carbohydrate content and increased M-T index. In a particular subgroup (n=4), patients who reported consuming such products or more times per day, was the number of missing teeth the highest. *(Orsós et al, 2021b)*

Table 8. *Relation between D-T; M-T; F-T index and self-reported smoking, drinking and eating habits of patients with PD. (data reported as frequency, mean (SD)) (Orsós et al, 2021b)*

Characteristic	n (%)	D-T	M-T	F-T
Smoking[1] (n=110)				
Yes	27 (24.54%)	5.37 (5.46)	12.48 (11.40)	2.37 (3.61)
No	82 (74.54%)	3.16 (3.68)	9.52 (9.12)	5.71 (5.14)
Alcohol consumption[2] (n=102)				
Any other reply	23 (22.55%)	5.33 (5.29)	12.09 (10.91)	3 (4.09)
Not in the past 30 days	79 (77.45%)	3.42 (4.02)	9.94 (9.79)	5.08 (4.99)
Daily consumption of sugar containing food and drink (n=77) [3]				
≥6	4 (5.19%)	0.5 (0.58)	13.75 (13.28)	2.75 (3.77)
5	13 (16.88%)	3.62 (4.68)	10.92 (9.57)	5.23 (4.69)
4	15 (19.48%)	4.46 (5.14)	7.33 (7.23)	5.13 (3.77)
3	14 (18.18%)	3.57 (4.69)	11.92 (11.43)	4.21 (4.56)
≤2	31 (40.26%)	3.45 (4.29)	10.61 (11.09)	4.65 (5.28)

[1]Subcategories of smoking are defined by aggregating the number of patients who reported either the permanent or occasional consumption of any tobacco product (cigarettes, cigars, pipe, snuff or any other kind)

[2]Subcategories of alcohol consumption are created by aggregating the number of patients who reported to regularly consume any amount of alcohol in the past 30 days.

[3]Subcategories of high risk food types are fresh fruit, pies and buns, jam and honey, chewing gum containing sugar, sugar or any kind of sweetener, lemonade or other soft drinks, tea served with sugar and coffee served with sugar.

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4.3 *Oral health, dental care and health behaviour of children with cerebral palsy during Conductive Education*

The gender ration was balanced, 101 (51%) boys and 98 (49%) girls. The mean (SD) age was 9.06±3.69 years. The mean df-t and DMF-T of the population were 1.87 and 1.15. In the GMFCS level II and III groups were the highest values, with df-t 3.00 and 2.42, and DMF-T 2.00 and 1.68. (Table 9.) The restorative index was 18.12% for deciduous and 27% for permanent teeth. (Table 10.) The highest percentage for primary teeth was in normal motor function group and for permanent teeth in GMFCS III. group. (Table 9.) In terms of the type of last dental visit 69% of the patients was on consultation and 46% was on urgent or total dental care. Caries experiences was the highest in the GMFCS classification groups I and IV. The proportion of untreated dental caries among CP and healthy children was higher in primary dentition than in permanent dentition.

In terms of frequency of tooth brushing 76.9% of children clean their teeth twice a day, 30% brush with help it. In a smaller group 20% of the children teeth are brushed by parents and caregivers or conductive teachers. In Table 11. it is visible, that toothbrushing performance had a significant effect on DMF-T scores. In GMFCS groups IV and V groups (in which toothbrushing was performed by other people: parents, caregivers or conductive teachers) the prevalence of gingivitis was 67%. The predilection site of the highest prevalence of gingivitis (above 31%) was around all the upper and lower incisors and the lower canines in the whole group. The used significance level was $p \leq 0.05$. For estimating the effect of the toothbrushing performance and using electric toothbrush on gingivitis the logistic regression model was used while controlling for age and gender. The effect of electric toothbrush was not significant in the ANOVA table. The results show that age has a significant effect on gingivitis ($p=0.032$). The different effect of toothbrushing performance (alone brushing or assisted) on gingivitis controlled by age is significant.

The effect of toothbrushing performance on DMF-T was examined with negative binomial generalized linear model controlled for age and gender. The results show the outstanding effect of age: the predicted values of DMF-T are higher when we increase the age in different toothbrushing performance groups, the age and the toothbrushing performance has a significant effect on DMF-T ($p=0.0135$). *(Orsós et al, 2021a)*

Table 9. *The d, f, df-t, D-T; M-T; F-T and DMF-T (mean (SD)) scores in the examined children groups (Orsós et al, 2021a)*

	0	**1**	**2**	**3**	**4**	**5**	**6**	**Overall**
	(n=50)	**(n=19)**	**(n=34)**	**(n=19)**	**(n=29)**	**(n=30)**	**(n=18)**	**(n=199)**
d								
Mean (SD)	1.56 (±2.28)	1.32 (±2.69)	1.23 (±2.70)	2.69 (±5.36)	2.00 (±3.80)	1.41 (±2.04)	1.13 (±1.36)	1.55 (±2.91)
Missing	23 (46.0%)	0 (0%)	4 (11.8%)	6 (31.6%)	10 (34.5%)	8 (26.7%)	2 (11.1%)	53 (26.6%)
f								
Mean (SD)	0.22 (±0.641)	0.53 (±1.17)	0.07 (±0.365)	0.31 (±0.630)	0.42 (±1.02)	0.59 (±1.40)	0.25 (±1.00)	0.32 (±0.924)
Missing	23 (46.0%)	0 (0%)	4 (11.8%)	6 (31.6%)	10 (34.5%)	8 (26.7%)	2 (11.1%)	53 (26.6%)
df-t								
Mean (SD)	1.78 (±2.52)	1.84 (±3.45)	1.30 (±2.74)	3.00 (±5.28)	2.42 (±3.83)	2.00 (±2.29)	1.38 (±2.09)	1.87 (±3.12)
Missing	23 (46.0%)	0 (0%)	4 (11.8%)	6 (31.6%)	10 (34.5%)	8 (26.7%)	2 (11.1%)	53 (26.6%)
	0	**1**	**2**	**3**	**4**	**5**	**6**	**Overall**
	(n=50)	**(n=19)**	**(n=34)**	**(n=19)**	**(n=29)**	**(n=30)**	**(n=18)**	**(n=199)**
D								
Mean (SD)	0.78 (±1.84)	0.75 (±1.54)	0.94 (±2.17)	1.08 (±1.73)	0.86 (±1.17)	0.78 (±1.57)	0.623 (±1.54)	0.81 (±1.66)
Missing	1 (2.0%)	7 (36.8%)	18 (52.9%)	7 (36.8%)	7 (24.1%)	7 (23.3%)	2 (11.1%)	49 (24.6%)
M								
Mean (SD)	0.02 (±0.143)	0.00 (±0.00)	0.00 (±0.00)	0.167 (±0.577)	0.00 (±0.00)	0.00 (±0.00)	0.00 (±0.00)	0.02 (±0.182)
Missing	1 (2.0%)	7 (36.8%)	18 (52.9%)	7 (36.8%)	7 (24.1%)	7 (23.3%)	2 (11.1%)	49 (24.6%)
F								
Mean (SD)	0.25 (±0.693)	0.00 (±0.00)	0.13 (±0.500)	0.75 (±1.36)	0.82 (±1.40)	0.087 (±0.288)	0.25 (±0.683)	0.31 (±0.852)
Missing	1 (2.0%)	7 (36.8%)	18 (52.9%)	7 (36.8%)	7 (24.1%)	7 (23.3%)	2 (11.1%)	49 (24.6%)
DMF-T								
Mean (SD)	1.04 (±2.26)	0.75 (±1.54)	1.06 (±2.41)	2.00 (±3.05)	1.68 (±1.78)	0.87 (±1.58)	0.88 (±1.59)	1.15 (±2.07)
Missing	1 (2.0%)	7 (36.8%)	18 (52.9%)	7 (36.8%)	7 (24.1%)	7 (23.3%)	2 (11.1%)	49 (24.6%)

0: healthy children in normal educational method
1: normal motor function in conductive education
2: GMFCS I. Children perform gross motor skills such as walking, climbing stairs, running and jumping, but speed, balance, and coordination are limited.
3: GMFCS II. Children have only minimal ability to perform gross motor skills, may experience difficulty walking, balancing, may use hand-held mobility device for long distances.
4: GMFCS III. Children are able to walk using a hand-held mobility device and wheeled mobility when traveling long distances.
5: GMFCS IV. Children require physical assistance or powered mobility, outdoors and within the community children are transported in wheelchair.
6: GMFCS V. Children are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements, they are transported in wheelchair.

Table 10. *Restorative index of the examined children (Orsós et al, 2021a)*

	0	1	2	3	4	5	6	Overall
	(n=50)	**(n=19)**	**(n=34)**	**(n=19)**	**(n=29)**	**(n=30)**	**(n=18)**	**(n=199)**
RI $_{decidous}$								
Mean	9.43	37.95	5.00	20.37	23.33	25.64	6.25	18.12
RI $_{permanent}$								
Mean	30.48	0.00	8.33	29.17	38.89	16.67	33.33	27.00

0: healthy children in normal educational method
1: normal motor function in conductive education
2: GMFCS I. Children perform gross motor skills such as walking, climbing stairs, running and jumping, but speed, balance, and coordination are limited.
3: GMFCS II. Children have only minimal ability to perform gross motor skills, may experience difficulty walking, balancing, may use hand-held mobility device for long distances.
4: GMFCS III. Children are able to walk using a hand-held mobility device and wheeled mobility when traveling long distances.
5: GMFCS IV. Children require physical assistance or powered mobility, outdoors and within the community children are transported in wheelchair.
6: GMFCS V. Children are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements, they are transported in wheelchair.

Table 11. *DMF-T according to toothbrushing performance of the examined children (data reported as Mean (SD), median and missing data) (Orsós et al, 2021a)*

	0 (n=101)	1 (n=59)	2 (n=39)	Overall (n=199)
DMF-T				
Mean (SD)	1.34 (±2.22)	1.13 (±2.15)	0.33 (±0.658)	1.15 (±2.07)
Median (Q1, Q3)	0.00 (0.00, 2.00)	0.00 (0.00, 1.00)	0.00 (0.00, 0.00)	0.00 (0.00, 2.00)
Missing	10 (9.9%)	21 (35.6%)	18 (46.2%)	49 (24.6%)

The toothbrushing performance scores:
0: toothbrushing alone
1: toothbrushing with help of parents/ caregivers/ conductive teachers
2: totally toothbrushing by parents/ caregivers/ conductive teachers

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5. Discussion

5.1 *Oral health, dental care and health behaviour of inpatients undergoing Physical Medicine and Rehabilitation*

The examined patient group had a higher DMF-T scores than the Hungarian population's (DMF-T = 16.2) reported by *Madléna et al, 2008.* Only 30% of the inpatients reported toothache in the past 12 month, which is contradict to their oral condition. This is similar what was seen by PD patients. People with disability often experience secondary pain. This pain and also the management of it can hide the pain of dental origins. *(Dudgeon et al, 2006, Ehde et al, 2003)* The recommended semi-annual dental visit was completed by the 30% of the patients. In practice, due to the priority of other medical care, the oral health care for hospitalized patients is may neglected, however oral inflammations can have a profound impact on systemic health. *(Konkel et al, 2019)* Pre-surgical dental evaluation is a routine nowadays *(Yasny et al, 2012)*, but there is no protocol for preventing oral disease in patients undergoing rehabilitation. An important part would be a dental screening before starting PM&R to explore and manage dental inflammations.

The self- reported usage of oral hygiene devices shows that the half of the population use mouthwash in addition to toothbrush. Other studies showed that mouthwash is a good solution for people with special needs whose may experience specific problems during brushing teeth. *(Zhou et al, 2019)* Chemical mouthwash is not a substitute for mechanical cleansing, but can be a good alternative or supplement in the early stages of rehabilitation, so it can be a short term solution.

Disability is a potentially burdensome and stressful situation. To manage the demands of stressful situation coping methods, behavioural and cognitive efforts, are starting to work. *(Reuman et al, 2013)* Among the many coping strategies in stress, smoking and alcohol consumption should be highlighted. *(Patterson et al, 2012, Holahan et al, 2001)* There is a common link between these bad habits and disabilities. To overcome physical pain, frustration and lacking alternative activities they are more prone to addiction. *(Hubbard et al, 1996)* These problems occur mostly after home release, during rehabilitation smoking and alcohol consumption is rare because the hospitalization acquiring such substances is difficult.

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To replace them they use boredom snacking. *(Moynihan et al, 2015)* Consuming high risk food types containing huge amount of carbohydrate five or six times per days is in correlation with DMF-T numbers.

5.2 *Oral health, dental care and health behaviour of physically disabled inpatients undergoing Physical Medicine and Rehabilitation*

The DMF-T score of PD patients was 18.90±7.85. The most current dental screening with the same method for the Hungarian average population from *Madléna et al, 2008* reported DMF-T = 16.2. It is noticeable that disabled persons regardless the type of the disability have higher DMF-T numbers than the non-disabled counterparts. In similar studies *Lee et al, 2019* reported the same experiences.

In this study we observed the factors which impact mostly the DMF-T scores. These factors were age, frequency of dental visits and tooth brushing. *Pradhan et al, 2009b* reported the same influencing factors on caries experience in physically and mentally disabled groups. Age was a calculated risk, yet it is also an indicator of the lack of prevention.

The frequency of dental visits was not sufficient. For special needs patients it is challenging to access dental care. Even though the environment is barrier-free at general practices, the facilities are limited. *(Lawton et al, 2002, Baird et al, 2008)* These are the physical obstacles, but on the other hand PD patients frequently facing a more important problem. Dental professionals are not always trained to manage special care for this patient group. In Hungary there is no specialisation in dental care for special needs patient and during undergraduate training it is also barely mentioned.

The frequency of toothbrushing and the devices for tooth cleansing both influenced the D-T; M-T; F-T scores. The degree of independent self-care is part of the FIM, hence the association between oral hygiene routine and the FIM values was remarkable. Patients with the lowest FIM values, only daily or less than daily brushed their teeth. *Moldvai et al, 2022* reported the same association. Those PD patients who used mouthwash and electric toothbrushes had the lowest FIM values. Might we can conclude these devices are used to replace the lost physical functions.

Two-thirds of the PD patients did not experience toothache in the past 12 months which is absolutely contradict their oral condition. PD is often associated with secondary or chronic pain. *(Dudgeon et al, 2006, Ehde et al, 2003)* According to the institutional database, during the rehabilitation and after discharge they got several painkillers. The

prescribed painkillers (or mainly based on their own decision) can hide the oral complaints.

PD puts a heavy burden on the mental health also. To endure this situation (hopelessness, boredom) various bad habits and addictions can develop. *Glazier et al, 2013* reported a more prevalent substance abuse among disabled than non-disabled. Based on the national census 26.8% of the Hungarian population admitted smoking and 25.4% reported regularly alcohol consuming, in the PD population we found out approximately the same. (*Központi Statisztikai Hivatal, 2019ab*) However, our observations did not support *Glazier et al, 2013* findings, another bad habit, snacking between meals was increased in the given population which influenced the M-T scores.

A potential limitation of the current study is the lack of periodontal examination of the given population. However most of the patients referred to rehabilitation from acute or intensive care. Patients during prolonged hospitalization are more prone to plaque accumulation and consequently to gingival inflammation. *(Carrilho et al, 2011)*

5.3 *Oral health, dental care and health behaviour of children with cerebral palsy during Conductive Education*

Cerebral palsy is a condition caused by brain damage before, during or shortly after birth. The consequences of central nervous system disorder impact the movement, posture and coordination. *(Sehrawat et al, 2014)* To investigate the oral health, DMF-T and df-t score was a good indicator. In *Ahmad et al, 2020* study with the same methodology the caries prevalence was 81.7%. The DMF-T score 0.5 and df-t score were 3.0. *Akhter et al,* 2019 examined also the dental status of children with CP, the dmf-t was 2.46 and the DMF-T 0.72 respectively. In our study it was visible that the grading of the motor disabilities (GMFCS classification) has a major impact on df-t and DMF-T scores. Children in GMFCS group IV. and V., those with the most severe functional mobility limitations had the lowest value. In these GMFCS groups children lost their self-sufficiency and the daily hygiene routine is performed by parents, caregivers or conductive teachers. Our findings are also in line with previous studies which reported lower caries prevalence in this two GMFCS group. (*Akhter et al, 2019)*

The df-t value was 2.39 and DMF-T was 1.84 in the Hungarian healthy population, by comparison our results are in the lower range. *(Nagy et al, 2018)*

There is no professional recommendation in Hungary for dental prevention for children with special needs yet. Children with CP suffer not only from motor disabilities CP is associated most of the cases with mental, sensory, learning disabilities. With these functional deficiencies, children with CP are unable to adequately master the techniques of plaque control, which leads to dental caries and periodontal problems. *(Rosenbaum et al, 2003, Glassmann et al, 2003, Maiya et al, 2015)* With neuromuscular disability is beneficial to use electric toothbrush. (*Ikeda et al, 2016)* In our study we could not confirm this fact. We could not find significant difference for gingivitis, df-t and DMF-T scores when using an electric toothbrush. Potential factors might be the lack of education about using electric toothbrushes, or other functional and anatomical dysfunctions. Hence further studies are required to find out the cause of the high level of gingivitis.

Intake of high risk foods containing fermentable carbohydrates increased the caries prevalence, both the df-t and DMF-T values were higher. It is difficult to pay attention to

the nutrient intake needed for the optimum growth of children with CP, while also keeping caries prevention in mind. As in other studies, the consumption of sugary drinks is the most critical. *(Hujoel et al, 2017, Ahmad et al, 2020)* Due to their poor masticatory muscular control the soft and cariogenic food (which is easy to swallow) stay in the vestibular sulcus. The progression of dental caries is enhanced by another factor, these are the sweetened and highly viscous medications like anticonvulsants. *(Sinha et al, 2015)* Moreover, these carious lesions keep on progressing, as providing treatment for them is more difficult. *(Somani et al, 2019)* In terms of enamel erosion, sugar intake and bad oral hygiene context it is visible that enamel erosion is less frequent (4.2%) in low sugar intake and better oral hygiene than by other counterparts (20.7%) It is proven that children with CP who consumed high levels of sugar demonstrated high caries prevalence. *(De Camargo et al, 2008)*

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6. Conclusions

The new results of my thesis are the following:

I-II.

Using the same methodology data were obtained from ***inpatients undergoing Physical Medicine and Rehabilitation and physically disabled inpatients undergoing Physical Medicine and Rehabilitation***. We gained information on dental status, dental care, health behaviour, nutritional habits and their correlation with DMF-T in these special needs patient groups.

1: The DMF-T scores of inpatients undergoing Physical Medicine and Rehabilitation and PD patients were higher than in the Hungarian adult population.

2: The RI was low in these patient groups which shows the low quantity of their dental care.

3: All of the variables (dental care, health behaviour, nutritional habits, age and gender) effect DMF-T scores.

III.

Data were obtained from ***children with cerebral palsy during Conductive Education***. We gained information on dental status, dental care, health behaviour, nutritional habits and their correlation with DMF-T/df-t.

1: The DMF-T and df-t scores of children with CP in GMFCS II. group were the highest and in the GMFCS IV. and V. were the lowest by comparison with the control population.

2: The RI was low which shows the low quantity of their dental care.

3: All of the variables (dental care, health behaviour, nutritional habits, age, gender and GMFCS) effect DMF-T/df-t scores. The effect of different types of toothbrushing performance (alone brushing or assisted) were significant on gingivitis and on DMF-T/df-t controlled by age.

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7. Summary

Oral health is essential for the well-being of people, especially important for people who struggle with health inequalities on a daily basis. In the current study it was apparent that patients with disability experience less favourable oral health status than in the general population. The study demonstrated the correspondence between df-t, DMF-T values and a number of contributing factors, such as age, frequency of dental visits, oral hygiene routines and health behaviour factors. The results of our research points to the fact that people undergoing rehabilitation or conductive program have difficulties in developing and maintaining proper oral health due to their disadvantages and therefore require special dental care and attention. Rehabilitation programs and conductive education-based programs consist of structured steps to improve patient's self-care skills, and specific design of the equipment promotes independence and self-efficacy. However, these self-care skills might be counterproductive from a dental perspective. Also the access to dental services is a key to achieve good oral health, but this can be often limited by barriers such as physical environment or the lack of adequate training for dental professionals.

As a dentist, member of the rehabilitation team, it is our responsibility to find our place in the rehabilitation or in the conductive team and to develop together appropriate prevention protocols based on our results. Targeted prevention and intervention models for this subgroup of patients can help to adapt them to their changed circumstances and provide an opportunity for reintegration into society.

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9. Appendix

Appendix 1. *Questionnaire for inpatients and PD inpatients undergoing Physical Medicine and Rehabilitation (Petersen et al, 2013)*

1. PERSONAL DATA:

Identification number:			
Sex:	□ Male	□ Female	
Location:	□ Urban	□ Periurban	□ Rural

2. HOW OLD ARE YOU TODAY? (YEARS)

_____

3. HOW MANY NATURAL TEETH DO YOU HAVE?

□	No natural teeth
□	1–9 teeth
□	10–19 teeth
□	20 teeth or more

4. DURING THE PAST 12 MONTHS, DID YOUR TEETH OR MOUTH CAUSE ANY PAIN OR DISCOMFORT?

□	Yes
□	No
□	Don't know

5. DO YOU HAVE ANY REMOVABLE DENTURES?

□	Partial denture
□	Full upper denture
□	Full lower denture

6. HOW OFTEN DO YOU CLEAN YOUR TEETH? (PUT A TICK/CROSS IN ONE BOX ONLY)

□	**Never**
□	Several times a month (2–3 times)
□	Once a week
□	Several times a week (2–6 times)
□	Once a day
□	2 or more times a day

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7. DO YOU USE ANY OF THE FOLLOWING TO CLEAN YOUR TEETH OR GUMS? (READ EACH ITEM)

	Yes	*No*
Toothbrush	□	□
Wooden toothpicks	□	□
Plastic toothpicks	□	□
Thread (dental floss)	□	□
Mouthwashl	□	□
Chewstick/miswak	□	□
Other: _____	□	□

8. DO YOU USE…

	Yes	*No*
a) … toothpaste to clean your teeth?	□	□
b) … toothpaste that contains fluoride?	□	□

9. WHEN DENTURE WEARING

a) Denture cleaner	□
b) Denture adhesive	□
c) Denture wearing at night	□

10. HOW LONG IS IT SINCE YOU LAST SAW A DENTIST? (PUT A TICK/CROSS IN ONE ONLY)

□	Less than 6 months
□	6–12 months
□	More than 1 year but less than 2 years
□	2 years or more but less than 5 years
□	5 years or more
□	Never received dental care

11. HOW OFTEN DO YOU EAT OR DRINK ANY OF THE FOLLOWING FOODS, EVEN IN SMALL QUANTITIES? (READ EACH ITEM)

	Several times a day	*Every day*	*Several times a week*	*Once a week*	*Several times a month*	*Never*
Fresh fruits	□	□	□	□	□	□
Biscuits, cakes, cream cakes, sweet pies, buns etc.	□	□	□	□	□	□
Lemonade, Coca Cola or other soft drinks	□	□	□	□	□	□
Jam/honey	□	□	□	□	□	□
Chewing gum containing sugar	□	□	□	□	□	□
Sweets/candy	□	□	□	□	□	□
Tea with sugar	□	□	□	□	□	□

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Tea	□	□	□	□	□	□
Tea with sweetener	□	□	□	□	□	□
Coffee with sugar	□	□	□	□	□	□
Coffee	□	□	□	□	□	□
Coffee with sweetener	□	□	□	□	□	□

12. HOW OFTEN DO YOU USE ANY OF THE FOLLOWING TYPES OF TOBACCO? (READ EACH ITEM)

	Every day	***Several times a week***	***Once a week***	***Several times a month***	***Seldom***	***Never***
Cigarettes	□	□	□	□	□	□
Pipe	□	□	□	□	□	□
Cigars	□	□	□	□	□	□
Chewing tobacco or snuff	□	□	□	□	□	□
Other: _____	□	□	□	□	□	□

13. DURING THE PAST 30 DAYS, ON THE DAYS YOU DRANK ALCOHOL, HOW MANY DRINKS DID YOU USUALLY DRINK PER DAY?

□	Less than 1 drink
□	1 drink
□	2 drinks
□	3 drinks
□	4 drinks
□	5 or more drinks
□	Did not drink alcohol during the past 30 days

14. WHAT LEVEL OF EDUCATION DID YOU COMPLETED

□	No formal schooling
□	Less than primary school
□	Primary school completed
□	Secondary school completed
□	High school completed
□	College/university completed
□	Postgraduate degree

15. WHAT IS YOUR MANPOWER STATUS NOW?

□	employee
□	entrepreneur
□	free intellectual
□	unemployed
□	student
□	other

Is it □ permanent, or □ occasional ?

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Appendix 2. *Questionnaire for children with CP during conductive education (Petersen et al, 2013)*

1. PERSONAL DATA:

Identification number:			
Sex:	□ Male	□ Female	
Location:	□ Urban	□ Periurban	□ Rural

2. HEALTH CONDITION:

ICD-10 code[1]	□
ICD-10 code[2]	□
ICD-10 code[3]	□
ICD-10 code[4]	□

3. MOVEMENT DEFICIENCES:

GMFCS I.	□
GMFCS II.	□
GMFCS III.	□
GMFCS IV.	□
GMFCS V.	□

4. HOW OLD ARE YOU TODAY? (YEARS)

_____

5. HOW WOULD YOU DESCRIBE THE HEALTH OF YOUR TEETH AND GUMS? (READ EACH ITEM)

Perfect	□
Really good	□
Good	□
Average	□
Bad	□
Really bad	□

6. HOW OFTEN DURING THE PAST 12 MONTHS DID YOU HAVE TOOTHACHE OR FEEL DISCOMFORT DUE TO YOUR TEETH?

Often	□
Occasionally	□
Rarely	□
Never	□
I don't know	□

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7. HOW OFTEN DID YOU GO TO THE DENTIST DURING THE PAST 12 MONTHS? (PUT A TICK/CROSS IN ONE ONLY)

Once	□
Twice	□
Three times	□
Four times	□
More than four times	□
I was'nt during this period	□
I was never in my life	□
I don't know	□

8. WHAT WAS THE REASON FOR YOUR LAST VISIT TO THE DENTIST? (PUT A TICK/CROSS IN ONE BOX ONLY)

□	Pain or trouble with teeth, gums or mouth
□	Treatment/follow-up treatment
□	Routine check-up of teeth/treatment
□	I don't know/don't remember

9. ARE YOU IN AN ORTHODONTIC TREATMENT?

Yes	□
No	□

10. HOW OFTEN DO YOU CLEAN YOUR TEETH? (PUT A TICK/CROSS IN ONE BOX ONLY)

□	**Never**
□	Several times a month (2–3 times)
□	Once a week
□	Several times a week (2–6 times)
□	Once a day
□	2 or more times a day

11. WHO CLEANS YOUR TEETH? (THE TOOTHBRUSHING PERFORMANCE)

_____

12. DO YOU USE ANY OF THE FOLLOWING TO CLEAN YOUR TEETH OR GUMS? (READ EACH ITEM)

	Yes	***No***
Toothbrush	□	□
Wooden toothpicks	□	□
Plastic toothpicks	□	□
Thread (dental floss)	□	□
Charcoal	□	□
Chewstick/miswak	□	□
Other: _____	□	□

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13. DO YOU USE…

	Yes	*No*
a) … toothpaste to clean your teeth?	□	□
b) … toothpaste that contains fluoride?	□	□

14. BECAUSE OF THE STATE OF YOUR TEETH AND MOUTH, DID YOU EXPERIENCE ANY OF THE FOLLOWING PROBLEMS DURING THE PAST YEAR?

	Yes	*No*
I am not satisfied with the appearance of my teeth	□	□
I often avoid smiling and laughing because of my teeth	□	□
Other children make fun of my teeth	□	□
Toothache or discomfort caused by my teeth forced me to miss classes at school or miss school for whole days	□	□
I have difficulty biting hard foods	□	□
I have difficulty in chewing	□	□

15. HOW OFTEN DO YOU EAT OR DRINK ANY OF THE FOLLOWING FOODS, EVEN IN SMALL QUANTITIES? (READ EACH ITEM)

	Several times a day	*Every day*	*Several times a week*	*Once a week*	*Several times a month*	*Never*
Fresh fruits	□	□	□	□	□	□
Biscuits, cakes, cream cakes, sweet pies, buns etc.	□	□	□	□	□	□
Lemonade, Coca Cola or other soft drinks	□	□	□	□	□	□
Jam/honey	□	□	□	□	□	□
Chewing gum containing sugar	□	□	□	□	□	□
Sweets/candy	□	□	□	□	□	□
Milk with sugar						
Tea with sugar	□	□	□	□	□	□
Tea	□	□	□	□	□	□
Tea with sweetener	□	□	□	□	□	□
Coffee with sugar	□	□	□	□	□	□
Coffee	□	□	□	□	□	□
Coffee with sweetener	□	□	□	□	□	□

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16. HOW OFTEN DO YOU USE ANY OF THE FOLLOWING TYPES OF TOBACCO? (READ EACH ITEM)

	Every day	*Several times a week*	*Once a week*	*Several times a month*	*Seldom*	*Never*
Cigarettes	□	□	□	□	□	□
Pipe	□	□	□	□	□	□
Cigars	□	□	□	□	□	□
Chewing tobacco or snuff	□	□	□	□	□	□
Other: _____	□	□	□	□	□	□

17. WHAT LEVEL OF EDUCATION HAS YOUR FATHER COMPLETED (OR YOUR STEPFATHER, GUARDIAN OR OTHER MALE ADULT LIVING WITH YOU)?

□	No formal schooling
□	Less than primary school
□	Primary school completed
□	Secondary school completed
□	High school completed
□	College/university completed
□	Postgraduate degree

18. WHAT IS YOUR FATHER MANPOWER STATUS NOW (OR YOUR STEPFATHER, GUARDIAN OR OTHER MALE ADULT LIVING WITH YOU)?

□	employee
□	entrepreneur
□	free intellectual
□	unemployed
□	student
□	other

Is it □ permanent, or □ occasional ?

19. WHAT LEVEL OF EDUCATION HAS YOUR MOTHER COMPLETED?

□	No formal schooling
□	Less than primary school
□	Primary school completed
□	Secondary school completed
□	High school completed
□	College/university completed
□	Postgraduate degree

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20. WHAT IS YOUR MOTHER MANPOWER STATUS NOW?

□	employee
□	entrepreneur
□	free intellectual
□	unemployed
□	student
□	other

Is it □ permanent, or □ occasional ?

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