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Role of Diet and Nutritional Supplements for Children with Cerebral Palsy

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ABSTRACT

Background: The majority of children with cerebral palsy would experience feeding difficulties due to impairment of facial muscles that hampers a child's ability to chew, suck, or swallow, thereby creating a high risk for undernourishment, malnutrition, failure to thrive, and digestive difficulties. **Aim of work**: Assessment of the effect of good nutrition and nutritional supplements on the general health status for the children with cerebral palsy to improve their quality of life. **Patients and Methods:** Experimental, prospective controlled study survey was conducted through face-to-face interview with the researcher on (84) patients diagnosed as having cerebral palsy by history, clinical examination and investigations in the neurology and gastroenterology and clinical nutrition units, pediatric department, Tanta university hospital. Using valid and reliable scales and questionnaires, (demographic and socioeconomic characteristics), anthropometric measurements, the food frequency and 24hour recall questionnaires to evaluate the actual daily intake of nutrients. **Results:** The median of age of children in both groups (6.5-6.8) years with the range (1.4-14) years in both groups, more than half of children of both diet and SP mix groups were males (57.1% and 54.8%, respectively). Most of children in both groups reported negative history of consanguinity by (90.5% for diet group and 92.9% of SP mix group). Medium social status prevailed over the participating patients with a percentage of (47.6%) in both groups. Type of CP (spastic diplegia), was presented in (57.1% -61.9%) in diet and SP mix groups respectively, level (5) of (GMFC) was presented in (40.5% in diet group and 47.6% of SP mix group). According to (feeding time, stress on caregiver, history of respiratory illnesses, the rate of forming of subcutaneous fat) was improved in SP mix group higher than diet group. The well-nourished children increased from (28.6% to 83.3%) in diet group, and from (38.1% to 78.6) in SP mix group. According to frequency consumption of grilled fish, liver, white bread, honey, boiled meat, butter, cottage cheese, salad, cooked vegetables, orange, legumes, lentils& bean), was increased. Moreover, consumption from some drinks and foods, for example (tea, soda, canned juice, candy, chocolate & margarine) decreased for lack, after nutrition intervention in the two groups. **Conclusion:** dietary management and nutritional supplements can improve the quality of life of children with cerebral palsy.

Keywords: cerebral palsy, spastic diplegia, sweet potato, wheat germ.

1. Introduction

The term "cerebral palsy" (CP) refers to a diverse collection of lifelong movement and posture abnormalities that are caused by immobility-limiting non-progressive defects in the developing fetus or infant brain. The primary symptom of CP is dyskinesia, which is frequently accompanied by sensory, cognitive, communication, perceptual, behavioral and epilepsy-related issues, as well as secondary musculoskeletal issues. One of the most prevalent causes of disability in children is known as cerebral palsy (CP), which places a heavy financial burden on children and their families for medical care, education, and rehabilitation (Hasan Alam *et al.,* 2023).

This disease first described using the term cerebral paralysis in 1843 by the English orthopedic surgeon William Little; there is still a huge disunity in defining cerebral palsy (Metz *et al.,* 2022).

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According to European data, the average frequency of CP is (2.08 per 1000) live births (Sadowska *et al.,* 2020). A study in Egypt reported a prevalence of (2.04 per 1 000) live births among children in Al-Karga District, New Valley Governorate and Another study in Al Quseir City, Red Sea Governorate reported a prevalence in children of (3.06 per 1 000)live births (Khalil et al.,2018 and Mohamed and Ali ., 2018).

Degrees of under nutrition in children with CP are positively correlated with the severity of their eating and drinking dysfunction and gross motor impairment. Blood indicators may not reflect nutritional status in children with CP (Zhao *et al.,* 2023).

2. Patients and Methods

2.1. Study design

Experimental, prospective controlled study survey was used and sample size was calculated with outcome of prevalence of malnutrition in CP children (Mushta *et al.,* 2021) by using Open Epi software, Version 3, available at https://www.openepi.com/SampleSize/SSCohort.htm

2.2. Sample size

Eighty-four children ages from (1.4-14) years and divided so that they were identical into two groups. Each group contains (42 child) received the usual dietary management, which was calculated by the researcher individually for each patient. In addition to sweet potato mixed with wheat germ nutritional supplements for group 2 only within their diet.

2.3. Duration

Study started August 2021 to July 2022. In addition, each patient interview took about 40-50 minutes.

2.4. Data collection and Study Tools

- Socioeconomic status scale for health validated Arabic version (Fahmy *et al.,* 2015)
- Anthropometric measures including (Weight taken by Taylor Precision 7506 Electronic weight scale,
- Height/ Length using this equation of (Stevenson, 1995 & Gauld *et al.,* 2004), Triceps was taken at the mid portion of the right arm over the triceps muscles and Subscapular Skin Fold Thickness by plastic Mc GAW skin fold caliper to measure skin fold thickness (Jung *et al.,* 1984),
- Clinical and Neurological assessment (Arvedson JC, 2013),
- Gross Motor Function Classification System (Palisano *et al.,* (2007).
- Dietary Assessment Subjective Global Nutritional Assessment (SGNA) (Secker& Jeejeebhoy, 2012 and Minocha *et al.,* 2018).

Dietary food recalls the 24-hour recall method used to assess the usual intake of energy and nutrients for three consecutive days. In the same day of interview, the patients asked to recall type and quantity of all foods and beverages consumed by the patients during the previous 24 hours, and they also asked to record the food intake during another three days in their homes then collected the questioners from them (FAO, 2018).

The food intake data analyzed using a computer program. The analysis by this program is based on food composition tables of the Egyptian National Nutrition Research Institute (NNI) on food composition tables for the Middle East (NNI, 2006). Results compared with current recommendations for nutrient intakes (Mahan and Stump; 2008). Twenty-four-hour recall is conducted in an in-depth interview manner and typically requires 20 to 30 minutes to complete a single day recall. (Shim *et al.,* 2014).

Dietary pattern “Food Frequency Questionnaire” (FFQ) this method used to obtain qualitative descriptive information about usual food and beverage consumption pattern for the patients per week (FAO, 2018).

The researcher individually for each patient in two groups calculated the diet and using sweet potato and wheat germ (S.P.MIX) for one group from their calories in their calculating diet, we monitored weight gain in response to dietary therapy, and avoided over- or underfeeding. According to patient tolerance the diet and prevented occurrence complications.

2.5. Data Processing and Analysis

Data were analyzed using SPSS version 25 Quantitative data were presented as Mean ± SD, median and interquartile range and qualitative data were presented as frequencies and percentages. The level of significance was considered at p value <0.05. (SPSS V.25, 2017).

3. Results

Table (1) shows more than half of children of both diet and SP mix groups were males (57.1% and 54.8%, respectively). Most of children in both groups reported negative history of consanguinity. The medium social status prevailed over the participating patients' in both groups; there were no statistically significant differences between the ages of children in both groups. Type of CP, spastic diplegia and level (5) of (GMFC) were presented in high percentage,

Table 1: Sociodemographic characteristics & clinical assessment of studied CP groups.

Variables		CP children				Test of significance	P value
		Diet group (n=42)		SP mix group (n=42)			
		n	%	n	%		
Sex	Male	24	57.1	23	54.8	χ^2=0.048	0.826
	Female	18	42.9	19	45.2		
Consanguinity	Present	4	9.5	3	7.1	MCET	1.000
	Absent	38	90.5	39	92.9		
Socioeconomic level	Low	4	9.5	4	9.5	χ2=0.000	1.000
	Medium	20	47.6	20	47.6		
	High	18	42.9	18	42.9		
Age	Mean ±SD	6.5±3.5		6.8±3.5		Z=-.377	0.706
	Range	1.5-14		1.4-13			
	Median (IQR)	6(2.7-9)		6(3.8-9.3)			
Type of CP	Spastic diplegia	24	57.1	26	61.9	χ2=1.199	0.753
GMFC	Transported in manual wheelchair (level 5)	17	40.5	20	47.6	χ2=5.500	0.240

χ^2=Chi square test MCET=Monte Carlo Exact Test Z= Z score of Mann Whitney U test
* = significant SD= Standard deviation IQR=Inter quartile range
GMFC (general motor function classification)

Table (2) illustrates that feeding time longer than 30 minutes & stress on caregiver after nutrition intervention were decreased in both groups and history of respiratory illnesses was decreased from (73.8%) to (14.3%) in SP mix group with statistically significant differences between two groups.

Table 2: Presences of "red flags" suggest present of feeding /swallowing problems among the studied cerebral palsy patients before and after nutrition intervention (N=84).

Variables		CP children				Test of significance	P value
		Diet group(n=42)		SP mix group (n=42)			
		n	%	n	%		
Feeding time longer than 30 minutes before	Present	28	66.7	32	76.2	χ^2=0.933	0.334
After	Present	6	14.3	0	0.0	MCET	**0.026***
Test of significance		MN		MN			
P value [b]		**0.000***		**0.000***			
Stress on caregiver before	Present	28	66.7	31	73.8	χ^2=0.513	0.474
After	Present	5	11.9	3	7.1	MCET	0.457
Test of significance		MN		MN			
P value [b]		**0.000***		**0.000***			
History of respiratory illnesses before	Present	23	54.8	31	73.8	χ^2=3.319	0.069
After	Present	31	73.8	6	14.3	χ^2=30.190	**0.000***
Test of significance		MN		MN			
P value [b]		1.000		0.000*			

χ^2=Chi square test MCET=Monte Carlo Exact Test * = significant z= Wilcoxon Signed Rank Test
P value [a]= between two groups P value [b]= within the same group MN=Mc Nemar test

Table (3) demonstrates non-statistically significant difference in SGNA between studied CP groups. However, the difference was highly significant within the same group where the well-nourished children increased and severe, malnourished decreased.

Table 3: Degree of malnutrition (SGNA) among studied CP groups before and after nutrition intervention

Variables		CP children				Test of significance	P value [a]
		Diet group (n=42)		SP mix group (n=42)			
		N	%	n	%		
Subjective Global Nutritional Assessment (SGNA) before	Well nourished	12	28.6	16	38.1	χ^2=2.369	0.306
	Moderate malnourished	22	52.4	15	35.7		
	Severe malnourished	8	19.0	11	26.2		
SGNA after	Well nourished	35	83.3	33	78.6	MCET	0.784
	Moderate malnourished	7	16.7	8	19.0		
	Sever malnourished	0	0.0	1	2.4		
Z		-5.396		-4.508			
P value [b]		**0.000***		**0.001***			

χ^2=Chi square test MCET=Monte Carlo Exact Test * = significant z= Wilcoxon Signed Rank Test
P value [a]= between two groups P value [b]= within the same group

Table (4) shows that the median (IQR) for weight; stature; BMI; triceps skin fold thickness; subscapular skin fold thickness and mid arm circumference were higher in SP mix group than diet group. There is statistically significant result for change in stature and in MAC before and after intervention among two groups, (diet and SP mix).

Table 4: Comparison between diet and SP mix groups regarding the change in anthropometric measures before and after nutrition intervention.

Variables		CP children		Mann Whitney U test	P value
		Diet group (n=42)	SP mix group (n=42)		
Weight change (kg)	Mean ± SD	1.6±2.2	2.2±0.7	751.000	0.237
	Range	-4.00-5	0.00-3.5		
	Median (IQR)	2(0.5-3)	2.5(1.7-2.6)		
Stature change(cm)	Mean ± SD	1.3±0.9	2.5±1.3	252.500	**0.000***
	Range	0.30-6.5	0.00-6.0		
	Median (IQR)	1.15(0.9-1.5)	2.4(1.9-2.9)		
BMI change(kg/m²)	Mean ± SD	1.3±2.2	1.8±1.4	778.000	0.352
	Range	-3.40-9.2	-0.70-7.7		
	Median (IQR)	1.2(0.2-2.7)	1.5(0.8-2.6)		
Triceps skin fold thickness(mm) change	Mean ± SD	.3±0.3	.5±0.4	669.500	0.050
	Range	-0.9-1.0	-1.0-2.0		
	Median (IQR)	0.4(0.0-0.5)	0.5(0.2-0.5)		
Subscapular skin fold thickness(mm) change	Mean ± SD	.2±0.2	.3±0.2	772.500	0.411
	Range	-0.5-0.5	0.0-0.9		
	Median (IQR)	0.3(0.0-0.5)	0.3(0.2-0.5)		
Mid Arm Circumference(cm) change	Mean ± SD	.2±0.2	.4±0.4	55.000	**0.030***
	Range	0.0-0.5	-0.50-1.5		
	Median (IQR)	0.0(0.0-0.5)	0.5(0.5-0.5)		

* = significant SD= Standard deviation IQR=Inter quartile range BMI=body mass index

Table (5): In both groups, the usual dietary management was modified to meet their requirements (either by addition or by discount). In addition, the intake of water and fiber were improved in two groups.

Table 5: (Mean ± SD) intake of energy, macronutrients, water & fiber among studied CP groups before and after nutrition intervention**.**

Variables		CP children		Mann Whitney U test	P value [a]
		Diet group (n=42)	S P Mix group(n=42)		
Energy intake before (kcal)	Mean ± SD	1424.2±290.9	997.0±351.8	836.000	0.681
	Range	361.5-1600.0	556.0-2609.1		
	Median (IQR)	944.5(784.7-1337.8)	962.9(796.7-1068.3		
Energy intake after (kcal)	Mean ± SD	1305.4±407.3	1240.8±430.2	763.000	0.287
	Range	837.0-2428.0	556.0-2613.1		
	Median (IQR)	1208.5(1005.6-1439.1)	1118.0(972.4-1412.3)		
Z		-3.632	-5.107		
P value [b]		**0.000***	**0.000***		
Protein intake (gm) before	Mean ± SD	53.8±31.9	42.3±13.4	718.500	0.144
	Range	14.5-167.9	25.9-87.8		
	Median (IQR)	42.6(34.9-60.3)	38.5(33.9-48.6)		
Protein intake(gm) after	Mean ± SD	50.5±14.7	59.5±21.2	663.000	0.050
	Range	30.0-95.0	32.0-100.9		
	Median (IQR)	45.6(40.7-58.8)	51.7(44.1-72.4)		
Z		-.128	-5.444		
P value [b]		0.898	**0.000***		
Fat intake (gm) before	Mean ± SD	58.7±51.2	30.4±12.9	598.000	**0.011***
	Range	9.2-245.2	14.0-76.1		
	Median (IQR)	41.2(23.4-74.4)	28.1(22.2-34.7)		
Fat intake (gm) after	Mean ± SD	36.6±11.3	36.2±12.9	783.000	0.376
	Range	21.9-72.0	20.0-76.1		
	Median (IQR)	34.2(29.6-39.3)	32.3(27.4-40.4)		
Z		-1.996	-3.017		
P value [b]		**0.046***	**0.003***		
Carbohydrate intake (gm) before	Mean ± SD	224.5±152.4	137.9±52.8	512.500	**0.001***
	Range	55.9-688.4	75.1-384.4		
	Median (IQR)	188.3(117.4-257.7)	132.6(104.9-156.8)		
Carbohydrate intake after (gm)	Mean ± SD	195.2±62.9	175.5±60.1	667.000	0.054
	Range	117.1-350.0	100.0-384.4		
	Median (IQR)	182.9(149.3-213.6)	152.0(136.4-198.4)		
Z		-.039	-5.137		
P value [b]		0.969	**0.000***		
Water intake before (mL)	Mean ± SD	788.9±308.1	696.4±247.9	722.000	0.152
	Range	205.8-1604.3	255.5-1231.1		
	Median (IQR)	754.8(573.7-999.9)	677.7(519.2-897.9)		
Water intake after (mL)	Mean ± SD	1064.3±248.2	1097.7±251.6	829.000	0.635
	Range	440.0-1604.3	490.0-1650.0		
	Median (IQR)	1028.1(950-1260)	1071.4(925.5-1292.5)		
Z		-4.782	-5.608		
P value [b]		0.000*	0.000*		
Fiber intake before (gm)	Mean ± SD	5.8±3.4	2.2±2.0	226.000	0.000*
	Range	1.5-17.3	.04-8.78		
	Median (IQR)	4.8(3.07-7.9)	2.14(0.9-2.9)		
Fiber intake after (gm)	Mean ± SD	8.4±1.2	9.0±1.7	661.000	0.048*
	Range	6.13-10.99	5.89-12.78		
	Median (IQR)	8.67(7.38-9.14)	9.02(7.78-10.06)		
Z		-3.998	-5.649		
P value [b]		**0.000***	**0.000***		

***** = significant SD= Standard deviation IQR=Inter quartile range z= Wilcoxon Signed Rank Test P value [a]= between two groups P value [b]= within the same group

Tables (6,7,8,9) shows frequency consumption from different types of foods &some drinks for example (white bread, honey, boiled meat, grilled fish, liver, legumes, lentils, bean, butter, cottage cheese, salad, cooked vegetables, orange ,herbs) increased after nutrition intervention. However, (Tea, soda, canned juice, candy, chocolate & margarine) decreased for lack, after nutrition intervention in the two groups.

Table 6: Frequency consumption from starches& meat of studied CP groups before and after nutrition intervention.

Variables		CP children				Test of significance	P value [a]
		Diet group (n=42)		S P Mix group (n=42)			
		n	%	n	%		
White bread before	1 to 3 times per month	5	11.9	0	0.0	MCET	**0.000***
	Once weekly	15	35.7	2	4.8		
	2 to 3 times a week	3	7.1	3	7.1		
	Once daily	0	0.0	7	16.7		
	2 to 3 times a day	0	0.0	4	9.5		
	None	19	45.2	26	61.9		
White bread After	1 to 3 times per month	0	0.0	3	7.1	MCET	**0.029***
	Once weekly	38	90.5	39	92.9		
	2 to 3 times a week	4	9.5	0	0.0		
Z		-3.963		-5.646			
P value [b]		**0.000***		**0.000***			
Honey before	Once monthly	0	0.0	4	9.5	MCET	0.188
	1 to 3 times per month	5	11.9	3	7.1		
	Once weekly	15	35.7	15	35.7		
	2 to 3 times a week	4	9.5	1	2.4		
	Once daily	1	2.4	0	0.0		
	2 to 3 times a day	0	0.0	1	2.4		
	None	17	40.5	18	42.9		
Honey after	Once weekly	0	0.0	3	7.1	MCET	**0.000***
	2 to 3 times a week	39	92.9	16	38.1		
	once daily	3	7.1	12	28.6		
	2 to 3 times a day	0	0.0	11	26.2		
Z		-2.024		-.484			
P value [b]		**0.043***		0.628			
Boiled meat before	1 to 3 times per month	1	2.4	1	2.4	MCET	**0.000***
	Once weekly	8	19.0	6	14.3		
	2 to 3 times a week	18	42.9	19	45.2		
	Once daily	6	14.3	3	7.1		
	2 to 3 times a day	9	21.4	0	0.0		
	None	0	0.0	13	31.0		
Boiled meat after	1 to 3 times per month	1	2.4	0	0.0	MCET	**0.005***
	Once weekly	8	19.0	10	23.8		
	2 to 3 times a week	18	42.9	29	69.0		
	Once daily	6	14.3	3	7.1		
	2 to 3 times a day	9	21.4	0	0.0		
Z		0.000		-3.021			
P value [b]		1.000		**0.003***			
Grilled Fish before	Once monthly	0	0.0%	8	19.0%	MCET	**0.000***
	1 to 3 times per month	2	4.8%	4	9.5%		
	Once weekly	17	40.5%	2	4.8%		
	2 to 3 times a week	2	4.8%	1	2.4%		
	None	21	50.0%	27	64.3%		
Grilled Fish After	Once monthly	0	0.0%	7	16.7%	MCET	**0.000***
	1 to 3 times per month	0	0.0%	24	57.1%		
	Once weekly	39	92.9%	9	21.4%		
	2 to 3 times a week	3	7.1%	2	4.8%		
Z		-4.483		-4.473			
P value [b]		**0.000***		**0.000***			
Liver before	Once monthly	4	9.5%	2	4.8%	MCET	0.960
	1 to 3 times per month	3	7.1%	3	7.1%		
	Once weekly	2	4.8%	2	4.8%		
	Once daily	0	0.0%	1	2.4%		
	None	33	78.6%	34	81.0%		
Liver after	Once monthly	37	88.1%	35	83.3%	MCET	0.890
	1 to 3 times per month	3	7.1%	4	9.5%		
	Once weekly	2	4.8%	2	4.8%		
	Once daily	0	0.0%	1	2.4%		
Z		-5.745		-5.821			
P value [b]		**0.000***		**0.000***			

* = significant z= Wilcoxon Signed Rank Test
P value [a]= between two groups P value [b]= within the same group MCET=Monte Carlo Exact Test

Table 7: Frequency consumption from legumes among studied CP groups before and after nutrition intervention.

Variables		CP children				Test of significance	P value [a]
		Diet group (n=42)		S P Mix group (n=42)			
		n	%	n	%		
Legumes before	1 to 3 times per month	9	21.4%	2	4.8%	MCET	**0.006***
	Once weekly	16	38.1%	15	35.7%		
	2 to 3 times a week	0	0.0%	2	4.8%		
	Once daily	0	0.0%	7	16.7%		
	2 to 3 times a day	1	2.4%	0	0.0%		
	none	16	38.1%	16	38.1%		
legumes A	1 to 3 times per month	1	2.4%	0	0.0%	MCET	0.361
	2 to 3 times a week	37	88.1%	33	78.6%		
	Once daily	3	7.1%	8	19.0%		
	2 to 3 times a day	1	2.4%	1	2.4%		
Z		-1.385		-2.188			
P value [b]		0.166		**0.029***			
Lentils before	Once monthly	2	4.8%	0	0.0%	MCET	0.068
	1 to 3 times per month	8	19.0%	3	7.1%		
	Once weekly	14	33.3%	16	38.1%		
	2 to 3 times a week	0	0.0%	2	4.8%		
	Once daily	0	0.0%	3	7.1%		
	None	18	42.9%	18	42.9%		
Lentils after	1 to 3 times per month	0	0.0%	1	2.4%	MCET	**0.000***
	Once weekly	42	100.0%	0	0.0%		
	2 to 3 times a week	0	0.0%	34	81.0%		
	Once daily	0	0.0%	6	14.3%		
	2 to 3 times a day	0	0.0%	1	2.4%		
Z		-3.492		-2.321			
P value [b]		**0.000***		**0.020***			
Bean before	Once monthly	3	7.1%	2	4.8%	MCET	**0.006***
	1 to 3 times per month	10	23.8%	1	2.4%		
	Once weekly	5	11.9%	3	7.1%		
	2 to 3 times a week	0	0.0%	1	2.4%		
	Once daily	0	0.0%	4	9.5%		
	None	24	57.1%	31	73.8%		
Bean after	1 to 3 times per month	12	28.6%	31	73.8%	MCET	**0.000***
	Once weekly	30	71.4%	6	14.3%		
	2 to 3 times a week	0	0.0%	1	2.4%		
	Once daily	0	0.0%	4	9.5%		
Z		-4.128		-5.366			
P value [b]		**0.000***		**0.000***			

* = significant z= Wilcoxon Signed Rank Test MCET=Monte Carlo Exact Test
P value [a]= between two groups P value [b]= within the same group

Table 8: Frequency consumption from fat and milk products among studied CP groups before and after nutrition intervention.

Variables		CP children				Test of significance	P value [a]
		Diet group (n=42)		S P Mix group (n=42)			
		n	%	n	%		
Margarine before	Once monthly	1	2.4%	0	0.0%	MCET	**0.000***
	Once weekly	7	16.7%	1	2.4%		
	2 to 3 times a week	4	9.5%	2	4.8%		
	Once daily	9	21.4%	4	9.5%		
	2 to 3 times a day	16	38.1%	4	9.5%		
	None	5	11.9%	31	73.8%		
Margarine after	Once monthly	2	4.8%	0	0.0%	MCET	**0.000***
	1 to 3 times per month	9	21.4%	0	0.0%		
	None	31	73.8%	42	100.0%		
Z		-1.067		-5.942			
P value [b]		0.286		**0.000***			
Butter before	Once monthly	3	7.1%	1	2.4%	MCET	**0.013***
	1 to 3 times per month	1	2.4%	1	2.4%		
	Once weekly	5	11.9%	3	7.1%		
	2 to 3 times a week	1	2.4%	3	7.1%		
	Once daily	3	7.1%	11	26.2%		
	2 to 3 times a day	1	2.4%	7	16.7%		
	None	28	66.7%	16	38.1%		
Butter after	1 to 3 times per month	6	14.3%	0	0.0%	χ^2=74.571	**0.000***
	Once weekly	33	78.6%	0	0.0%		
	2 to 3 times a week	0	0.0%	13	31.0%		
	Once daily	3	7.1%	11	26.2%		
	2 to 3 times a day	0	0.0%	18	42.9%		
Z		-5.084		-1.651			
P value [b]		**0.000***		0.099			
Cottage cheese before	Once monthly	0	0.0%	2	4.8%	MCET	**0.042***
	1 to 3 times per month	4	9.5%	0	0.0%		
	Once weekly	5	11.9%	1	2.4%		
	2 to 3 times a week	0	0.0%	2	4.8%		
	Once daily	3	7.1%	5	11.9%		
	2 to 3 times a day	5	11.9%	3	7.1%		
	None	25	59.5%	29	69.0%		
Cottage cheese after	1 to 3 times per month	21	50.0%	15	35.7%	MCET	0.258
	Once weekly	12	28.6%	16	38.1%		
	2 to 3 times a week	0	0.0%	3	7.1%		
	Once daily	3	7.1%	5	11.9%		
	2 to 3 times a day	5	11.9%	3	7.1%		
	NOne	1	2.4%	0	0.0%		
Z		-4.490		-4.923			
P value [b]		**0.000***		**0.000***			

***** = significant z= Wilcoxon Signed Rank Test MCET=Monte Carlo Exact Test
P value [a]= between two groups P value [b]= within the same group χ^2=Chi square test

Table 9: Frequency consumption from vegetables, fruits, some drinks & miscellaneous food among studied CP groups before and after nutrition intervention.

Variables		CP children					
		Diet group (n=42)		S P Mix group (n=42)		Test of significance	P value [a]
		n	%	n	%		
Salad before	Once weekly	0	0.0%	1	2.4%	MCET	0.120
	2 to 3 times a week	6	14.3%	11	26.2%		
	Once daily	3	7.1%	8	19.0%		
	2 to 3 times a day	3	7.1%	2	4.8%		
	None	30	71.4%	20	47.6%		
Salad after	Once daily	38	90.5%	8	19.0%	χ^2=43.249	**0.000***
	2 to 3 times a day	4	9.5%	34	81.0%		
Z		-5.072		-.675			
P value [b]		**0.000***		0.500			
Cooked vegetables before	Once monthly	2	4.8%	1	2.4%	MCET	**0.000***
	1 to 3 times per month	6	14.3%	0	0.0%		
	Once weekly	17	40.5%	6	14.3%		
	2 to 3 times a week	3	7.1%	0	0.0%		
	Once daily	1	2.4%	8	19.0%		
	2 to 3 times a day	0	0.0%	3	7.1%		
	None	13	31.0%	24	57.1%		
Cooked vegetables after	Once daily	35	83.3%	6	14.3%	χ^2=40.070	**0.000***
	2 to 3 times a day	7	16.7%	36	85.7%		
Z		-3.088		-.435			
P value [b]		**0.002***		0.664			
Orange (citrus and grapefruit) before	Once monthly	10	23.8%	0	0.0%	MCET	**0.000***
	1 to 3 times per month	3	7.1%	0	0.0%		
	Once weekly	0	0.0%	10	23.8%		
	2 to 3 times a week	0	0.0%	5	11.9%		
	Once daily	0	0.0%	9	21.4%		
	None	29	69.0%	18	42.9%		
Orange (citrus and grapefruit) after	Once weekly	0	0.0%	2	4.8%	MCET	**0.000***
	2 to 3 times a week	42	100.0%	30	71.4%		
	Once daily	0	0.0%	10	23.8%		
Z		-3.000		-3.614			
P value [b]		**0.003***		**0.000***			
Tea before	Once monthly	13	31.0%	0	0.0%	MCET	**0.000***
	1 to 3 times per month	4	9.5%	1	2.4%		
	Once weekly	1	2.4%	0	0.0%		
	2 to 3 times a week	1	2.4%	9	21.4%		
	Once daily	1	2.4%	2	4.8%		
	2 to 3 times a day	19	45.2%	12	28.6%		
	None	3	7.1%	18	42.9%		
Tea after	None	42	100.0%	42	100.0%	**NA**	
Z		-5.546		-4.378			
P value [b]		**0.000***		**0.000***			
Soda before	Once monthly	13	31.0%	5	11.9%	MCET	**0.000***
	1 to 3 times per month	5	11.9%	1	2.4%		
	Once weekly	1	2.4%	2	4.8%		
	2 to 3 times a week	2	4.8%	0	0.0%		
	Once daily	3	7.1%	2	4.8%		
	2 to 3 times a day	12	28.6%	4	9.5%		
	None	6	14.3%	28	66.7%		
Soda after	None	42	100.0%	42	100.0%	**NA**	
Z		-5.287		-3.430			
P value [b]		**0.000***		**0.001***			

Table 9: Cont.

Canned juice before	1 to 3 times per month	0	0.0%	5	11.9%	MCET	**0.035***
	Once weekly	4	9.5%	0	0.0%		
	2 to 3 times a week	2	4.8%	4	9.5%		
	Once daily	14	33.3%	18	42.9%		
	2 to 3 times a day	17	40.5%	12	28.6%		
	None	5	11.9%	3	7.1%		
Canned juice after	None	42	100.0%	42	100.0%	**NA**	
Z		-5.402		-5.530			
P value [b]		**0.000***		**0.000***			
Herbs before	1 to 3 times per month	1	2.4%	0	0.0%	MCET	0.881
	Once weekly	2	4.8%	1	2.4%		
	Once daily	9	21.4%	9	21.4%		
	2 to 3 times a day	10	23.8%	13	31.0%		
	None	20	47.6%	19	45.2%		
Herbs after	Once monthly	7	16.7%	0	0.0%	MCET	**0.000***
	1 to 3 times per month	7	16.7%	0	0.0%		
	Once weekly	28	66.7%	0	0.0%		
	2 to 3 times a week	0	0.0%	19	45.2%		
	Once daily	0	0.0%	18	42.9%		
	2 to 3 times a day	0	0.0%	5	11.9%		
Z		-5.690		-4.722			
P value [b]		**0.000***		**0.000***			
Chocolate before	1 to 3 times per month	4	9.5%	5	11.9%	MCET	**0.009***
	Once weekly	0	0.0%	2	4.8%		
	2 to 3 times a week	2	4.8%	6	14.3%		
	Once daily	3	7.1%	3	7.1%		
	2 to 3 times a day	12	28.6%	1	2.4%		
	None	21	50.0%	25	59.5%		
Chocolate after	Once monthly	12	28.6%	0	0.0%	χ^2=14.000	**0.000***
	None	30	71.4%	42	100.0%		
Z		-1.465		-3.652			
P value [b]		0.143		**0.000***			
Candy before	Once monthly	7	16.7%	2	4.8%	MCET	**0.000***
	1 to 3 times per month	10	23.8%	1	2.4%		
	Once weekly	6	14.3%	3	7.1%		
	2 to 3 times a week	3	7.1%	4	9.5%		
	Once daily	3	7.1%	8	19.0%		
	2 to 3 times a day	13	31.0%	13	31.0%		
	None	0	0.0%	11	26.2%		
Candy after	None	42	100.0%	42	100.0%	**NA**	
Z		-5.680		-4.915			
P value [b]		**0.000***		**0.000***			

***** = significant z= Wilcoxon Signed Rank Test MCET=Monte Carlo Exact Test
P value [a]= between two groups P value [b]= within the same group χ^2=Chi square test

4. Discussion

Our results showed a great dominance in gender of males where more than half of our participants were males (55.95%) which agree with (Reid *et al.,* 2012; Silva *et al.,* 2017; Aydin *et al.,* 2018; OSAMA *et al.,* 2018; Bell *et al.,* 2019& García Ron *et al.,* 2020) about male were more than female participants in their CP studies. CP occurs more frequently in males than in females, probably due to a greater biological vulnerability in males in terms of cerebral structure, hormone protective role, and genetic polymorphisms, the greater biological vulnerability of male children is also supported by the higher incidence of preterm birth, mortality from preterm birth, death, and interventricular hemorrhage in this sex. Epidemiological data indicate that females at all ages have a substantially lower mortality rate for respiratory diseases, including sudden infant death syndrome, suggesting that they may be more resistant to hypoxia (Romeo *et al.,* 2023).

Most of children in both groups, reported negative history of consanguinity by (90.5% for diet group and 92.9% of SP mix group) and this disagree with (Rashmi *et al.,* 2021) who found that cerebral palsy was (2.5 times) higher in consanguineous marriage: due to autosomal recessive transmission, and

(Başaran *et al.,* 2023) reported that more than half of children with CP had parents who were relatives in his study. Medium social status prevailed over the participating, which disagree with (Silva *et al.,* 2017) who reported that approximately (70%) of the patients had a family income lower than half a minimum wage per person. (GÜNAYDIN., 2021) found that low socioeconomic status was remarkable in terms of CP risk factor due to inadequate nutrition of the mother during pregnancy may cause many physiological and metabolic problems, emaciation, low birth weight, or many conditions that threaten the health of the baby, such as chronic diseases.

Regarding type of CP, spastic presented in high percentage, which agree with (Aydin *et al.,* 2018 &Bell *et al.,* 2019) and disagree with (Silva *et al.,* 2017) about the high percentage of this type of CP. We used the 24-hour recall technique and we found mean intake of (energy, protein, fat and carbohydrate) as percent from DRI among studied CP was (96.9%, 100.4%, 156.6%&109.8% respectively) before nutrition intervention in diet group and become (92.8%,93.2%,92.9%&92.9% respectively) after nutrition intervention. Moreover, was (73.7%, 68.6%, 82.2%&73.9% respectively) before nutrition intervention in SP. mix group and become (90.2%, 92.8%, 95.1%&91.8% respectively) after nutrition intervention. Diet group consumed more than body's demand in most of macronutrients especially from fat before nutrition intervention unlike the other group, which was the least consumed in all macronutrients. All children in the study of Lopes *et al.* (2013) presented low intake of carbohydrates, adequate intake of proteins and high intake of lipids. According to frequency consumption of (grilled fish, liver, white bread, honey, boiled meat, butter, cottage cheese, salad, cooked vegetables, orange ,legumes, lentils& bean), was increased. Moreover, consumption from some drinks and foods, for example (tea, soda, canned juice, candy, chocolate & margarine) decreased for lack, after nutrition intervention in the two groups.

5. Conclusion

Dietary management and nutritional supplements can improve the quality of life of the children with cerebral palsy

6. Recommendations

- Routine nutritional assessment should be done early in CP children for identification of children at risk of malnutrition.
- Nutritional supplements with appropriate nutritional diet improve the quality of life of CP children.
- Take into account individual differences in each case.
- Response to nutritional interventions should be carefully monitored to avoid overfeeding &excessive weight gain.

7. Study limitations

- The current study findings should be interpreted considering the following limitations: First, some defects in 24-hour recall method such as recall bias, inaccurate estimation of portion sizes, possible over/under-reporting of certain foods,
- Secondly, we did not test the hormones such as insulin, leptin and ghrelin that have important roles in appetite.
- Short study period.

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