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Passive Stretching Efficacy on Improvement of Gross Motor Function in Children with Cerebral Palsy

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Abstract

Background: *The widespread idea that passive stretching can cure and extend tight or contracted soft tissues has led to its widespread use in the treatment of spasticity. There is a lack of evidence regarding the effectiveness of passive stretching for patients dealing with spasticity. The purpose of this study was to summarize and analyze the studies that have looked at the effects of passive stretching on children with spastic cerebral palsy. Passive stretching is frequently done in the hope that tightness or contracture of soft tissues can be reduced and stretched. There is little proof that passive stretching helps people with spasticity. This review's objective was to assess the research on passive stretching's benefits for kids with spastic CP.* ***Aim of the study****; using the visual analog scale (VAS) and the Western Ontario and McMaster Universities cerebral palsy (WOMAC) Questionnaire, this study intends to evaluate the effectiveness of floppy passive stretching with spastic passive stretching in children with cerebral palsy.* ***Materials and method****; 60 patients were participated in this study, their ages between 1 – 9 years, both female and male. The patients were diagnosed with cerebral palsy. The participants are divided in to two groups; group (A) 30 patient used spastic passive stretching, group (B) 30 Patient used floppy passive stretching Cerebral palsy. All the patients were assessed before treatment and after three months of follow-up, using analogscale (VAS) and the western Ontario and McMaster Universities cerebral palsy (WOMAC) Questionnaire.* ***Result:*** *The results showed that floppy passive stretching, were effective in standing and walking in this study, that there is a statistically significant association between floppy and spastic standing up p-vale (0.031) and walking p-vale (0.01) is less than the significant level of α =0.05 respectively.* ***Conclusion:*** *Study results suggest that children with spastic cerebral palsy can benefit from passive stretching activities to improve their gross motor skills. Furthermore, the current evidence suggests that, when it comes to enhancing range of motion and decreasing spasticity in particular muscles and joints in children with spastic cerebral palsy, continual passive stretching may be more helpful than manual stretching. Passive stretching exercise is a veritable tool for the improvement of gross motor function in children with spastic cerebral palsy.*

Keywords*: Cerebral Palsy, Spastic Passive Stretching, Floppy Passive Stretching, Muscle Ton.*

INTRODUCTION

Cerebral palsy is a non-progressive condition resulting from early brain damage (1), (2). It leads to changes in muscle structure, including elongated sarcomeres and muscle atrophy (3), (4), causing fewer sarcomeres in series and shorter muscle fibres (3). Muscle growth is impaired (5). In addition to a reduced range of active joint action, discomfort and impaired gross and fine motor performance are all possible side effects of spasticity. Spasticity, on the other hand, may be able to compensate for muscle weakness and boost performance. Various methods like stretching, botulinum toxin injections, casts, and ankle-foot orthoses are used to address muscle shortening. If these treatments

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are insufficient, permanent contractures may require surgery. In children with cerebral palsy (CP), the damage to the nervous system results in muscle atrophy, fibrosis, muscle shortening, and stretched sarcomeres, but this is usually less desirable because a carry-over effect to function is unlikely. Various stretching methods have been used to increase range of motion. Stretching techniques aim to enhance range of motion (ROM), with passive and active stretches administered by healthcare professionals or patients. Ankle-foot orthoses can help maintain joint position at the limit of motion. These techniques aim to improve daily function, delay contracture onset, and reduce the need for surgery, assuming muscles can generate force over a broader ROM. However, stretching exercises can be uncomfortable for children and time-consuming (6). Passive stretching is commonly used to address soft tissue tightness (7). It can be performed manually or with external devices like splints, casts, and tilts. While passive stretching is widely used, research on its effectiveness and the rationale behind stretch-based treatments for muscle spasticity is limited. Isolated stretching may not have a significant impact on children's growth or muscle function in cerebral palsy. Combining stretching with botulinum toxin and electrical stimulation may promote joint lengthening, but more research is needed to determine whether this effect targets muscle or tendon (8). Some claims suggest that "active stretches" involving eccentric contractions can enhance gait and mobility (9).

METHODOLOGY

60 patients were participated in this study. Their ages between 1 – 9 years, both female and male. The patients were diagnosed with cp. the participants are divided in to two group; group (A) 30 patient used spastic passive stretching group (B) 30 Patient used floppy passive stretching Cerebral palsy while experimental research and exercise are applied at the Helnea Center ,Helnea Center Bnalalsawa Branch , Aylan Center Private during the period December 2021 to december2022. It is a practical study in which a small selection of 6 patients was initially taken to ensure the validity and reliability of the questionnaire method, and to ensure data stability, Cronbach's alpha was used for the sequential questions of the survey form [25, 26, 22, 27]. According to Cronbach's equation, the value was found to be (0.852), which indicates a very high degree of reliability of the sequence questions of the survey model.

Inclusion and Exclusion criteria:

Visible hip dislocation, scoliosis, high spasticity and disability, uncontrolled seizures, hydrocephalus, diagnosis of CP, no orthopedic surgery or contracture reduction stiffness in the previous six months.

Intervention

Using the Gross Motor Function Measurement Tool (GMFM-66), to assess the functional level of the children this tool n at different time points. This tool evaluates motor function in children with cp based on various dimensions of movement. The assessments were conducted by specialists.

Procedure

This study, we took history from persons asked the clinical finding and pattern what problem the child manual passive stretching for lower limb Baseline assessment Gross Motor Function Measurement. The developmental history include was preformed when and how a milestone was achieved.

Statistical Analysis

The data was analyzed using SPSS software version (26). Data analysis presented the use of these rules and tools to achieve the objectives of the study, which are: Mean, Standard deviation, and

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Chi-Square, [27]. Chi-square test is a statistical study to find out the association between two categorical variables. [30, 28, 29]. The results are shown in descriptive statistics such as, frequency, percentage, and bar chart for the demographic questions, Non-Parametric approach was utilized like chi-square test to find the association between type (Floppy and Spastic) with each of the (GMFM, Sitting, Crawling, and Standing up) for the first, second, and third month follow up (F1, F2, and F3) separately (22) (23). For all test $p < 0.05$ was considered to be statistically significant.

RESULTS

Table 1: Descriptive Statistics for Demographic Questions

		F	%
Age Group	Less than 1 year	8	13.3%
	Two years	10	16.7%
	Three years	9	15.0%
	Four years	11	18.3%
	Five years	8	13.3%
	Six years	14	23.3%
Gender	Male	42	70.0%
	Female	18	30.0%
Type	Floppy	23	38.3%
	Spastic	37	61.7%
Seizures	Yes	5	8.3%
	No	55	91.7%

Table1 shows the descriptive statistics for all demographic questions such as age, gender, type, and Seizures. The percentage of male (70%) is higher than the percentage of female's participants (30%) while the percentage of Spastic type (61.7%) is higher than the percentage of Floppy type (38.3%). Most of the participants are aged six years (23.3%) followed by four years (18.3%), two years (16.7%), three years (15%), five years (13.3%) and less than one year (13.3%) respectively. The percentage of patients who have Seizures (8.3%) is less than the percentage for those patients do not have it (91.7%).

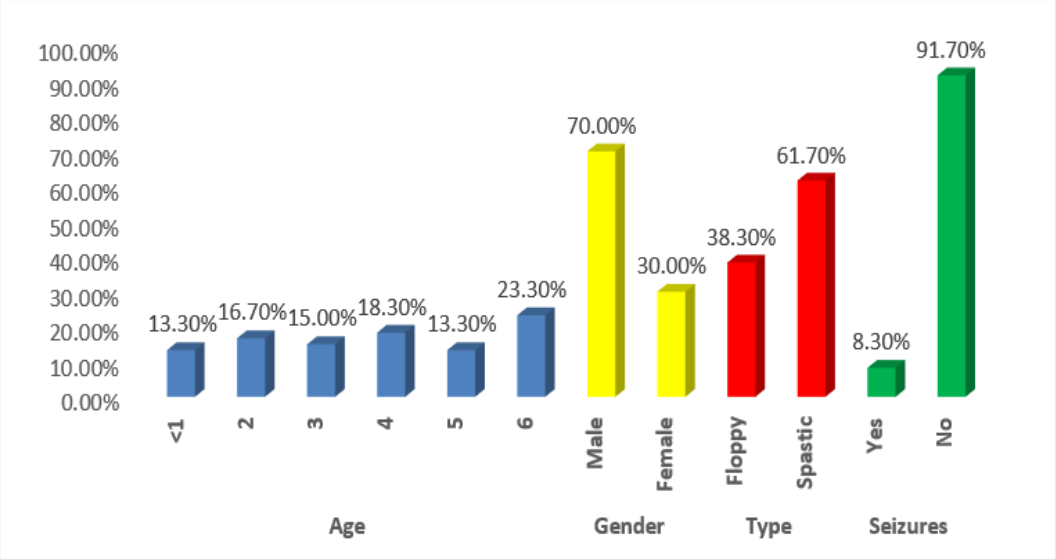

Figure 1: Bar chart for Demographic Questions

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Table 2: Association between type (Floppy and Spastic) with each of the (GMFM, Sitting, Crawling, and Standing up) for the first month follow up (F1) using Chi-square test

			Type		Total	Chi Square	p-value
			Floppy	Spastic			
GMFM	GMFCS level I	Count	11	10	21	3.018	0.389
		%	52.4%	47.6%	100.0%		
	GMFCS level II	Count	7	13	20		
		%	35.0%	65.0%	100.0%		
	GMFCS level II	Count	3	8	11		
		%	27.3%	72.7%	100.0%		
	GMFCS level IV	Count	2	6	8		
		%	25.0%	75.0%	100.0%		
Sitting	Yes	Count	20	30	50	0.353	0.414
		%	40.0%	60.0%	100.0%		
	No	Count	3	7	10		
		%	30.0%	70.0%	100.0%		
Crawling	Yes	Count	14	17	31	0.265	0.195
		%	45.2%	54.8%	100.0%		
	No	Count	9	20	29		
		%	31.0%	69.0%	100.0%		
Standing up	Yes	Count	7	3	10	5.083	0.031
		%	70.0%	30.0%	100.0%		
	No	Count	16	34	50		
		%	32.0%	68.0%	100.0%		

Table 2 demonstrates that there is a statistically significant association between Floppy and Spastic with Standing up because its p-value (0.031) is less than the significant level of α =0.05. For example, the percentage of Floppy type who can standing up (70%) is higher than the percentage of Spastic (30 %), as well as the percentage of Floppy suffering standing up (32 %) is less than the percentage of spastic facing it (68%). On the other hand, that there is no statistically significant association between Floppy and Spastic with each of the (GMFM, Sitting, and Crawling) because their p-values (0.389, 0.414, and 0.195) are higher than the significant level of α =0.05 respectively.

Table 3: Association between type (Floppy and Spastic) with each of the (GMFM, Sitting, Crawling, and Standing up) for the first second month follow up (F2) using Chi-square test

			Type		Total	Chi Square	p-value
			Floppy	Spastic			
GMFM	GMFCS level I	Count	11	10	21	3.771	0.289
		%	52.4%	47.6%	100.0%		
	GMFCS level II	Count	8	13	21		
		%	38.1%	61.9%	100.0%		
	GMFCS level II	Count	2	8	10		
		%	20.0%	80.0%	100.0%		
	GMFCS level IV	Count	2	6	8		
		%	25.0%	75.0%	100.0%		
Sitting	Yes	Count	22	36	58	0.119	0.624
		%	37.9%	62.1%	100.0%		
	No	Count	1	1	2		
		%	50.0%	50.0%	100.0%		
Crawling	Yes	Count	19	29	48	0.159	0.481
		%	39.6%	60.4%	100.0%		
	No	Count	4	8	12		
		%	33.3%	66.7%	100.0%		
Standing Up	Yes	Count	13	15	28	1.455	0.174

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		%	46.4%	53.6%	100.0%		
	No	Count	10	22	32		
		%	31.3%	68.8%	100.0%		
Walking	Yes	Count	5	1	6	5.711	0.027
		%	83.3%	16.7%	100.0%		
	No	Count	18	36	54		
		%	33.3%	66.7%	100.0%		

Table 3 demonstrates that there is a statistically significant association between Floppy and Spastic with walking because its p-value (0.027) is less than the significant level of α =0.05. For example, the percentage of Floppy type who can walking (83.3%) is higher than the percentage of Spastic (16.7 %), as well as the percentage of Floppy suffering walking (33.3%) is less than the percentage of spastic facing it (66.7%). On the other hand, that there is no statistically significant association between Floppy and Spastic with each of the (GMFM, Sitting, Crawling, and standing up) because their p-values (0.289, 0.624, 0.481, and 0.174) are higher than the significant level of α =0.05 respectively.

Table 4: Association between type (Floppy and Spastic) with each of the (GMFM, Sitting, Crawling, and Standing up,) for the third month follow up (F3) using Chi-square test

			Type		Total	Chi Square	p-value
			Floppy	Spastic			
GMFM	GMFCS level I	Count	13	12	25	3.541	0.315
		%	52.0%	48.0%	100.0%		
	GMFCS level II	Count	6	13	19		
		%	31.6%	68.4%	100.0%		
	GMFCS level II	Count	2	6	8		
		%	25.0%	75.0%	100.0%		
	GMFCS level IV	Count	2	6	8		
		%	25.0%	75.0%	100.0%		
Sitting	Yes	Count	22	36	58	0.119	0.624
		%	37.9%	62.1%	100.0%		
	No	Count	1	1	2		
		%	50.0%	50.0%	100.0%		
Crawling	Yes	Count	21	34	55	0.008	0.842
		%	38.2%	61.8%	100.0%		
	No	Count	2	3	5		
		%	40.0%	60.0%	100.0%		
Standing up	Yes	Count	18	23	41	1.692	0.154
		%	43.9%	56.1%	100.0%		
	No	Count	5	14	19		
		%	26.3%	73.7%	100.0%		
Walking	Yes	Count	11	6	17	6.975	0.01
		%	64.7%	35.3%	100.0%		
	No	Count	12	31	43		
		%	27.9%	72.1%	100.0%		

Table 4 demonstrates that there is a statistically significant association between Floppy and Spastic with walking because its p-values (0.01) is less than the significant level of α =0.05. For example, the percentage of Floppy type who can walking (64.7%) is higher than the percentage of Spastic (35.3%), but the percentage of Floppy suffering walking (27.9%) is less than the percentage of spastic facing it (72.1%). On the other hand, that there is no statistically significant association between Floppy and Spastic with each of the (GMFM, Sitting, Crawling, and standing up) because their p-values (0.315, 0.624, 0.842, and 0.154) are higher than the significant level of α =0.05 respect

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DISCUSSION

The study examined the effects of passive stretching exercise on children with cerebral palsy. Because both groups' participants were homogeneous, it was possible to attribute the results to participant confounding characteristics or random chance. The study's findings showed that a 12-week passive stretching exercise program significantly improved the floppy patient group's gross motor function in terms of standing, kneeling, sitting, rolling, and crawling, as well as their overall scores (11).Standing and walking were significantly improved over the three-month follow-up, and enhancing walking abilities regarded as the primary functional goal to physical rehabilitation group assessment for children with CP. The effectiveness of therapies aimed at improving CP children's walking ability and their receptivity to such interventions, however, remain little understood. Though about potential effectiveness in evaluate changes in walking abilitie associated with cerebral palsy, the 6-minute walk test (6MWT) is a valid technique to examine this function in children with CP, with interventions in construed to other study (13). That showed significant change in spastic cp patients. This could be related the age group, which were less than 2 years.

The important results showed that, both after treatment and during follow-up, the majority of study participants in both groups were older than two years of age (p-values 0.315, 0.624, 0.842, and 0.154). Passive stretching was found to have no significant effects when compared to conventional approaches the treatment in children with cerebral palsy. The study, conducted the Children Hospital of Michigan, involved 57 child who randomly assigned control and treatment group. For eight to ten weeks, the kids got an hour each week of physical, occupational, and speech therapy. This was followed by a four-week at-home program. The Adeli suit was to be worn for four weeks as part of the experimental program.

Bar-Haim et al. (2006) carried up a second study in which they examined the effects of AST and NDT on GMF improvement two group in CP child (spastic and floppy). After 9 months of treatment and follow-up, the researchers employed the GMFM-66 to measure GMF in 60 children who had both floppy and spastic passive stretching. Significant changes were identified between the two groups of children.

There was a greater proportion of men than women among the 60 participants in our study. Males make about 70% of the population, which is higher than females. This result is consistent with earlier research of a similar nature6, 27, 28, which indicated that men predominated. This finding may be explained by the fact that men have a higher percentage of cp prevalence than women do. In contrast to a study conducted in Nigeria by Adekoje et al.6 that included participants in the same age range as the present study, they reported that the majority of their participants (63.4%) were 2 years of age or older. In this study, the majority (86.7%) of the participants recruited were found to be older than 2 years. Additional comparable earlier research (14), (16). Additionally, displayed their age distribution with ages bellow 2 years old, which are attributable in difference inclusion criteria of participants. This difference in age distribution could be explained by earlier diagnose of CP in other countries compared to our country this due to advantages of health serves centers and population educations that have higher level of information for taken care of their baby regarding health care services and people information and education health about the cp early diagnosis as camper to our country (health services, health education). (14).

Conversely, gross motor exercises (walking, cycling, etc.) involving both limbs are typically part of lower limb rehabilitation (15). These exercises can occasionally be performed without conscious thought, and they improve gross motor ability and gait performance (16). To provide persons with CP a better understanding of the potential benefits of each training modality, it is

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important to make the distinction between the various forms of training (aerobic training, strengthening training).

It was discovered that, in comparison to children without CP, children with CP produced 57% and 73% less force in knee extension and ankle plantar flexion, respectively (17). They also discovered deficiencies in muscle activation, with a 49% decrease in triceps sure activity and a 39% drop in quadriceps femoris activation**.** The authors noted that children with CP had an increased co-activation of antagonistic muscles, which led to a reduction in knee force output (18), (19).

The results of this study suggest that SRM could be a helpful treatment intervention for children with cerebral palsy to improve their muscle strength and gait. Following SRM training, the peak torque of the knee extensor muscles improved significantly ($p<0.05$); the mean value increased from 31.11±7.42 to 40.55±10.37 Nm. Following training, there was a substantial improvement in the knee flexor peak torque ($p<0.05$), with a mean value increase from 20.22±16.2 to 26.33±19.11 Nm. (19), (21)

CONCLUSION AND RECOMMENDATION

Based on the findings of this study, it can be deduced that passive stretching exercises can be a valuable tool for enhancing the gross motor function of children with spastic cerebral palsy. The evidence suggests that such stretching exercises may offer benefits in terms of physical performance improvement and a reduction in spasticity. Moreover, the available data indicates that continuous passive stretching might be more effective than manual stretching in improving range of motion and reducing spasticity in specific joints and muscles in children with spastic cerebral palsy. As a result, it is advisable to include passive stretching exercises, especially continuous stretching, as an important component of therapy for these children to enhance their physical abilities and overall quality of life. Further research and clinical trials could help in developing more comprehensive guidelines and protocols for the utilization of passive stretching exercises in the management of this condition.

References

1) Aroian K, Uddin N, Blbas H. Longitudinal study of stress, social support, and depression in married Arab immigrant women. Health care for women international. 2017 Feb 1; 38(2):100-17.

2) Behrman RE, Vaughan III VC. Nelson textbook of pediatrics. WB Saunders Company; 1983.

3) Blbas H. Statistical analysis for the most influential reasons for divorce between men and women in Erbil-Iraq. International Journal. Malmö, Sweden. 2019.

4) Colver A, Fairhurst C, Pharoah POD. Cerebral palsy. The Lancet. 2014 Apr 5; 383(9924):1240-1249. doi: 10.1016/S0140-6736(13)61835-8

5) De Deyne PG. Application of passive stretch and its implications for muscle fibers. Physical therapy. 2001 Feb 1; 81(2):819-27.

6) Eliasson AC, Krumlinde-Sundholm L, Rösblad B, Beckung E, Arner M, Öhrvall AM, Rosenbaum P. The Manual Ability Classification System (MACS) for children with cerebral palsy: scale development and evidence of validity and reliability. Developmental medicine and child neurology. 2006 Jul; 48(7):549-54.

Volume 71 Number 04
ISSN: 0047-262X
DOI: 10.5281/zenodo.10990102

7) Frisk RF, Lorentzen J, Barber L, Nielsen JB. Characterization of torque generating properties of ankle plantar flexor muscles in ambulant adults with cerebral palsy. European Journal of Applied Physiology. 2019 May 1; 119:1127-36.

8) Gracies, J.M., 2001. Pathophysiology of impairment in patients with spasticity and use of stretch as a treatment of spastic hypertonia. Physical medicine and rehabilitation clinics of North America, 12(4), pp.747-768..

9) Graham, H.K., Rosenbaum, P., Paneth, N., Dan, B. and Lin, J.P., 2016. Damiano DL et al. Cerebral palsy. Nat. Rev. Dis. Primers, 2, p.15082.

10) James, S.F.M., 2001. Contractures in orthopaedic and neurological conditions: a review of causes and treatment. Disability and rehabilitation, 23(13), pp.549-558.

11) Johnson, T.L., Chin, E.M., Hoon, A.H., Batshaw, M.L., Roizen, N.J., Pellegrino, L., 2019. Cerebral palsy. In: Children with disabilities. 8th ed. Baltimore: Paul Brookes, 2019:423-56.

12) Kalkman BM, Bar-On L, O'Brien TD, Maganaris CN. Stretching interventions in children with cerebral palsy: why are they ineffective in improving muscle function and how can we better their outcome?. Frontiers in physiology. 2020 Feb 21; 11:131.

13) Korzeniewski SJ, Slaughter J, Lenski M, Haak P, Paneth N. The complex aetiology of cerebral palsy. Nature Reviews Neurology. 2018 Sep; 14(9):528-43.

14) Lindén O, Hägglund G, Rodby-Bousquet E, Wagner P. The development of spasticity with age in 4,162 children with cerebral palsy: a register-based prospective cohort study. Acta orthopaedica. 2019 May 4; 90(3):286-91.

15) Massagli TL. Spasticity and its management in children. Physical Medicine and Rehabilitation Clinics of North America. 1991 Nov 1; 2(4):867-89.

16) Michael-Asalu A, Taylor G, Campbell H, Lelea LL, Kirby RS. Cerebral palsy: diagnosis, epidemiology, genetics, and clinical update. Advances in pediatrics. 2019 Aug 1; 66:189-208.

17) Novak I, Morgan C, Adde L, Blackman J, Boyd RN, Brunstrom-Hernandez J, Cioni G, Damiano D, Darrah J, Eliasson AC, De Vries LS. Early, accurate diagnosis and early intervention in cerebral palsy: advances in diagnosis and treatment. JAMA pediatrics. 2017 Sep 1; 171(9):897-907.

18) Pakula AT, Braun KV, Yeargin-Allsopp M. Cerebral palsy: classification and epidemiology. Physical Medicine and Rehabilitation Clinics. 2009 Aug 1; 20(3):425-52.

19) Palisano R, Rosenbaum P, Walter S, Russell D, Wood E, Galuppi B. Development and reliability of a system to classify gross motor function in children with cerebral palsy. Developmental medicine & child neurology. 1997 Apr; 39(4):214-23.

20) Palisano RJ, Hanna SE, Rosenbaum PL, Russell DJ, Walter SD, Wood EP, Raina PS, Galuppi BE. Validation of a model of gross motor function for children with cerebral palsy. Physical therapy. 2000 Oct 1; 80(10):974-85.

21) Blbas HT, Aziz KF, Nejad SH, Barzinjy AA. Phenomenon of depression and anxiety related to precautions for prevention among population during the outbreak of COVID-19 in Kurdistan Region of Iraq: based on questionnaire survey. Journal of Public Health. 2020 Jun 10:1-5.

Volume 71 Number 04
ISSN: 0047-262X
DOI: 10.5281/zenodo.10990102

22) Ahmed S, Abdulqadir S, Hussein S, Qurbani K, Omar R, Mohamed M, Blbas H. Knowledge, Attitudes, and Willingness to Vaccinate for Mpox among Healthcare Workers in Kurdistan Region of Iraq: A Nationwide Cross-Sectional Study.

23) Blbas H. Student's Knowledge and Practices Regarding Standard Use of The Mobile Phone at Cihan University-Erbil–Iraq. Journal of Al-Rafidain University College for Sciences (Print ISSN: 1681-6870, Online ISSN: 2790-2293). 2020(1):466-72.

24) Faraj, S.M; Blbas, H.T. and, Ahmed A. I., (2022). A statistical study of the influence of COVID-19 on the agricultural supply chain (vegetative) production in Halabja governorate. Cihan University-Erbil Scientific Journal, 6(1), pp.1-6.

25) Blbas, H.T.A., Mahmood, S.H. and Omer, C.A., (2017). A Comparison results of factor analysis and cluster analysis to the migration of young people from the Kurdistan Region to Europe. ZANCO Journal of Pure and Applied Sciences, 29(4), pp.44-55.

26) Blbas, H.T.A., (2021) Statistical Analysis About Negative Reasons Of Summer Training At Salahaddin University Using Factor Analysis By Spss. Pragya, 81, p.64.

27) Aziz, K.G., Blbas, H.T.A. and Tofiq, A.H., (2023). Evaluation of significant factors influencing the survival time of breast cancer patients using the Cox regression model. Journal of Public Health, pp.1-6.

28) Blbas, H.T.A., Kahwachi, W.T.S., Ahmed, S.K., Aziz, K.G., Faraj, S.M. and Mohammed, M.S., 2024. Factors contributing to vitamin D deficiency in Erbil, Iraq: A statistical investigation. Clinical Nutrition Open Science.

29) Ahmed, S., Abdulqadir, S., Hussein, S., Qurbani, K., Omar, R., Mohamed, M. and Blbas, H., (2023). Knowledge, Attitudes, and Willingness to Vaccinate for Mpox among Healthcare Workers in Kurdistan Region of Iraq: A Nationwide Cross-Sectional Study.

30) Saadi, H.O., Sdeeq, H.S., Hussein, M.M., Blbas, H.T., Qadir, K. and Muhammed, S.M., (2023). Umbilical Cord Care Knowledge and Practice among Sample of Kurdish Women. Technium BioChemMed, 6, pp.41-55.