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Research article

The impact of perception regarding therapeutic exercises and dietary changing adherence of subjects known with low back pain

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Abstract: Debates regarding the role of therapeutic exercises and diet as modulators of an anti-inflammatory state occurred in the last years in the medical environment**.** The synergy between moderate-intensity exercise and a proper diet targeting decreasing IL-1 inhibits the production of the pro-inflammatory cytokine TNF-α**,** the key regulator of local and systemic inflammation. One of the most important causes of short and long-term disability in all occupational groups is back pain, impacting the quality of life. Degeneration of the intervertebral disc (IVD) causes low back pain that intensifies with age. Assessment of the Oswestry Disability Index was applied on 23 subjects with low back pain to investigate the degree of disability. Nutrition of IVD, implying therapeutic exercises, and a customized diet may be crucial adjuvants for the rehabilitation process. The appropriate diet and therapeutic exercise approach are meant to evaluate the impact of awareness regarding the possibility of improving health outcomes. In this present study, women have a strong positive Pearson correlation (p<0.05) with minimal (66-70 years) disability and moderate disability (r=1.000, CI =99%). Subjects with moderate disability conditions have "no" intention to implement diet changes and maintain therapeutic exercise adherence (r=0.902, CI = 95%). Men (71-75 years, r=0.995, CI =99%) registered a positive strong correlation with maximum deficiency (r=1.000, CI =99%) and "possible no" change in diet and exercise adherence will be applied (r=0.866, CI = 95%). Total disability responders answered with a "probable yes" option (r=0.884, CI=95%) but the dependence on their careers is decisive. The education strategy is essential because diet change implementation can cause resistive behavior as well as adherence to exercise therapy. A key to effectively managing the inflammatory state due to different comorbidities is to use the cumulative effects of health professionals' prescriptions. The challenge is to ensure adherence to these actions for each patient.

Keywords: anti-inflammatory, therapeutic exercises, rehabilitation, diet, Oswestry Disability Index (ODI), back pain, intervertebral disc, nutrition, perception, disability.

1. Introduction

Debates regarding the role of therapeutic exercises and diet as modulators of an anti-inflammatory state occurred in the last years in the medical environment. The inflammatory process is a factor in chronic diseases and pain related to this factor delays the rehabilitation phase and impacts the quality of life.

20% of the European adult population is affected by chronic pain, cost estimated at €300 billion, the category spinal or cervical pain is in the second place of the top 5 most commonly reported pain diagnoses with 12.1% [1–3].

Pain is coded according to the World Health Organisation's International Classification of Diseases (ICD- 11) as a primary condition or secondary as a symptom of another condition. One of the most important causes of short and long-term disability in all occupational groups is back pain. Low back pain is a common condition in working-age populations.

Degeneration of the intervertebral disc (IVD) causes low back pain that intensifies with age. The composition of the intervertebral disc consists of a matrix of collagen fibers that are incorporated into a proteoglycan gel and water [4] . Degenerative change is a response to a mechanical or metabolic injury, rather than a disease [5].

The nutritional pathway of the disc is precarious [6] . Oxygen and glucose concentration are lowest at the center of the disc that leading to cellular apoptosis. The mechanical effect and inflammatory agents in this case cause pain. The physiological link between metabolism and nutrition shows that nutrient concentrations must remain above critical levels to maintain cell viability and activity. Due to low nutrient intake and low hydration, nutrient flow is poor or non-existent in degenerated intervertebral discs and biological repairs in this situation failed [7].

Besides nutrient flow, therapeutic exercises are primordial. Duration, frequency, and magnitude of dynamic axial loading determine tissue engineering using mesenchymal stem cells. Compression and hydrostatic pressure are physical factors that affect disc cell behavior [8].

The intradiscal pressure in degenerated discs was significantly reduced compared with that of normal discs [9]. The role of optimal loading strategy by lumbar exercise interventions to promote the healing or regeneration of the disc is based on a dose-response relationship. Exercises help to hydrate and nourish the joints due to differences in osmotic pressure. Joint movement and mobilization are necessary for cartilage, favoring the diffusion mechanism that underlies its nutrition [10].

Regular exercise protects against diseases associated with chronic low-grade systemic inflammation (rheumatism in the early stages, diabetes, coronary heart disease) and has health benefits, including weight control, improved bone density, and muscle strength. The effect of long-term exercise triggers an anti-inflammatory response, which is partially mediated by muscle-derived IL-6, protecting against TNF-induced insulin resistance [11–13].

The anti-inflammatory action of exercise is related to myokines as mediators:

1. The physiological concentrations of IL-6 stimulate the circulation of the anti-inflammatory cytokines IL-1ra and IL-10 and inhibit the production of the proinflammatory cytokine TNF-α [11].

2. IL-6 stimulates lipolysis as well as fat oxidation [11].

3. The selected functions for each myokine released by muscle contraction have a specific function according to Table 1 [12].

Table 1. Myokines Functions induced by exercises (after [12])

Muscle Myokines induced by exercises	**Function**
IL-6	**Inflammation↓,** ↑Fatty acid oxidation
Irisin	↑Fatty acid oxidation
Myonectin	Autophagy↓, ↑ Mitochondrial biogenesis
Decorin	↑ Myogenesis
FGF (fibroblast growth factor) 21	↑ Mitochondrial biogenesis
SPARC (secreted protein acidic and rich in cysteine)	↑ Muscle repair
IL-15	↑Fat metabolism, ↑ Myoblast differentiation
BDNF (brain-derived neurotrophic factor)	↑ Muscle regeneration, ↑ Fatty acid oxidation

Systemic inflammation associated with a high cardiovascular risk, metabolic disorders, and muscle loss is a typical feature of inflammatory rheumatic diseases that can lead to decreased physical activity and disability. Chronic diseases are often confronted with exacerbation of inflammation due to the natural evolution of diseases and non-compliance with treatment. Exercise is used as a therapy for rheumatic diseases. Myokines induce anti-inflammatory responses to each workout and mediate long-term improvements in cardiovascular risk factors. Therefore, exercise is considered to be a potential treatment for patients with rheumatic diseases. Exercises work directly and indirectly, by improving cardiovascular risk factors [14].

A single session of 20-minutes of moderate exercise can also act as an anti-inflammatory for chronic diseases such as arthritis, fibromyalgia, obesity, and autoimmune diseases. This process of activation during exercise produces immune responses, which include the production of many cytokines or proteins. TNF is a key regulator of local and systemic inflammation that helps stimulate immune responses. A session of about 20 minutes of moderate treadmill exercise resulted in a five percent decrease in the number of stimulated immune cells that produce TNF. The anti-inflammatory effects of regular exercise can be mediated both by reducing the mass of visceral fat (with a subsequent low release of adipokines) and by inducing an anti-inflammatory environment at each workout [15].

Nutrition favored by exercise must target the pro-inflammatory mediators.

A 3-month anti-inflammatory diet was effective in reducing the pro-inflammatory mediators as interferon-γ, interleukin-1β, and interleukin-6, which negatively correlated with anti-inflammatory nutrients, including vitamin A, carotenoids, omega-3 fatty acids, and zinc. [16].

Interleukin-1 explains the pathogenesis of disc degeneration. TNF (tumor necrosis factor) is a regulator of disc degeneration molecules [16].

The strategy of regeneration therapies' success must be addressed to IVD degeneration together with inflammation. Macrophage activity can induce spontaneous disc regression or increase of inflammations by secretions of TNF-α (tumor necrosis factor-alpha), PGE2 (prostaglandin E2), NO (nitric oxide) and IFN-γ (interferon-γ), NGF (nerve growth factor) and substance P production, Lymphocytes B and T are activated by additional recruitment [17].

T-lymphocytes and NK (natural killer) cells were counted using cytometry from blood samples after a 120-min experimental high-fat/high-carbohydrate meal and an increasing trend of leukocytes was demonstrated regarding baseline in both conditions. The participants (n=10) were adults with a chronic spinal cord injury [18].

Nutritional interventions show the impact of anti-inflammatory factors by balancing energy support, and repairing oxidative damage, leading to neuroprotection and neuroplasticity [19].

Changing the style of eating becomes a mandatory aspect to reduce inflammation.

4. Materials and Methods

Two questionnaires were applied; Q1-Oswestry Disability Index (the gold standard for low back functional outcome tools) and Q2-a perception questionnaire regarding the possibility of diet change and therapeutic exercise adherence. An observational study (n=57,199) for the assessment of the Oswestry Disability Index (ODI) revealed that the ODI is a useful tool for capturing outcomes in clinical practice. [20]. Oswestry Disability Index (known as the Oswestry Low Back Pain Disability Questionnaire) relies on ten sections comprising pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life (if applicable), social life, and traveling with six questions each quantified from 0 to 5, the total possible score being 50. Interpretation is based on a criterion by dividing the score obtained by the total score of 50 calculated as a percentage [21].

The questionnaire Oswestry was applied on 23 subjects outpatients known with low back pain to investigate the degree of disability: 10 women and 13 men, aged between 61 and 82 years, period 01.11.2021-31.08.2022, approval no.32/20.10.2021 from own practice physiotherapy cabinet. All subjects gave their informed consent and received physical therapy at home accordingly to the medical recommendations. Information was provided regarding specific interventions as therapeutic exercises adherence and additional ones like a dietary approach to evaluate the impact of awareness regarding the possibility of improving health outcomes.

Oswestry Interpretation score has five result items. Minimal disability (0% - 20%) - subjects can cope with all the usual daily activities, do not need special treatment, only limitations imposed on lifting weights and exercises. Moderate disability (21%-40%) - subjects have difficulty walking, sitting, or standing upright for longer, the ability to travel or social life is possible with difficulty, some of them are not able to work but personal care, sleep is not severely affected. Severe disability (41%-60%) - the persistence of pain is the main problem and affects even basic daily activities. Maximum deficiency (61%-80%) - low back pain or radiation to the lower limb affects all aspects of the patient's life largely so active invasive measures are needed; Total disability (81%-100%) - subjects are immobilized in bed or simulated.

The second questionnaire was quantified as a response to the question "Are you willing to continue therapeutic exercises at home and change your diet to improve your well-being?" in four options as ''yes'', ''no'', ''probable yes'', ''possible no''.

Data analyzes were conducted using Excel software. IBM SPSS software version 25 was used for statistical analysis.

2. Results

23 subjects were classified after age into four groups (Figure 1 – Age Distribution Groups), 43.48% women and 56.52% men (Figure 2 – Gender Distribution on groups age), mean of 71.22±6.127 std. deviation, min. = 61 years, max. 82 years: Age group ≤65years n=5 (21.74%), mean 63.40 ±1.817 years std. deviation, min. 61 years, max. 65 years, Age group 66-70 years n=5 (21.74%), mean 67.60 ±1.517 years std. deviation, min. 66, max. 70 years, Age group 71-75 years n=8 (34.78%), mean 72.88±1.246 years std. deviations, min. 71, max. 75 years, Age group ≥ 76 years n=5 (21.74%), mean 80.00±1.817 years std. deviations, min. = 77, max. 82 years. (Table 2 - Descriptive Statistics- Mean, Std. Deviation)

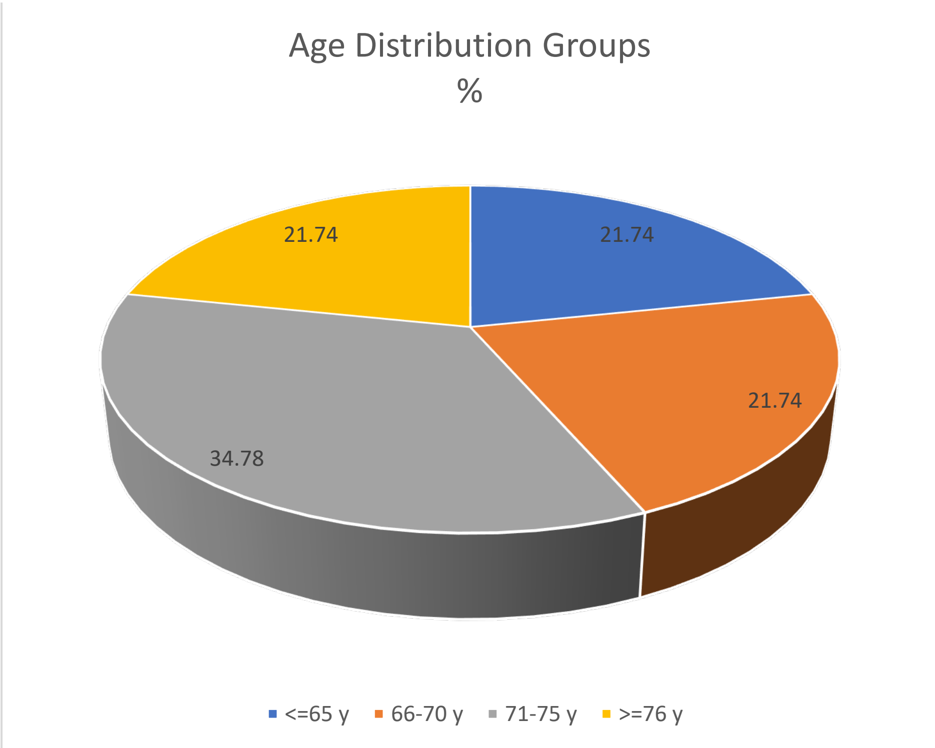


Figure 1. Age Distribution Groups

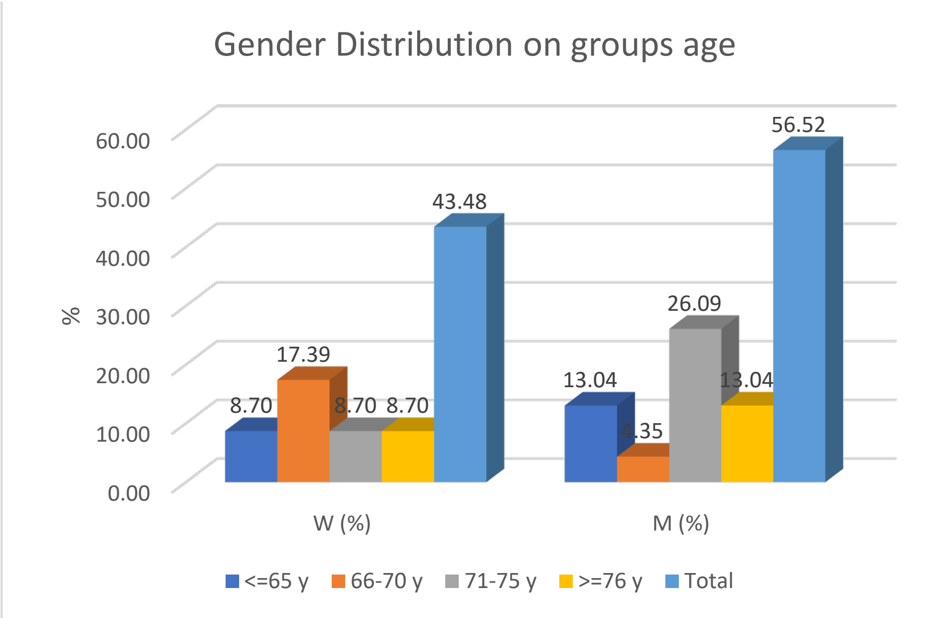


Figure 2. Gender Distribution

Table 2. Descriptive Statistics- Mean, Std. Deviation Groups Age

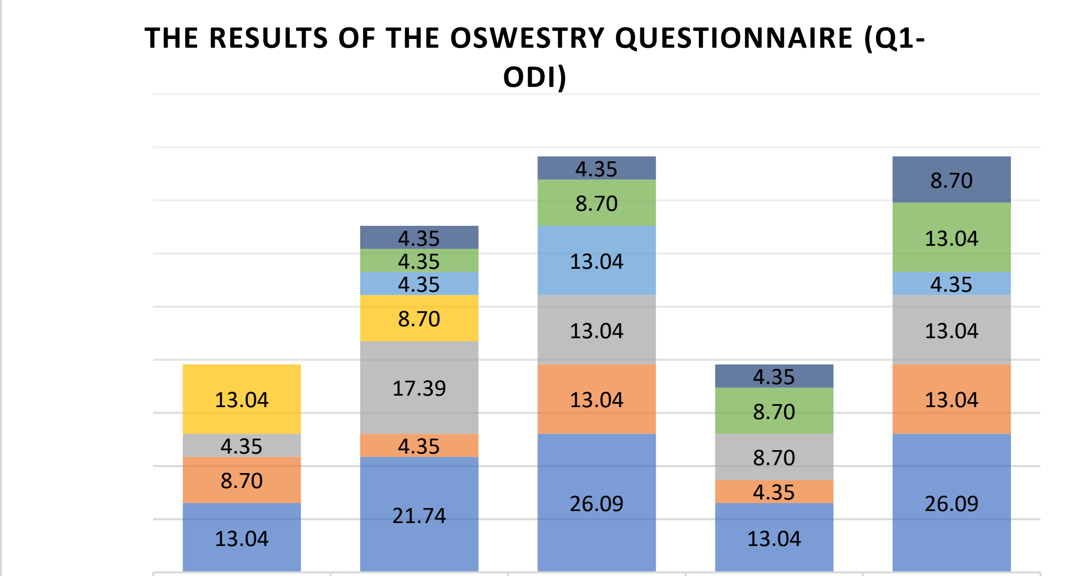
Groups Age	N	Minimum	Maximum	Mean	Std. Deviation
≤ 65 y	5	61	65	63.40	1.817
66-70 y	5	66	70	67.60	1.517
71-75 y	8	71	75	72.88	1.246
≥76 y	5	77	82	80.00	1.871

Oswestry Interpretation score has five result items. Low back pain (lumbar) caused minimal disability on 3 (13.04%) subjects (two women and one man), ≤65years. Moderate disability was registered on 5 (21.75%) subjects (one woman and four men), two of ≤65years and one of the other age group each. Severe disability on 6 (26.09%) subjects (three women and three men), three of 66-70 years, two of 71-75 years, one ≥ 76 years, maximum deficiency on 3 (13.04%) subjects (one woman and two men), two 71-75 years, one ≥ 76 years and total disability on 6 (26.09%) subjects (three women and three men), one 66-70 years, three 71-75 years, two ≥ 76 years. (Table 3, Figure 3)

Table 3. Q1 ODI – descriptive statistics

No.	Remarks	T	W	M	<=65 y	66-70 y	71-75 y	>=76 y
1	Minimal disability	3	2	1	3	0	0	0
2	Moderate disability	5	1	4	2	1	1	1
3	Severe disability	6	3	3	0	3	2	1
4	Maximum deficiency with severe degree of disability	3	1	2	0	0	2	1
5	Total disability with bed imobilization	6	3	3	0	1	3	2
	Total	**23**	**10**	**13**	**5**	**5**	**8**	**5**

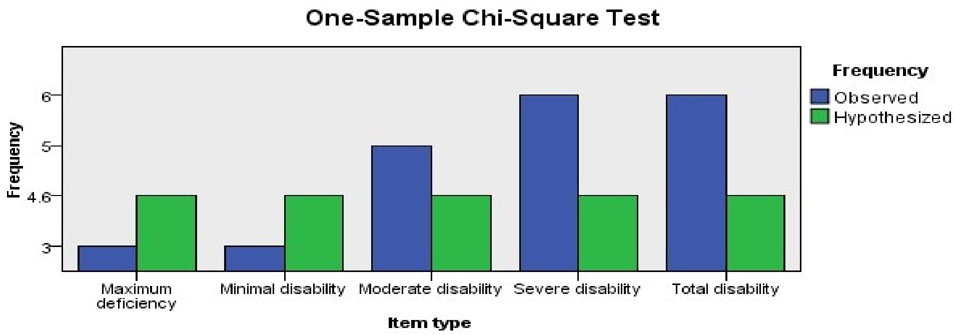
Figure 3 illustrates ODI results.



	Minimal disability	Moderate disability	Severe disability	Maximum deficiency	Total disability
≥ 76 y		4.35	4.35	4.35	8.70
71-75 y		4.35	8.70	8.70	13.04
66-70 y		4.35	13.04		4.35
≤ 65 y	13.04	8.70			
M (%)	4.35	17.39	13.04	8.70	13.04
W (%)	8.70	4.35	13.04	4.35	13.04
T (%)	13.04	21.74	26.09	13.04	26.09

Figure 3. The results of the Oswestry Questionnaire Q1

One-Sample Chi-Square Test retains the null hypothesis sig 0.736 (> significance level 0.05) so disability categories occur with equal probabilities, n=23, degrees of freedom = 4. (Figure 4 - One-Sample Chi-Square Test Q1)



Total N	23
Test Statistic	2.000
Degrees of Freedom	4
Asymptotic Sig. (2-sided test)	.736

1. There are 5 cells (100%) with expected values less than 5. The minimum expected value is 4.600.

Figure 4. One-Sample Chi-Square Test Q1

One-Sample T-Test shows significance for Severe Disability and Total disability p=0.014(<0.05), CI=95% (Tabel 4 – One-Sample Test).

Tabel 4. One-Sample Test

One-Sample Test	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Minimal disability	3.000	1	0.205	1.500	-4.85	7.85
Moderate disability	5.000	1	0.126	2.500	-3.85	8.85
Severe disability	5.196	3	0.014	1.500	0.58	2.42
Maximum deficiency	3.000	1	0.205	1.500	-4.85	7.85
Total disability	5.196	3	0.014	1.500	0.58	2.42

Valid Pearson correlations (Table 5) were found between age, gender, and disability degree. Women have a very strong relationship (r=1.000, sig. 0.000, CI =99%) positive with Minimal disability and Moderate disability and a negative one with Maximum deficiency; Men have a very strong relationship with the age group 71-75 years (r=0.995, sig. 0.005, CI =99%) negative with Minimal disability and Moderate disability and positive one with Maximum deficiency (r=1.000, sig. 0.000, CI =99%).

Regarding age, a negative relationship correlation was recorded on age group ≤65years Moderate disability and Maximum deficiency items (r=1.000, sig. 0.000, CI =99%). Age group 66-70 years negative correlates on Maximum deficiency; Age group 71-75 years positive correlation was recorded with gender men (r=0.995, sig. 0.005, CI =99%), negative with Minimal disability and Moderate disability and positive one with Maximum deficiency (r=1.000, sig. 0.000, CI =99%). Age group ≥ 76 years recorded positive correlation with Moderate disability (r=1.000, sig. 0.000, CI =99%).

Regarding the five items, Minimal disability recorded a negative correlation with men, age group 71-75 years and positive with 66-70 years; Moderate disability recorded a positive correlation with women, negative with men, ≤65years, 71-75 years and positive with age group ≥ 76 years; Maximum deficiency recorded negative correlation with women, age group ≤65years, 66-70 years and positive with 71-75 years. (r=1.000, sig. 0.000, CI =99%).

Tabel 5. Pearson Correlation (r) between Groups Age – Disability degree- Gender

Pearson Correlation (r)		W	M	≤65 y	66-70 y	71-75 y	≥76 y	Minimal disability	Moderate disability	Severe disability	Maximum deficiency	Total disability
W	Pearson	1	-0.899	0.329	0.882	-0.926	0.126	1.000**	1.000**	-0.436	-1.000**	0.218
	Sig. (2-tailed)		0.101	0.671	0.118	0.074	0.874	0.000	0.000	0.564	0.000	0.782
M	Pearson	-0.899	1	0.091	-0.754	.995**	-0.058	-1.000**	-1.000**	0.704	1.000**	0.101
	Sig. (2-tailed)	0.101		0.909	0.246	0.005	0.942	0.000	0.000	0.296	0.000	0.899
≤65 y	Pearson	0.329	0.091	1	0.522	0.000	-0.174	.b	-1.000**	0.302	-1.000**	0.905
	Sig. (2-tailed)	0.671	0.909		0.478	1.000	0.826		0.000	0.698	0.000	0.095
66-70 y	Pearson	0.882	-0.754	0.522	1	-0.816	-0.333	1.000**	.b	-0.577	-1.000**	0.577
	Sig. (2-tailed)	0.118	0.246	0.478		0.184	0.667			0.423	0.000	0.423
71-75 y	Pearson	-0.926	.995**	0.000	-0.816	1	0.000	-1.000**	-1.000**	0.707	1.000**	0.000
	Sig. (2-tailed)	0.074	0.005	1.000	0.184		1.000		0.000	0.293	0.000	1.000
≥76 y	Pearson	0.126	-0.058	-0.174	-0.333	0.000	1	.b	1.000**	0.577	.b	-0.577
	Sig. (2-tailed)	0.874	0.942	0.826	0.667	1.000			0	0.423		0.423

**. Correlation is significant at the 0.01 level (2-tailed).

b. Cannot be computed because at least one of the variables is constant.

Information regarding the importance of the anti-inflammatory role of therapeutic exercises and diet was provided to assess the perception. The second questionnaire applied was the response to the question "Are you willing to continue therapeutic exercises at home and change your diet to improve your well-being" (Table 6, Figure 6)

Table 6. Second questionnaire results Q2

Results	Count	W	M	Minimal disability	Moderate disability	Severe disability	Maximum deficiency	Total disability
Yes	6	6	0	2		1	1	2
No	7	0	7	1	2	2		2
Probable yes	6	3	3		3	2		1
Possible no	4	1	3			1	2	1
Total	23	10	13	3	5	6	3	6

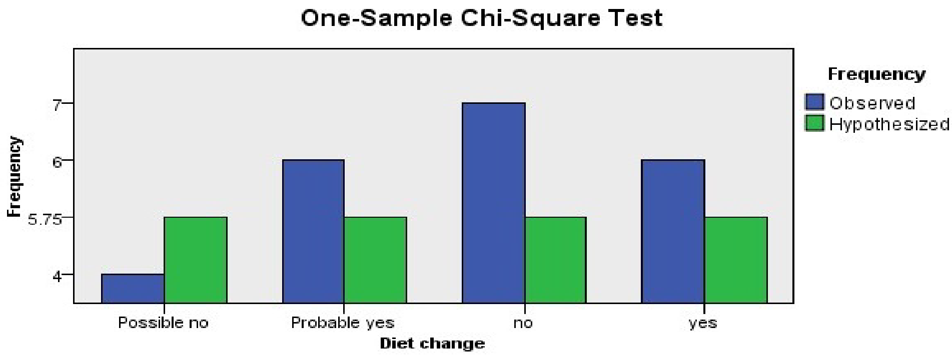
Result "Yes" a total of 6 (26.09%) subjects out of which 2 (8.70%) subjects ≤65years, 2 (8.70%) subjects of 66-70 years, 1 (4.35%) subject of 71-75 years, and 1(4.35%) subjects ≥ 76 years, 2 subjects with Minimal disability, 1 subject with Severe disability, 1 subject with Maximum deficiency and 2 with Total disability.

Result "No", a total of 7 (30.43%) subjects out of which 2 (8.70%) subjects ≤65years, 1 subject (4.35%) of 66-70 years, 3 (13.04%) subjects of 71-75 years, and one (4.35%) subject ≥ 76 years, 1 subject with Minimal disability, 2 subjects with Moderate disability, 2 subjects with Severe disability and 2 with Total disability.

Result "Probable yes", a total of 6 (26.09%) subjects out of which one (4.35%) subject ≤65years, one (4.35%) subject of 66-70 years, 2 (8.70%) subjects of 71-75 years and 2 (8.70%) subjects ≥ 76 years, 3 subjects with Moderate disability and 2 subjects with Severe disability.

Result "Possible no", a total of 4 (17.39%), subjects out of which one (4.35%) subject of 66-70 years, 2 (8.70%) subjects of 71-75 years, and 2 (8.70%) subjects ≥ 76 years, 1 subject with Severe disability, 2 subjects with Maximum deficiency and 1 with Total disability.

One-Sample Chi-Square Test retains the null hypothesis sig 0.843 (> significance level 0.05), so response categories occur with equal probabilities, n=23, degrees of freedom = 3. (Figure 5)

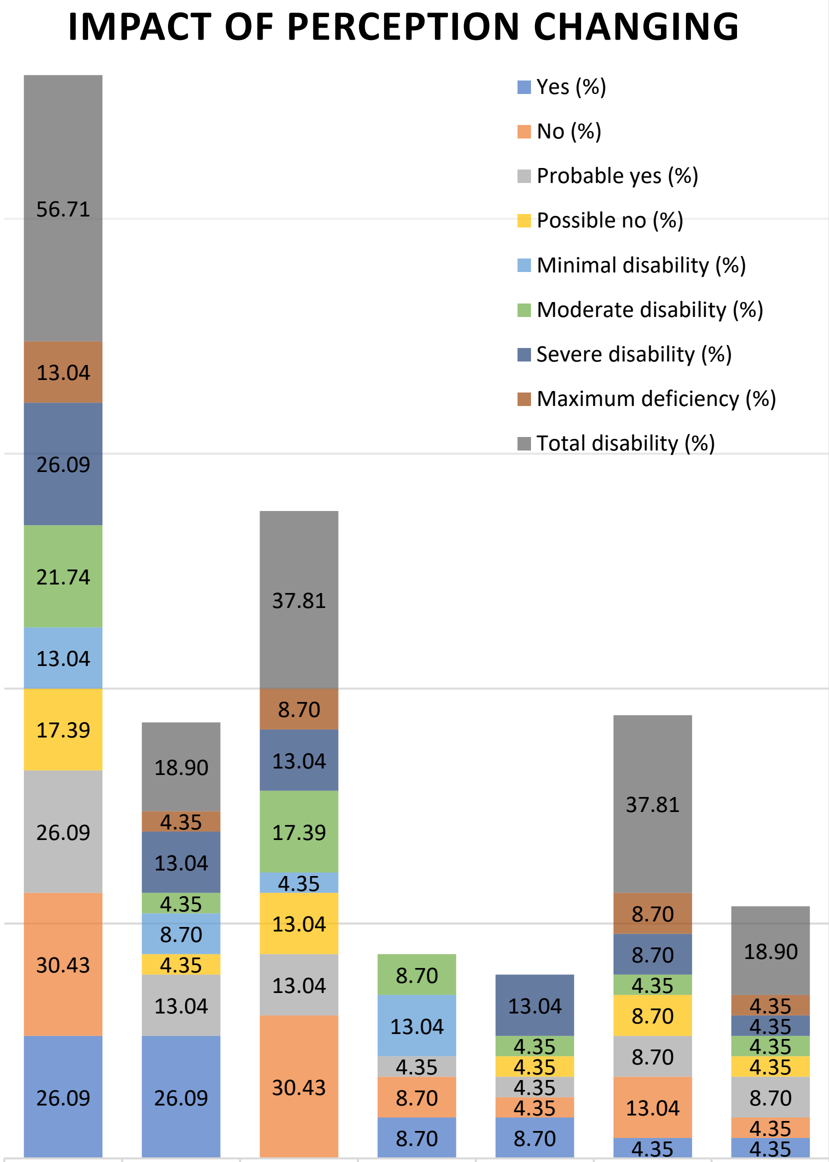


Total N	23
Test Statistic	.826
Degrees of Freedom	3
Asymptotic Sig. (2-sided test)	.843

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 5.750.

Figure 5. One-Sample Chi-Square Test Q2

Figure 6 illustrates the impact of perception changes regarding therapeutic exercise adherence and diet compliance.



	Count	W	M	≤ 65 y	66-70 y	71-75 y	≥76 y
Total disability (%)	56.71	18.90	37.81			37.81	18.90
Maximum deficiency (%)	13.04	4.35	8.70			8.70	4.35
Severe disability (%)	26.09	13.04	13.04		13.04	8.70	4.35
Moderate disability (%)	21.74	4.35	17.39	8.70	4.35	4.35	4.35
Minimal disability (%)	13.04	8.70	4.35	13.04			
Possible no (%)	17.39	4.35	13.04		4.35	8.70	4.35
Probable yes (%)	26.09	13.04	13.04	4.35	4.35	8.70	8.70
No (%)	30.43		30.43	8.70	4.35	13.04	4.35
Yes (%)	26.09	26.09		8.70	8.70	4.35	4.35

Figure 6. Impact of Perception Changes Q2

Valid Pearson correlations were found between "No "option and Moderate disability r=0.902, CI = 95%, sig. =0.014; "Probable yes "and Total disability r=0.884, CI=95%, sig.0.019, "Possible no" and Maximum deficiency r=0.866, CI = 95%, sig. =0.026 ($p<0.05$). (Tabel 7 Pearson Correlation Impact changing versus disability degree)

Tabel 7. Pearson Correlation (r) Impact changing versus disability degree

Pearson Correlation (r)		Minimal disability	Moderate disability	Severe disability	Maximum deficiency	Total disability
Yes	Pearson	0.452	-0.472	0.226	-0.320	0.075
	Sig. (2-tailed)	0.368	0.344	0.667	0.537	0.887
No	Pearson	-0.063	.902*	0.189	0.625	0.316
	Sig. (2-tailed)	0.905	0.014	0.719	0.184	0.542
Probable yes	Pearson	0.000	0.369	0.530	0.750	.884*
	Sig. (2-tailed)	1.000	0.471	0.279	0.086	0.019
Possible no	Pearson	-0.459	0.586	0.612	.866*	0.765
	Sig. (2-tailed)	0.360	0.221	0.196	0.026	0.076

*. Correlation is significant at the 0.05 level (2-tailed).

No one of the participants of the present study is very compliant to control diet according to each specific condition (hypertension, cardiovascular disease, diabetes, rheumatism).

3. Discussion

Evidence regarding the anti-inflammatory effects of therapeutic exercises and dietary approaches are enhanced in various studies and are valid hypotheses to sustain the present study.

An emerging area of nutrition research is diet adapted to specific inflammation to suit the needs of end-consumers following their comorbidities. The Framework method was used to analyze 12,622 subjects' comments, taken from the Massive Open Online Course forum, which included a unit titled Foods and Inflammation. Subjects identified avoidance of core food groups, such as dairy and grains, as key in managing inflammation. An anti-inflammatory diet includes vegetables, legumes/lentils, fruits, oily fish, nuts and seeds, herbs and spices, olive oil, and whole grains. Mediterranean diet and the importance of nutraceuticals were advocated as being anti-inflammatory and were emphasized [22].

Dietary Inflammatory Index (DII) is used in research to categorize individuals' diets on anti- to pro-inflammatory ones [23]. DII is based on a large base of research involving six of the most commonly studied inflammatory markers (IL-1β, IL-4, IL-6, IL- 10, TNF-α, and C-reactive protein). Scores can be calculated from any dietary assessment tool that can provide nutrient intake data [24].

Mediterranean-like diet intervention with proposed anti-inflammatory foods compared with a Western diet reduced the systemic inflammation in patients with Rheumatoid Arthritis that had high compliance to the dietary intervention. ($n = 29$). Systemic inflammation decrease was proved by erythrocyte sedimentation rate values [25].

Dietary change intervention based on an anti-inflammatory diet ($n=20$) and control diabetes diet ($n=10$) improved inflammation as well as other cardiometabolic risk factors by reducing markers of inflammation, especially with weight loss. Glucose, lipids, and triglycerides had an equally decreasing trend in both groups [26].

An umbrella quantitative review estimates existing evidence of the positive associations between DII and health outcomes such as cancer, metabolic disease, cardiovascular disease, mortality, and depression [27].

Healthy nutrition requires multiple socio-political and economic interactions regarding food, individual perceptions, educational factors, risk understanding, and a sense of control over eating patterns. Long-term nutritional programs need to incorporate strategies that address individual-level factors (perception of food and sense of control over eating patterns), as well as structural level factors (poverty) [28]. Health behavior theories rely on intentions and health beliefs as self-efficacy beliefs, risk perception, and outcome expectancies. Risk perception was more closely related to objective parameters (like age, gender, body weight, blood pressure, and total cholesterol) than to social-cognitive variables and self-efficacy and intention was specified as a moderator, making a distinction between two groups differently motivated to eat healthy foods [29].

The importance of improving nutrition education is the first step toward making healthier food choices. These actions should be accompanied by strengthening the policies aimed at improving the food environment and making healthy choices easier [30].

A scoping review examining the effect of disability on food access and security shows a consistently increased risk of food insecurity among people with disabilities, a problematic category regarding food access and insecurity [31].

People with disabilities often have dietary patterns that lack essential nutrients. Health professionals must support the implementation of interventions that promote engagement with a healthy lifestyle. Interventions may consist of supporting them to make healthy dietary choices, offering information, and collaborating with careers for implementation [32].

Regular physical activity has health benefits such as weight control, improved heart function, bone density, and muscle strength, and reduced cardiovascular risks, targeting rheumatism in the early stages, diabetes, and coronary heart disease.

Exercises at home for the quadriceps muscles improve osteoarthritis of the knee as well as NSAID medication [33].

Therapeutic exercise has been shown to reduce pain and improve physical function for people with osteoarthritis of the knee [34]. Chronic kidney disease is associated with a complex state of immune dysfunction characterized by immune depression, predisposition to infections, and an increased risk of cardiovascular disease. Exercise can improve immune function and have anti-inflammatory effects. Six months of regular walking exercises (30 min/day 5 times/week) exerted anti-inflammatory effects (reduced ratio of plasma levels of IL-6 and IL-10) and a downward regulation of T lymphocyte and monocyte activation. Exercise did not change kidney function, proteinuria, and blood pressure in the case of chronic kidney disease. So walking exercise is safe for immune and inflammatory responses and has the potential to be an effective anti-inflammatory therapy in predialysis [35].

The rehabilitation program significantly reduced the local expression of TNF-alpha, IL-1-beta, IL-6, and iNOS in the skeletal muscle of patients with chronic myocardial infarction. These local anti-inflammatory effects of exercise can alleviate the process of catabolic loss associated with the progression of congestive heart failure [36]. Exercise in patients with myositis is considered safe, benefits from the clinical outcome, and can reduce inflammation [37].

5. Conclusions

One core role of therapy is the prevention and reducing the exacerbation of inflammation. The inflammatory process is a factor of chronic diseases and pain related to this factor delays the rehabilitation phase and impacts the quality of life. An adequate hygienic-dietary regime, as part of a framework treatment, prophylactic and curative as well as the motivation to continue the exercises prescribed are necessary to be approached multidisciplinary.

The synergy between moderate-intensity exercise and a proper diet targeting ↓ IL-1 inhibits the production of the pro-inflammatory cytokine TNF-α. (Figure 6)

LOW BACK PAIN - Degeneration of IVD	
Interleukin-1 explains the pathogenesis of disc degeneration	
IMMUNE SYSTEM STIMULATION – TNF α - driver	
TNF α - driver is a key regulator of local and systemic inflammation that helps stimulate immune responses	
THERAPEUTIC EXERCISES (minimum 20 minutes moderate intensity)	**ANTI-INFLAMMATORY DIET (minimum 3 months)**
Miokines muscle-derived (IL-6) **IL-6 marker, IL-1 mediator**	**IL-1, IL-6 mediators**
↑anti-inflammatory cytokines IL-1ra, sTNF-R and IL-10	↓ the pro-inflammatory mediators as IFN-γ,
inhibitory effects on TNF-α and IL-1(α ,β) production	↓ the pro-inflammatory mediators as IL-1β, and IL-6
inhibit the production of the pro-inflammatory cytokine TNF-α	
TNF (tumor necrosis factor) is a regulator of disc degeneration molecules	
One session of about 20 minutes of moderate exercise decreased the number of stimulated immune cells that produce TNF by 5%.	

Figure 6. The synergy between a moderate intensity exercise and a proper diet targeting ↓ IL-1 (after [11–13], [15–17], [24] **)**

In this present study, women have a strong positive correlation between minimal (66-70 years) disability and moderate disability. Subjects with moderate disability conditions have "no" intention to implement diet changes and maintain exercise adherence. Men (71-75 years) registered a positive strong correlation with maximum deficiency and "possible no" change in diet and exercise adherence will be applied. Total disability responders answered with a "probable yes" option but the dependence on their careers is decisive. (Figure 7. Conclusions flow chart)

n=23 (10 W-43.48%, 13 M-56.52%)
≤ 65 y (n= 5, 21.74%) 66-70 y (n= 5, 21.74%) 71-75 y (n=8, 34.78% ≥76 y (n= 5, 21.74%)

Q1 RESULTS	**Q2 RESULTS**
Minimal disability n=3 (13.04%) 2W,1M Moderate disability n=5 (21.74%) 1W, 4M Severe disability n=6 (26.09%) 3W, 3M Maximum deficiency n=3 (13.04%) 1W, 2M Total disability n=6 (26.09%) 3W, 3M	"Yes" n=6 (26.09%) 6W "No" n=7 (30.43%) 7M Probable Yes" n=6 (26.09%) 3W, 3M "Posible No" n= 4 (17.39) 1W, 3M
Conclusions - Valid Pearson positive correlations between Q1, Q2, group age	
Women / Minimum (66-70 y) and Moderate disability ; Men (71-75 y) / Maximum deficiency ≥ 76 y/ Moderate disability Men 66-70 years/ Minimal disability "No "option/ Moderate disability, Possible no" /Maximum deficiency, "Probable yes "/Total disability	

Figure 7. Conclusions - Flow chart

Education strategy in the early stages of rehabilitation providing appropriate advice on nutrition and motivational support to continue the prescribed exercises is needed. Change implementation can cause resistive behavior. Strategies based on progressive goals must be supported by evidence such as sleep quality, changes in joint stiffness or mobility, fatigue degree, well-being, and quality of life.

A key to effectively managing the inflammatory state due to different comorbidities is to use the cumulative effects of health professionals' prescriptions. The challenge is to ensure adherence to these actions for each patient.

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References

1. Pain Alliance Europe. *Patients Report on Diagnosis and Treatment*.; 2021. https://pae-eu.eu/wp-content/uploads/2021/09/PAE-Short-Report-Diagnosis-Treatment-2021-final-.pdf
2. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: Prevalence, impact on daily life, and treatment. *Eur J Pain*. 2006;10(4):287. doi:10.1016/j.ejpain.2005.06.009
3. Pain SI of. *Impact of Pain on Society Costs the EU up to 441 Billion Euros Annually Experts*. Vol 549.; 2017. https://www.sip-platform.eu/files/structure_until_2016/Assorted Photos/SIP related Pdfs/Press information_SIP_Impact of pain on society costs up to 441 bn Euros.pdf
4. Joshua A. Waxenbaum; Vamsi Reddy; Bennett Futterman. Anatomy, Back, Intervertebral Discs. National Library of Medicine. Published 2021. https://www.ncbi.nlm.nih.gov/books/NBK470583/
5. Kushchayev S V., Glushko T, Jarraya M, et al. ABCs of the degenerative spine. *Insights Imaging*. 2018;9(2):253-274. doi:10.1007/s13244-017-0584-z
6. Knezevic NN, Mandalia S, Raasch J, Knezevic I, Candido KD. Treatment of chronic low back pain - New approaches on the horizon. *J Pain Res*. 2017;10:1111-1123. doi:10.2147/JPR.S132769
7. Huang YC, Urban JPG, Luk KDK. Intervertebral disc regeneration: Do nutrients lead the way? *Nat Rev Rheumatol*. 2014;10(9):561-566. doi:10.1038/nrrheum.2014.91
8. Chan SCW, Ferguson SJ, Gantenbein-Ritter B. The effects of dynamic loading on the intervertebral disc. *Eur Spine J*. 2011;20(11):1796-1812. doi:10.1007/s00586-011-1827-1
9. Sato K, Kikuchi S, Yonezawa T. In vivo intradiscal pressure measurement in healthy individuals and in patients with ongoing back problems. *Spine (Phila Pa 1976)*. 1999;24(23):2468-2474. doi:10.1097/00007632-199912010-00008
10. Steele J, Bruce-Low S, Smith D, Osborne N, Thorkeldsen A. Can specific loading through exercise impart healing or regeneration of the intervertebral disc? *Spine J*. 2015;15(10):2117-2121. doi:10.1016/j.spinee.2014.08.446
11. Petersen AMW, Pedersen BK. The anti-inflammatory effect of exercise. *J Appl Physiol*. 2005;98(4):1154-1162. doi:10.1152/japplphysiol.00164.2004
12. Lee JH, Jun HS. Role of myokines in regulating skeletal muscle mass and function. *Front Physiol*. 2019;10(JAN):1-9. doi:10.3389/fphys.2019.00042
13. Pedersen BK, Steensberg A, Fischer C, et al. Searching for the exercise factor: Is IL-6 a candidate? *J Muscle Res Cell Motil*. 2003;24(2-3):113-119. doi:10.1023/A:1026070911202
14. Benatti FB, Pedersen BK. Exercise as an anti-inflammatory therapy for rheumatic diseases - Myokine regulation. *Nat Rev Rheumatol*. 2015;11(2):86-97. doi:10.1038/nrrheum.2014.193
15. Dimitrov S, Hulteng E, Hong S. Inflammation and exercise: Inhibition of monocytic intracellular TNF production by acute exercise via β2-adrenergic activation. *Brain Behav Immun*. 2017;61:60-68. doi:10.1016/j.bbi.2016.12.017
16. Allison DJ, Beaudry KM, Thomas AM, Josse AR, Ditor DS. Changes in nutrient intake and inflammation following an anti-inflammatory diet in spinal cord injury. *J Spinal Cord Med*. 2019;42(6):768-777. doi:10.1080/10790268.2018.1519996
17. Molinos M, Almeida CR, Caldeira J, Cunha C, Gonçalves RM, Barbosa MA. Inflammation in intervertebral disc degeneration and regeneration. *J R Soc Interface*. 2015;12(104). doi:10.1098/rsif.2014.1191
18. Dix GU, Jackson GS, Todd KR, et al. The effects of a high-fat/high-carbohydrate meal on leukocyte populations in adults with chronic spinal cord injury. *Spinal Cord Ser Cases*. 2021;7(1). doi:10.1038/s41394-021-00412-7
19. Jonas Campos, Nuno A Silva AJS. Nutritional interventions for spinal cord injury: preclinical efficacy and molecular mechanisms. *Nutr Rev*. 2022;80(5):1206–1221. doi:10.1093/nutrit/nuab068
20. Cook CE, Garcia AN, Wright A, Shaffrey C GO. Measurement Properties of the Oswestry Disability Index in Recipients of Lumbar Spine Surgery. *Spine (Phila Pa 1976)*. 2021;46(2):E118-E125. doi:10.1097/BRS.0000000000003732
21. Fairbank JCT, Pynsent PB. The Oswestry Disability Index. *Spine (Phila Pa 1976)*. 2000;25(22):2940-2953.
22. Cowan S, Sood S, Truby H, Dordevic A, Adamski M, Gibson S. Inflaming Public Interest: A Qualitative Study of Adult Learners' Perceptions on Nutrition and Inflammation. *Nutrients*. 2020;12(2). doi:10.3390/nu12020345
23. Shivappa N, Steck SE, Hurley TG, Hussey JR, Hébert JR. Designing and developing a literature-derived, population-based dietary inflammatory index. *Public Health Nutr*. 2014;17(8):1689-1696. doi:10.1017/S1368980013002115
24. Hébert JR, Shivappa N, Wirth MD, Hussey JR, Hurley TG. Perspective: The Dietary Inflammatory Index (DII) - Lessons

Learned, Improvements Made, and Future Directions. *Adv Nutr*. 2019;10(2):185-195. doi:10.1093/advances/nmy071

25. Hulander E, Bärebring L, Turesson Wadell A, et al. Proposed Anti-Inflammatory Diet Reduces Inflammation in Compliant, Weight-Stable Patients with Rheumatoid Arthritis in a Randomized Controlled Crossover Trial. *J Nutr*. 2021;151(12):3856-3864. doi:10.1093/jn/nxab313
26. Zwickey H, Horgan A, Hanes D, et al. Effect of the Anti-Inflammatory Diet in People with Diabetes and Pre-Diabetes: A Randomized Controlled Feeding Study. *J Restor Med*. 2019;8(1):1-16. doi:10.14200/jrm.2019.0107
27. Liu FH, Liu C, Gong TT, et al. Dietary Inflammatory Index and Health Outcomes: An Umbrella Review of Systematic Review and Meta-Analyses of Observational Studies. *Front Nutr*. 2021;8(May). doi:10.3389/fnut.2021.647122
28. Yoshimi Fukuoka, Teri G Lindgren, Kemberlee Bonnet EK. Perception and Sense of Control Over Eating Behaviors Among a Diverse Sample of Adults at Risk for Type 2 Diabetes. *Physiol Behav*. 2017;176(1):139-148. doi:10.1177/0145721714522717.Perception
29. Renner B, Schwarzer R. The motivation to eat a healthy diet: How intenders and nonintenders differ in terms of risk perception, outcome expectancies, self-efficacy, and nutrition behavior. *Polish Psychol Bull Vol 361 2005 715*. 2005;(June 2014).
30. Batis C, Castellanos-Gutiérrez A, Aburto TC, Jiménez-Aguilar A, Rivera JA, Ramírez-Silva I. Self-perception of dietary quality and adherence to food groups dietary recommendations among Mexican adults. *Nutr J*. 2020;19(1):1-12. doi:10.1186/s12937-020-00573-5
31. Schwartz N, Buliung R, Wilson K. Disability and food access and insecurity: A scoping review of the literature. *Heal Place*. 2019;57(April):107-121. doi:10.1016/j.healthplace.2019.03.011
32. Harper L, Ooms A. Developing dietary interventions for people with learning disabilities. *Nurs Times*. 2021;117(4):30-33. https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=149605736&site=ehost-live
33. Doi T, Akai M, Fujino K, et al. Effect of home exercise of quadriceps on knee osteoarthritis compared with nonsteroidal antiinflammatory drugs: A randomized controlled trial. *Am J Phys Med Rehabil*. 2008;87(4):258-269. doi:10.1097/PHM.0b013e318168c02d
34. Fransen M, McConnell S, Bell M. Therapeutic exercise for people with osteoarthritis of the hip or knee. A systematic review. *J Rheumatol*. 2002;29(8):1737-1745.
35. Viana JL, Kosmadakis GC, Watson EL, et al. Evidence for anti-inflammatory effects of exercise in CKD. *J Am Soc Nephrol*. 2014;25(9):2121-2130. doi:10.1681/ASN.2013070702
36. Gielen S, Adams V, Möbius-Winkler S, et al. Anti-inflammatory effects of exercise training in the skeletal muscle of patients with chronic heart failure. *J Am Coll Cardiol*. 2003;42(5):861-868. doi:10.1016/S0735-1097(03)00848-9
37. Nader GA, Lundberg IE. Exercise as an anti-inflammatory intervention to combat inflammatory diseases of muscle. *Curr Opin Rheumatol*. 2009;21(6):599-603. doi:10.1097/BOR.0b013e3283319d53