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Original article

KINESTHETIC AND VISUAL IMAGERY IN YOUNG ADULTS WITH CHRONIC NECK PAIN

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Abstract: **Background:** Young adults complain of neck pain almost every year. In recent years the ability of motor imagery (kinesthetic and visual imagery) in many musculoskeletal system problems other than neck pain in young adults has been investigated in the literature. The Cross-Sectional study aimed to question motor imagery ability in young adults with chronic neck pain.

Methods: Two groups were included in the study: the chronic neck pain group (n = 83) and the control group (n = 91). Motor imagery ability of both groups was evaluated with Movement Imagery Questionnaire-3. Additionally, in the chronic neck pain group, pain was evaluated with the Short Form-McGill Pain Questionnaire, disability was evaluated with the Neck Disability Index, and kinesiophobia was evaluated with Tampa Scale for Kinesiophobia.

Conclusions: Internal visual imagery and kinesthetic imagery were significantly different between chronic neck pain and control groups. There was a negative linear relationship between disability and internal visual imagery, external visual imagery, and kinesthetic imagery. Motor imagery ability is reduced in young adults with chronic neck pain. In addition, as the severity of disability increases, the motor imagery ability decreases. Therefore, it is considered appropriate to include a motor imagery training program when treating chronic neck pain in the future.

Keywords: Chronic, Movement, Pain, Young adults.

INTRODUCTION

One of the most commonly reported musculoskeletal problems in young adults is neck pain. The incidence of neck pain has increased in recent years (1, 2). As time progresses in neck pain, there are permanent structural and functional changes in the neuromuscular system of the cervical region (3). Recent studies indicate changes not only in this region, but also in the central region (4, 5). Changes in the central system are considered as neurochemical, structural, and functional changes in the cortical system (6). In recent years, musculoskeletal problems have also been manifested by the influence of motor imagery, an indicator of cortical reorganization (7).

Motor imagery is defined as the mental representation of movement without any body movement. Motor imagery is divided into two. The first is kinesthetic imagery based on feeling the movement, and the second is visual imagery based on visualizing the movement (8). Motor imagery is evaluated by different methods such as laterality judgment, mental chronometer, and questionnaire forms (9). The literature points out that motor imagery decreases in various musculoskeletal problems. The number of studies on individuals with neck pain is insufficient, and the results of these studies are under debate (10).

No studies are evaluating kinesthetic and visual imagery in detail with neck-pained individuals. In the literature, the study conducted on individuals with lower back pain states that motor imagery is affected by disability, kinesiophobia, and pain parameters. To establish successful treatment programs, we need studies evaluating motor imagery, by taking into consideration factors that are related to and affecting it. Our primary aim was to investigate the motor imagery ability of young adults with chronic neck pain. Our secondary aim was to determine the relationship between motor imagery and the factors that are related to and affecting it.

MATERIALS AND METHODS

Our cross-sectional study was carried out at Manisa Celal Bayar University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation. All students of the department were informed (n = 590). Volunteers were divided into two groups, those with neck pain (chronic neck pain group) and those without neck pain (control group).

Inclusion criteria

Voluntary individuals aged 18-24 years with neck pain for at least 3 months were included in the chronic neck pain group. The control group consisted of healthy individuals aged 18-24 years who had no neck pain for at least 3 months.

Exclusion criteria

In both groups, patients with any neurological disorder, regular medication, and who had spinal surgery were excluded from the study. In addition, individuals in both groups were asked whether they had used any medication for at least 24-48 hours. Patients who were on medication were evaluated on another day.

Outcome measurement

The sociodemographic data of all young adult individuals were evaluated with data record form and motor imagery ability was evaluated with Movement Imagery Questionnaire-3. In addition to these evaluations, the pain level and quality of the chronic neck pain group were evaluated with the short-form McGill Pain Questionnaire, the level of disability was evaluated with the Neck Disability Index, and the kinesophobia was evaluated with the Tampa Scale for Kinesiophobia accompanied by a physiotherapist.

Firstly, gender, age, height, and weight information of the individuals were taken for sociodemographic information, and the duration of neck pain was recorded for months for individuals with neck pain. Both groups were then asked to answer the Movement Imagery Questionnaire-3.

Movement Imagery Questionnaire-3

The imagery influences of the individuals were evaluated with the Movement Imagery Questionnaire-3. The validity and reliability of the questionnaire, which was revised by Williams et al., were performed by Dilek et al. (11, 12, 13). The questionnaire consists of 3 sub-groups: kinesthetic, internal visual, and external visual imagery. The questionnaire, which consists of twelve questions, assesses the imagery ability of the person after 4 different movements. The person is asked to make the movement first and then image it. The higher the score, the more positive the imagery ability of the patient.

The short-form McGill Pain Questionnaire

The quality of pain was assessed by the Short Form McGill Pain Questionnaire. The validity and reliability of the questionnaire in Turkish, which was created by Melzack, were ensured by Yakut et al. (14, 15). The survey consists of three parts. In the first part, the features of pain are asked, 11 of which are sensory and 4 are perceptual. The higher the score, the greater the pain. In the second part of the questionnaire, five groups of words ranging from “mild pain” to “unbearable pain” are used to determine the severity of the person’s pain. In the third part, the current pain intensity of the person is evaluated using VAS (Visual Analog Scale).

Neck Disability Index

Neck Disability Index was used to evaluate the perceived limitation of the individual in daily living activities due to neck pain. The validity and reliability of the Neck Disability Index in Turkish, developed by Vernon and Mior, were made by Aslan et al. (16, 17). An increase in score indicates an increase in the level of disability.

Tampa Scale for Kinesiophobia

The Tampa Scale for Kinesiophobia is a 17-item scale developed to assess the fear of movement / (re)-injury. The validity and reliability of the questionnaire in Turkish, which was prepared by Miller et al., were made by Yılmaz et al. (18, 19). The increase in the score of the person on the scale indicates that the kinesiophobia is also high.

Statistical Methods

Sample size

The size to be included in the study and the smallest sample numbers of the volunteer and control groups were calculated with G Power 3.1. program. In the study conducted by La Touche R et al. (20), the mean and standard deviations of visual motor imagery were calculated with the values of 24.40 ± 2.86 in the low back pain group and 22.48 ± 3.75 in the control group ($d = 0.57$) and $\alpha = 0.05$ significance level was calculated at 80% strength. It was planned to include a minimum of 160 people, having at least 80 people in each group.

Data analysis

Since parametric test assumptions were not provided for numerical variables as descriptive statistics in the study, median (minimum-maximum), frequency (n), and percentage (%) were given for categorical data. Whether there was a difference between the groups in terms of numerical variables was analyzed by the Mann-Whitney U test, one of the nonparametric tests. Pearson chi-square test was used to evaluate categorical data. The linear relationship between the variables and the strength of the relationship was examined with Significance Testing of the Spearman Rank Correlation Coefficient. A multiple linear regression model was formed by using a forward-selection method with the independent variables which were thought to affect the internal, external, and kinesthetic imagery as dependent variables. The adequacy of the model; Multiple correlation coefficients (R2), the overall significance of the model, and determination of multicollinearity were evaluated with VIF (Variance Inflation Factors) values, determination of autocorrelation was evaluated with the Durbin Watson test. The probability of Type I error was determined to be 0.05. Analyzes were performed using IBM SPSS V22.

RESULTS

There was no significant difference between the chronic neck pain and control groups in terms of age, height, weight and gender distributions (p = 0.173; p = 0.433; p = 0.894; p = 0.479, respectively) (Table 1).

Motor imagery

In terms of internal, external, and kinesthetic imagery values, a significant difference was found between internal visual and kinesthetic imagery, chronic neck pain, and control groups. There was no significant difference in terms of external visual imagery (p = 0.037; p = 0.047; p = 0.108, respectively) (Table 1).

Table 1. *Descriptive Statistics for Demografic Variables*

Variables	CNPG (n = 83)	CG (n = 91)	P value
	Medyan (Min-Max)	Medyan (Min-Max)	
Gender			
Female, n (%)	59 (71.1)	69 (75.8)	
Male, n (%)	24 (28.9)	22 (24.2)	0.479[b]
Age (years)	20 (18-24)	20 (18-23)	0.173[a]
Boy (cm)	168 (155-188)	167 (153-187)	0.433[a]
Kilo (kg)	60 (40-97)	60 (40-105)	0.894[a]
IVI	6.25 (3.5-7)	6.50 (4-7)	**0.037[a]**
EVI	6.50 (2.5-7)	6.75 (4-7)	0.108[a]
KI	5.50 (2.25-7)	5.75 (4.25-7)	0.047[a]

a: Mann-Whitney U Test
b: Pearson Ki-Kare Test
CNPG: Chronic neck pain group; CG: Control group; KI: Kinesthetic Imagery; IVI: Internal Visual Imagery; EVI: External Visual Imagery

Table 2. *Results of Chronic neck pain group*

Variables	**CNPG**
	Medyan (Min-Max)
Pain Duration (months)	36 (4-120)
NDI (%)	22 (8-48)
SF-MPQ	
Sensory score	9 (1-20)
Affective score	2 (0-11)
Present Pain Intensity	2 (1-4)
VAS	3.50 (0.50-8.50)
TSK	36 (24-47)

CNPG: Chronic neck pain group; NDI: Neck Disability Index; SF-MPQ:Short Form-McGill Pain Questionnaire; TSK: Tampa Scale of Kinesiophobia.

Correlation analysis

A negative linear relationship was found between the kinesthetic imagery score and the Neck Disability Index score (p = 0.003). When the degree of significant correlation coefficient was examined, the correlation was weak (rs = -0,324) (Table 2).

There was a negative linear relationship between internal visual imagery scores and the Neck Disability Index, Tampa Scale for Kinesiophobia scores and neck pain duration (p = 0.020; p = 0.001; p = 0.020, respectively). When the degree of the three significant correlation coefficients were examined, the correlation was weak (rs = -0.255; rs = -0.371; rs = 0.254) (Table 2).

A negative linear relationship was found between the external visual imagery score and Neck Disability

Index and Tampa Scale for Kinesiophobia scores (p = 0.005; p = 0.009). When the degree of significant correlation coefficients was examined, the correlation was weak (rs = -0.302; rs = -0.284) (Table 2).

Regression analysis

A multiple linear regression model was established with independent variables (duration of pain, disability, kinesophobia, pain quality) which were thought to affect kinesthetic imagery. According to the established regression model, two significant variables were found. The Neck Disability Index and Short Form McGill Pain Questionnaire's perceptual influence together can explain 18.4% of the kinesthetic imagery dependent variable (p < 0.001; R2 = 0.184) (Table 3).

A multiple linear regression model was established with independent variables (duration of pain, disability, kinesophobia, pain quality) which were thought to affect internal visual imagery. According to

Table 3. *Correlation Between Movement Imagery Questionnaire-3 Results And NDI, MPQ, TSK*

	n = 83	**IVI**	**EVI**	**KI**
NDI	r_s	-0.255	-0.302	-0.324
	p	**0.020**	**0.005**	**0.003**
TSK	r_s	-0.371	-0.284	-0.197
	p	**0.001**	**0.009**	0.075
SF-MPQ Sensory Score	r_s	-0.136	-0.157	0.080
	p	0.219	0.156	0.470
SF-MPQ Affective Score	r_s	-0.135	-0.137	0.003
	p	0.223	0.218	0.976
SF-MPQ Present Pain Intensity	r_s	-0.046	-0.090	-0.150
	p	0.681	0.418	0.176
SF-MPQ Visual Analog Score	r_s	0.009	-0.157	-0.206
	p	0.939	0.156	0.062
Neck pain duration (months)	r_s	-0.254	-0.126	-0.207
	p	**0.020**	0.258	0.061

r_s: Spearman's Correlation Coefficient, KI:Kinesthetic Imagery; IVI:Internal Visual Imagery; EVI:External Visual Imagery; NDI: Neck Disability Index; MPQ: Short Form-McGill Pain Questionnaire; TSK: Tampa Scale of Kinesiophobia

Table 4. *Regression Analysis of Movement Imagery Questionnaire-3*

IVI	R^2		**Anova p value**		
	0.170		0.001		
Independent Variables	Unstandardized Coefficients		p	95,0% Confidence Interval for B	
	B	Standart Error		Lower Bound	Upper Bound
TSK	-0.054	0.018	**0.004**	-0.090	-0.017
Neck pain duration (months)	-0.008	0.004	**0.031**	-0.015	-0.001
EVI	$\mathbf{R^2}$		**Anova p value**		
	0.149		< 0.001		
Independent Variables	Unstandardized Coefficients		p	95,0% Confidence Interval for B	
	B	Standart Error		Lower Bound	Upper Bound
NDI	-0.043	0.012	**< 0.001**	-0.066	-0.020
KI	$\mathbf{R^2}$		**Anova p value**		
	0.184		< 0.001		
Independent Variables	Unstandardized Coefficients		p	95,0% Confidence Interval for B	
	B	Standart Error		Lower Bound	Upper Bound
NDI	-0.052	0.012	**< 0.001**	-0.066	-0.020
MPQ Affective Score	0.099	0.046	**0.037**	-0.077	-0.028

KI: Kinesthetic Imagery; IVI: Internal Visual Imagery; EVI: External Visual Imagery; NDI: Neck Disability Index; MPQ: Short Form-McGill Pain Questionnaire; TSK: Tampa Scale of Kinesiophobia the established regression model, two significant variables were found. the Tampa Scale for Kinesiophobia and duration of pain can explain 17% of the internal visual imagery dependent variable ($p = 0.001$; $R2 = 0.170$) (Table 3).

A multiple linear regression model was established with independent variables (duration of pain, disability, kinesophobia, pain quality) which are thought to affect external visual imagery. According to the established regression model, only 1 variable was found. Neck Disability Index can explain 14.9% of the external visual imagery dependent variable ($p < 0.001$; $R2 = 0.149$) (Table 3).

DISCUSSION

As a result of our study, we found out that kinesthetic and internal visual imagery ability has decreased in young adults with chronic neck pain. In addition, there has been a low correlation between disability and internal visual, external visual, and kinesthetic imagery. It has been seen that visual imagery has a negative linear relationship with kinesiophobia. In addition, it has been seen that the visual imagery of the neck decreases as the pain duration increases and the kinesthetic imagery decreases as the sensory intensity of the pain increases.

Motor imagery ability

In a review of studies evaluating motor imagery in musculoskeletal problems, it has been seen that motor imagery was affected in lower extremity-upper extremity-facial pain-low back pain patient groups. The results differ only in neck pain. (7). In line with our results, Elsig et al. show that motor imagination is reduced in adults with chronic neck pain (21). Two different studies indicate that motor imagery is not affected in patients with neck pain (22, 23).

In studies evaluating individuals with neck pain, it has been observed that the groups have been classified into recurrent neck pain (21), whiplash (23), and whiplash with non-specific neck pain groups (22). In two studies that evaluated the same whiplash patient group, it was reported that motor imagery was not affected (22, 23). However, it supports the presence of motor imagery in non-whiplash diagnoses.

When we examine the literature methodologically, unlike in our study, it has been seen that motor imagery has been assessed from the neck (21), neck and foot (23), or hand region (22) of the patients. We think that the results might be different with the heterogeneity of the methods of the studies. (21, 22, 23). In our study, the motor imagery of the whole body was evaluated.

In terms of determinants (24) that make a difference in the cortical system such as age (25) and gender, our study consists of women between 18-24 years of age, with a ratio of 71-75%. All other studies were conducted with an adult age group. Gender is another factor that determines the innate difference in the cortical system (26). Gender ratios of studies indicating no motor imagery influences are close to each other (22, 23). In the study of Elsig et al. together with our study, where it is supported that there is a motor imagery influence, the female gender constitutes the majority of the groups (21). Differences created by different sexes and ages in the cortical system might also affect the results of our studies.

Factors Affecting Motor Imagery

The relationship between disability and motor imagery

In our study, there was a negative linear relationship between disability and all imagery types. In addition, a 1-unit increase in disability results in a 0.04 decrease in external visual imagery. Elsig et al. also show a negative linear relationship with disability, similar to our motor imagery results (21). There is no different study showing the relationship between disability and motor imagery level in neck-pained individuals. It has been seen that the results of the study evaluating the visual and kinesthetic imaging abilities of lower back pain patients- a group of otherwise diagnosed patients, and our results are similar (20). Even if the number of subjects is insufficient, there is a relationship between disability and imagery even in a group with different diagnoses. This shows that motor imagery decreases as the level of restriction increases during daily life activities.

The relationship between kinesiophobia and motor imagery

In our study, the increase of kinesiophobia decreases internal visual imagery and external visual imagery. In addition, a 1-unit increase in kinesiophobia reduces internal visual imagery by 0.05 units. In the study of Touche et al., it has been seen that there is a significant relationship between visual imagery and kinesiophobia in lower back pain patients, the same as in our study. Touche et al. assessed visual and kinesthetic imagery the same as in our study (20). However, the questionnaire used does not examine the types of visual imagery. But in our study, information on the two types of visual imagery, i.e. internal and external visual imagery levels, can be obtained.

The relationship between pain and motor imagery

In our study, as the duration of pain increases, the level of internal visual imagery decreases. Our study is the first to describe the relationship between pain and visual and kinesthetic imagery types. Among the studies, only Elsig et al.'s study shows that the increase in pain duration results in a decrease in motor imagery (21). It is reported in the literature that pain that is becoming chronic in any part of the body continues cortical reorganization (27, 28, 29). Our study supports that motor imagery, which is a part of cortical influence, is affected by the process of pain becoming chronic.

It is also seen that one unit of sensory influence of pain reduces kinesthetic imagery by 0.09 units. Therefore, an increase in the perceived pain intensity indicates that kinesthetic imaging ability decreases. In the literature, there is not any study explaining this relationship, either.

Strengths, limitations, and recommendations for further research

In the literature, our study is the first to assess the young adult age group according to types of motor imagery (internal visual, external visual, and kinesthetic imagery). In the studies examined, it has been observed that motor imagery evaluation was limited to a small region of the body. Our study evaluates the imaging ability of the whole body. Moreover, there is an insufficient number of cases in studies evaluating individuals with neck pain (21, 23). Our study is the only one with the highest number of cases as well as evaluating the young adult group only.

Our study is a descriptive study evaluating people according to the survey results. We did not evaluate motor imagery performance times during the assessment of motor imagery ability. In addition, the female gender was dominant in both groups.

Further studies are needed considering the factors that may affect the level of motor imagery such as gender and age in future studies due to cortical differences. Studies are showing the positive effects of motor imagery training on different parameters in the treatment of chronic neck pain (30). In our study, it is shown that kinesthetic and internal visual imagery training can be added to treatment programs.

CONCLUSION

As a result of this study, internal visual imagery and kinesthetic imaging ability decreased in young adults with chronic neck pain. With the increase in disability, the overall motor imagery ability is reduced. Visual imaging ability is also affected by the increase of kinesiophobia.

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Sažetak

KINESTETIČKE I VIZUELNE SLIKE KOD MLADIH ODRASLIH OSOBA SA HRONIČNIM BOLOM U VRATU

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Uvod: Mladi se žale na bol u vratu skoro svake godine. Poslednjih godina u literaturi se istražuje sposobnost motoričke slike (kinestetičke i vizuelne slike) kod mnogih problema mišićno-skeletnog sistema, pored bolova u vratu, kod mladih.Studija preseka imala je za cilj ispitivanje sposobnosti motoričke slike kod mladih odraslih osoba sa hroničnim bolom u vratu.

Metode: U istraživanje su uključene dve grupe: grupa sa hroničnim bolom u vratu (n = 83) i kontrolna grupa (n = 91). Sposobnost motoričkih slika obe grupe je procenjena pomoću Upitnika o slikama pokreta-3. Pored toga, u grupi sa hroničnim bolom u vratu, bol je procenjen kratkim MekGil upitnikom za bol, invalidnost je procenjena indeksom invalidnosti vrata,a kineziofobija je procenjena Tampa skalom za kineziofobiju.

Zaključak: Unutrašnje vizuelne slike i kinestetičke slike bile su značajno različite između grupe sa hroničnim bolom u vratu i kontrolne grupe. Postojala je negativna linearna veza između invaliditeta i unutrašnjih vizuelnih slika, spoljašnjih vizuelnih slika i kinestetičkih slika. Sposobnost motoričkih slika je smanjena kod mladih odraslih osoba sa hroničnim bolom u vratu. Pored toga, kako se težina invaliditeta povećava, sposobnost motoričke slike se smanjuje. Stoga se smatra prikladnim uključiti program obuke motoričkih slika kada se u budućnosti leči hronični bol u vratu.

Ključne reči: hronični, pokret, bol, mladi.

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