

# Gender Disparities and Oral Health on Low Back Pain among Middle and Older Korean Adults: The 6th KNHANES

Moon-Hee Kwon<sup>\*1</sup>Junghyun Kim<sup>2</sup>

<sup>1</sup> Department of Nursing, Kyungdong University, Gangwon-do, 26495, Korea

<sup>2</sup> Department of Biomedical laboratory science, Kyungbok University, Gyeonggi-do, 11138, Korea

## Abstract

**Background/Objectives:** Previous studies on back pain have documented but rare studies on the sex and oral health are existing. This study was aimed to observe related factors of low-back- pain.

**Methods/Statistical analysis:** To observe the associated factors of low- back- pain, we used crosssectional study from 6th KNHANES which was known for nationally representative data with validity and reliability. A total of 2,433 participants aged (50≤) were included and analyzed by multi-variable logistic regression of complex-sampling methods. Low back pain was defined as diagnosed by doctor. Periodontitis and chewing level were chosen for the indicators of oral health.

**Findings:** As results, gender(female) and oral health factors such as chewing difficulty and periodontitis were identified as the most significant factors of low-back-pain. Next determinant factors of low-back-pain were ageing, lowering of income level and sedentary time (5hrs.≤) in order. The important point of view compared to existing studies was that we dealt with gender disparities and including periodontitis and chewing level as oral health indicators leading cause of general health. To our best knowledge, this is the first one to identify the association of gender disparities, the impact of chewing level, periodontitis as the major factors of oral health of low- back-pain. The strength of our study, we used nationally reliable data with validity. These results might be helpful for preventing low back pain in remarkably ageing population worldwide.

**Improvements/Applications:** Therefore, multidisciplinary policies and strategies focusing on gender disparities and oral health might be needed to manage the low back pain caused of serious disability among this population.

**Keywords:** Low back pain, Gender, Oral health, Age, Income, Sedentary time

\*Corresponding Author :

Name :Moon-Hee Kwon

Email : ellizabeth@hanmail.net

Contact :+82-010-9722-2127

Fax :033-738-1406

Date of Submission :October 5, 2020

## INTRODUCTION

Low-back-pain (LBP) is rapidly growing worldwide. Recently, low-back-pain was known as being related with significant disability(Doualla M *et al.*, 2019) causing specific mortality such as cardiovascular and cancer of older women by cohort study(Konijnenberg E *et al.*, 2018)and being higher risk of men with chronic disease (Heuch I *et al.*, 2019). According to occupational research, the relationship of low back pain and work exposure was highlighted by gender specific job-exposure matrix (Azfar S M *et al.*, 2019; Hanvold T N *et al.*, 2019). And that, sedentary behaviors were reported to be associated with increasing occupational risks like back pain including mental health problems (Hanna F *et al.*, 2019) as well as the association of low-back -pain, little exercise and female gender(Jonsdottir S *et al.*, 2019). And it was reported that personal factors like gender, age, marital state, BMI(body-mass-index) and smoking were identified as not associated one with low-back-pain of physicians(Al-Ruwaili B *et al.*, 2019). But female gender and high body mass index were reported to be as risk factors of chronic back-pain among oldest-old people (Mallon T *et al.*, 2019). Also, age and pain chronicity factors were reported to be related with influencing outcomes of therapy in chronic back pain and function by prospective multicenter clinical trial (Steinmet, A *et al.*, 2019).Especially, long duration of disabling back pain was more related with socio-demographic factors such as ageing, female gender, lower occupational-status, married status as well as health-related factors such as smoking (Claus M *et al.*, 2019). Moreover, racial inequities among diverse individuals in low back pain were critically reported by the racially diverse sample (Trost Z *et al.*, 2019). Low back pain emerges as significant health threatening problem (Maher C *et al.*, 2017) and it is great need to explore the determinant factors related with the disability. And also, it was reported that biopsychosocial profiles and physical function were related to chronic low-back-pain especially among elderly(Weiner D K *et al.*, 2019) as well as losing time due to back pain according to the systemic review of US recent study (Ferguson S A *et al.*, 2019). And that, fascial system was more effective than standard physical practice in pain reduction of low back pain regardless of age and gender (Harper B *et al.*, 2019). Additionally, physically being active was reported to be associated with lowering the risk of musculoskeletal-pain, but smoking was related to more pain in musculoskeletal-area like low- back, neck-shoulder of general working population (Micheletti J K *et al.*, 2019). And also, it was reported that racial inequities were identified as the critical point of view in chronic low-back-pain (Trost Z *et al.*, 2019), which caused of seeking medical health care and lost time (Ferguson S A *et al.*, 2019). Furthermore, people who have low back pain were reported to get the information of prognosis, treatment and self-management strategies (Lim Y Z *et al.*, 2019). In viewing of current studies, we conducted to investigate determinant factors of low-back-pain among middle and older

Koreans using the useful and representative data of KNHANES. Considering its potentially impact on individuals and lifestyle, we used socio-demographic, health-related and oral health characteristics.

## **MATERIALS& METHODS**

This is cross-sectional-study, population-based stratified sampling design and the data was analyzed by complex-sampling methods and used multi-variable logistic regression after exclusion of missing data with the SPSS (ver. 21.0). We used the data which was known as the representative one with necessary ethical clearance.

### **Study design**

The combined data of 6th KNHANES, Korea-National-Health and Nutritional-Examination-Survey, which composed by health examination, health interview, and nutrition survey conducted annually, with the stratified cluster sampling methods, especially related with low back pain, were used.

### **Study analysis**

Descriptive statistics was used for general characteristics. And chi-square test was used for the prevalence of association of low-back-pain and the determinants. To find out associated determinants of low-back-pain and impact of oral health, multi-variable logistic regression was adopted. We selected and analyzed the 2,433 participants ( $50 \leq$ ) who submitted the informed consent and completed the survey of nutrition and health examination for identifying the determinants of low back pain of older subjects using the complex sampling methods through multi-logistic regression as well as including descriptive and analytic methods by SPSS package (ver. 21.0). The p-value ( $p < .05$ ) was employed as statistically significant.

## **RESULTSAND DISCUSSION**

In total, 2433 participants after excluding the missing values data, were included. Table 1. shows general-characteristics of the participants. Prevalence of low back pain was 22.3%. 1410(58.0%) were female while 1023(42.0%) were male. 65 and over aged participants were 1162(47.8%). The subjects who complained low back pain were 542(22.3%). Over half of them (54.4%) were suffered from chewing difficulty and about one third (38.1%) of respondents had periodontitis. The lowest education group (elementary) group was 1044(42.9%). With life-style factors, no physical activity (76.4%), sedentary time (5 hrs.  $\leq$ ) (72.8%) smoking (38.1%) and drinking (80.3%) factors were showed. In view of socio-economic status, almost all subjects (98.9%) were in married status with spouse and about a quarter was in lowest income level.

**Table 1: General-characteristics of the study-population**

Variables	N (2433)	%
Gender		
Male	1023	42.0
Female	1410	58.0
Age		
50-64	1271	52.2
65 and over	1162	47.8
Residence		
Urban(Dong)	1851	76.1
Rural(Eup, Myeon)	582	23.9
Marital status(spouse)		
Yes	2406	98.9
No	27	1.1
Income level		
Lowest	562	23.1
Middle-low	625	25.7
Middle-high	615	25.3
Highest	631	25.9
Education level		
Elementary	1044	42.9
Middle	428	17.6
High	593	24.4
College	368	15.1
Smoking		
Yes	927	38.1
No	1506	61.9
Drinking		
Yes	1953	80.3
No	480	19.7
Physical activity		
Yes	573	23.6
No	1860	76.4
Sedentary time		
Less than 5 hrs.	662	27.2
5 hrs. and over	1771	72.8
Chewing difficulty		
Severe	919	37.8
Moderate	405	16.6
None	1109	45.6
Periodontitis		
Yes	927	38.1
No	1506	61.9
Back pain		
Yes	542	22.3
No	1891	77.7

Table 2 presents prevalence of association between low-back-pain and determinant factors. This study explained that the associated factors of low-back-pain were no physical-activity (84.7%), sedentary time (more than 5 hours) (78.2%), female gender (74.4%), drinking (73.6%), smoking(71.4%), living urban area(70.5%), 65 aged and over (62.4%), lowest education level (60.9%), severe chewing difficulty (55.0%), periodontitis(52.2%) and lowest income level (31.5 %) in order.

**Table 2: Association between low-back-pain and determinant factors among 50 and over aged subjects**

Variables	Back pain		P-value*
	Yes	No	
Gender			<.001
Male	139(25.6)	884(46.7)	
Female	403(74.4)	1007(53.3)	
Age			<.001
50-64	204(37.6)	1067(56.4)	
65 over	338(62.4)	824(43.6)	
Residence			<.001
Urban(Dong)	382(70.5)	1469(77.7)	
Rural(Eup, Myeon)	160(29.5)	422(22.3)	
Marital status(spouse)			0.238
No	534(98.5)	1872(99.0)	
Yes	8(1.5)	19(1.0)	
Income level			<.001
Lowest	171(31.5)	391(20.7)	
Middle-low	146(26.9)	479(25.3)	
Middle-high	116(21.4)	499(26.4)	
Highest	109(20.1)	522(27.6)	
Education level			<.001
Elementary	330(60.9)	714(37.8)	
Middle	81(14.9)	347(18.4)	
High	89(16.4)	504(26.7)	
College	42(7.7)	326(17.2)	
Smoking			<.001
No	155(28.6)	772(40.8)	
Yes	387(71.4)	1119(59.2)	
Drinking			<.001
No	399(73.6)	1554(82.2)	
Yes	143(26.4)	337(17.8)	
Physical activity			<.001
No	83(15.3)	490(25.9)	
Yes	459(84.7)	1401(74.1)	
Sedentary time			<.001
Less than 5 hrs.	118(21.8)	544(28.8)	
5 hrs. and over	424(78.2)	1347(71.2)	
Chewing difficulty			<.001
Severe	298(55.0)	621(32.8)	
Moderate	91(16.8)	314(16.6)	
None	153(28.2)	956(50.6)	
Periodontitis			<.001
No	259(47.8)	668(35.3)	
Yes	283(52.2)	1223(64.7)	

Results are shown as frequency(%).

\*Calculated by Chi-square test.

Table 3. explains major determinants of low back pain. By multiple logistic regression showed that gender(female) (OR 3.279; 95% CI 2.262-4.753: p<.05), severe chewing difficulty (OR 2.259; 95% CI 1.777-2.872: p<.05), and periodontitis (OR 1.674; 95% CI 1.353-2.071: p<.05)

as oral health factors were the strongest determinants of low back pain after adjustment. The next related factors were 65 and over aged group (OR 1.855; 95% CI 1.471-2.339:  $p < .05$ ) compared to 50-64 aged group, lowest income level (OR 1.819; 95% CI 1.340-2.470:  $p < .05$ ), and more than 5 hours of sedentary time factors (OR 1.674; 95% CI 1.353-2.071:  $p < .05$ ) statistically significant.

**Table 3: The determinant factors of low back pain of middle and older adults**

Variables	OR	95% CI	P-value*
Gender			
Male		Reference	
Female	3.279	2.262-4.753	<.001
Age			
50-64		Reference	
65 over	1.855	1.471-2.339	<.001
Residence			
Urban(Dong)		Reference	
Rural(Eup, Myeon)	1.211	0.954-1.537	.116
Marital status(spouse)			
No	1.703	0.665-4.357	.267
Yes		Reference	
Income level			
Lowest	1.819	1.340-2.470	<.001
Middle-low	1.236	0.911-1.677	.174
Middle-high	0.993	0.728-1.355	.965
Highest		Reference	
Education level			
Elementary	1.461	0.982-2.173	.061
Middle	1.155	0.751-1.778	.512
High	1.122	0.743-1.693	.585
College		Reference	
Smoking			
No		Reference	
Yes	1.330	0.923-1.916	.125
Drinking			
No		Reference	
Yes	0.916	0.710-1.182	.501
Physical activity			
No	1.294	0.980-1.708	.069
Yes		Reference	
Sedentary time			
Less than 5 hrs.		Reference	
5 hrs. and over	1.437	1.126-1.833	.004
Chewing difficulty			
Severe	2.259	1.777-2.872	<.001
Moderate	1.575	1.161-2.136	.003
None		Reference	
Periodontitis			
No		Reference	
Yes	1.674	1.353-2.071	<.001

Results are shown as odds ratios with 95% confidence intervals.

Abbreviations: OR, odds ratio; CI, confidence intervals.

\*Calculated by multivariate logistic regression.

This is the first to investigate the association between gender disparities and the impact of oral health specifically on low back pain within to our knowledge. The major findings of our study were that female gender, chewing ability and periodontitis factors as the indicators of oral health were predominantly pointed as the strongest determinants of low back pain, which was known as the cause of work loss and significant disability, through analyzing with 2433 participants ( $\leq 50$ ) of representative nation-wide study, the 6th Korea- National-Health and Nutrition-Examination-Survey. Next major risk determinants of low-back- pain were ageing ( $\leq 65$ ) group compared to 50-64 aged group, lower income level and long sedentary time (5hrs. $\leq$ ) in order significantly. The prevalence of low back pain was 22.3% of middle and elderly Koreans. In view of gender disparities, especially female gender was identified to be in accordance with low-back-pain and it was also reported through other similar researches (Alin C K *et al.*, 2019; Jonsdottir S *et al.*, 2019; Mallon T *et al.*, 2019) while both genders were related to low-back- pain in recent another study of considering of gender-specific job exposure (Hanvold T N *et al.*, 2014). And these results were not consisted with another study which low-back-pain was more being prevalent in men especially among physicians (Al-Ruwaili B *et al.*, 2019) and in more men among low back pain patients (Azfar S M *et al.*, 2019). On the other hand, the reason of more females than men having low back pain might be explained in aspects of physiological, anatomical and structural difference and especially in experiencing menopause. But in men, which was diagnosed of diabetes, they were reported to have the more risk of chronic low-back- pain while women, they have no association according to population-based cohort study (Heuch I *et al.*, 2019). Chewing ability, as the leading indicator of oral health, which was identified as the most influencing factor of low back pain through our study, was recognized as the great implications for preventing of pathologies and improving quality of life as well as related with general health and well-being. And it was reported that orofacial pain was significantly related with poorer quality of life including psychological distress in middle-aged women (Bäck K, 2019). Moreover, chewing discomfort was reported to be clearly associated with memory declining and physical health such as limitations of daily life (Shin S M, 2020). Regarding periodontitis, as the disease of chronic inflammation, which was indicated in low- back-pain of our study was partially in consistent with another study (Bäck K, 2019). but oral health including periodontitis was still not known well despite of its importance (Abu-Gharbieh E *et al.*, 2019). Ageing, which was suggested as the influencing factor of low back pain, was, some part of them, similar to other researches which was reported to be correlated with biopsychosocial profiles and function declining among adults or older adults (Claus M *et*

*al.*,2019; Doualla M *et al.*,2019; Weiner D K *et al.*,2019). And age and pain chronicity factors were reported to be seemed to being influenced therapy outcomes (Steinmet, A *et al.*,2019). In terms of Income level, lowest income was highlighted as the important determinant factor of low-back-pain of our study, these results were in common being with other studies which significant inequalities of socio-economic status were related with low back pain of elderly (Claus M *et al.*,2019; Ikeda Tet *al.*,2019).Long sedentary time (5 hrs.≤) was showed as the important determinant of worsening low-back- pain of our results, and higher BMI, and little exercise as lifestyle factors were also related to increasing the risk of chronic back-pain and those results were similar to those one of other studies (Alnaami I *et al.*,2019; Hanna F T *et al.*,2019; Jonsdottir S *et al.*,2019; Mallon T *et al.*,2019; Micheletti J.K *et al.*,2019; Monnier A *et al.*,2019). And another point of view, vitamin D deficiency was reported to be closely related with muscle atrophy of low-back- pain patients (Dzik K P *et al.*,2019).Additionally, it may be more important for early intervention to prevent low-back-pain in advance cause of being no effective status of even intensive education in developing acute low back pain (Traeger A C *et al.*,2019).Some major strengths of our study were using nation-wide representative data, the socio-economic differences of this population were small and suggesting the universality of clear themes. And we highlighted on low-back-pain and on subjects, middle-older adults who are vulnerable to be related with adverse conditions, for preparing of successful ageing against super-aged society of the world as well as for rapidly ageing Korea. Our findings may contribute for early intervening on planning and preparing strategies against preventing low back pain which was remarkably resulted in worsening disability and lowering quality of life. Some of our study limitations include racial criteria not to be generalized and lack of specific anatomical and clinical findings. Considering these kinds of limitations, findings of our population-based study might be generalized and provide some evidences with validity for remarkably increasing of ageing population of Korea.Multidisciplinary cooperation policies and strategies highlighting on gender disparities and good oral health considering socio-economic and health related factors by healthcare professionals might be prepared to manage low back pain cause of disability and death among these elderly populations. Further robust researches will be needed to explore links on low-back-pain and gender disparities, oral health and socio-demographic factors in order to manage early interventions and treatment of low-back-pain in view of primary-health-care for future directions.

## CONCLUSION

Through our study which was based on nationally reliable data, we suggested that gender(female), the level of chewing difficulty and periodontitis problems were remarkably related with low- back-pain, which is connected with serious disability and lowering quality of



life. And ageing group ( $\leq 65$ ) compared to 50-64 aged one, in lower income level group and long sedentary time more than 5hrs. factors were also associated with low back pain in order significantly. We used and analyzed the data of a total of 2433 participants aged 50 and over in nation-wide study design, from 6th Korea-National-Health-and-Nutrition-Examination-Survey. Government, local authorities and public professionals should prepare preventive policies and strategies focusing on gender disparities and oral health in primary care health aspects. Further researches might be urgently continued on the association of low-back-pain and other unhealthy determinants as well as the close physical and psychological mechanisms to prevent low back pain.

### **Acknowledgment**

The first two authors, Moon-Hee Kwon and Junghyun Kim contributed equally to this work.

### **References**

1. Abu-Gharbieh E., Saddik B., El-Faramawi M., Hamidi S., and Basheti, M., 2019. Oral health knowledge and behavior among adults in the United Arab Emirates. *BioMed research international*.
2. Al-Ruwaili B., and Khalil T., 2019. Prevalence and Associated Factors of Low Back Pain Among Physicians Working at King Salman Armed Forces Hospital, Tabuk, Saudi Arabia. *Open Access Macedonian Journal of Medical Sciences*, 7(17), pp.2807.
3. Alin C.K., Uzunel E., Kronhed A.C.G., Alinaghizadeh H., and Salminen H., 2019. Effect of treatment on back pain and back extensor strength with a spinal orthosis in older women with osteoporosis: a randomized controlled trial. *Archives of osteoporosis*, 14(1), pp.5.
4. Alnaami I., Awadalla N.J., Alkhairy M., Alburidy S., Alqarni A., Algarni A., and Mahfouz, A.A., 2019. Prevalence and factors associated with low back pain among health care workers in southwestern Saudi Arabia. *BMC musculoskeletal disorders*, 20(1), pp.56.
5. Azfar S.M., Murad M.A., Azim S., and Baig, M., 2019. Rapid Assessment of Physical Activity and its Association Among Patients with Low Back Pain. *Cureus*, 11(12).
6. Bäck K., 2019. Temporomandibular disorders in women—symptoms and signs in population-based studies.
7. Claus M., Schuster M., Webendörfer S., Groneberg D.A., Jähner J., and Schiffmann D., 2019. Prevalence of back pain in employees of a German chemical company: results of a large cross-sectional study. *Journal of Occupational Medicine and Toxicology*, 14(1), pp.16.
8. Doualla M., Aminde J., Aminde L.N., Lekpa F.K., Kwedi F.M., Yenshu, E.V., and Chichom A. M., 2019. Factors influencing disability in patients with chronic low back pain attending a tertiary hospital in sub-Saharan Africa. *BMC musculoskeletal disorders*, 20(1), pp.25.

9. Dzik K.P., Skrobot W., Kaczor K.B., Flis D.J., Karnia M.J., Libionka W., and Kaczor J.J., 2019. Vitamin D deficiency is associated with muscle atrophy and reduced mitochondrial function in patients with chronic low back pain. *Oxidative medicine and cellular longevity*.
10. Ferguson S.A., Merryweather A., Thiese M.S., Hegmann K.T., Lu M.L., Kapellusch J.M., and Marras W.S., 2019. Prevalence of low back pain, seeking medical care, and lost time due to low back pain among manual material handling workers in the United States. *BMC musculoskeletal disorders*, 20(1), pp.1-8.
11. Hanna F., Daas R.N., Elshareif T.J., Almarridi H.H.F.H., Al-Rojoub Z.M.D.B., and Adegboye D., 2019. The relationship between sedentary lifestyle, back pain and psychosocial correlates among university employees. *Frontiers in public health*, 7, pp.80.
12. Hanvold T.N., Sterud T., Kristensen P., and Mehlum I.S., 2019. Mechanical and psychosocial work exposures: the construction and evaluation of a gender-specific job exposure matrix (JEM). *Scandinavian journal of work, environment & health*, 45(3), pp.239-247.
13. Hanvold T.N., Wærsted M., Mengshoel A.M., Bjertness E., Twisk J., and Veiersted K.B., 2014. A longitudinal study on risk factors for neck and shoulder pain among young adults in the transition from technical school to working life. *Scandinavian journal of work, environment & health*, 597-609.
14. Harper B., Steinbeck L., and Aron A., 2019. Fascial manipulation vs. standard physical therapy practice for low back pain diagnoses: A pragmatic study. *Journal of Bodywork and Movement Therapies*, 23(1), pp.115-121.
15. Heuch I., Hagen K., Sørgerd E.P., Åsvold B.O., and Zwart J.A., 2019. Does diabetes influence the probability of experiencing chronic low back pain? A population-based cohort study: the Nord-Trøndelag Health Study. *BMJ open*, 9(9), e031692.
16. Ikeda T., Sugiyama K., Aida J., Tsuboya T., Watabiki N., Kondo K., and Osaka, K., 2019. Socioeconomic inequalities in low back pain among older people: the JAGES cross-sectional study. *International journal for equity in health*, 18(1), pp.15.
17. Jonsdottir S., Ahmed H., Tómasson K., and Carter, B., 2019. Factors associated with chronic and acute back pain in Wales, a cross-sectional study. *BMC musculoskeletal disorders*, 20(1), pp.215.
18. Konijnenberg E., Carter S.F., Ten Kate M., Den Braber A., Tomassen J., Amadi C., and Demuru, M., 2018. The EMIF-AD Preclin AD study: study design and baseline cohort overview. *Alzheimer's research & therapy*, 10(1), pp.75.
19. Lim Y.Z., Chou L., Au R.T., Seneviwickrama K.M.D., Cicuttini F.M., Briggs A.M., and Wluka A.E., 2019. People with low back pain want clear, consistent and personalised information on prognosis, treatment options and self-management strategies: a systematic review. *Journal of Back Musculoskeletal Rehabilitation*.

- l of physiotherapy*, 65(3), pp.124-135.
20. Maher C., Underwood M., and Buchbinder R., 2017. Non-specific low back pain. *The Lancet* , 389(10070), pp.736-747.
  21. Mallon T., Eisele M., König H.H., Brettschneider C., Röhr S., Pabs, A., and Fuchs, A., 2019. Lifestyle Aspects As A Predictor Of Pain Among Oldest-Old Primary Care Patients—A Longitudinal Cohort Study. *Clinical Interventions in Aging*, 14, pp.1881.
  22. Micheletti J.K., Bláfoss R., Sundstrup E., Bay H., Pastre C.M., and Andersen L.L., 2019. Association between lifestyle and musculoskeletal pain: cross-sectional study among 10,000 adults from the general working population. *BMC Musculoskeletal Disorders*, 20(1), pp.1-8.
  23. Monnier A., Larsson H., Nero H., Djupsjöbacka M., and Äng B.O., 2019. A longitudinal observational study of back pain incidence, risk factors and occupational physical activity in Swedish marine trainees. *BMJ open*, 9(5), e025150.
  24. Shin S.M., 2020. Associations of Food-Chewing Discomfort with Health Behaviors and Cognitive and Physical Health Using Pooled Data from the Korean Health Panel (2010–2013). *Nutrients*, 12(7), pp.2105.
  25. Steinmet, A., Psczolla M., Seidel W., Niemier K., Derlien S., and Nisser J., 2019. Effect of subgroup-specific multimodal therapy on chronic spinal back pain and function—a prospective inpatient multicentre clinical trial in Germany. *Medicine*, 98(1).
  26. Traeger A.C., Lee H., Hübscher M., Skinner I.W., Moseley G.L., Nicholas M.K., and Hush J. M., 2019. Effect of intensive patient education vs placebo patient education on outcomes in patients with acute low back pain: a randomized clinical trial. *JAMA neurology*, 76(2), pp.161-169.
  27. Trost Z., Sturgeon J., Guck A., Ziadni M., Nowlin L., Goodin B., and Scott W., 2019. Examining injustice appraisals in a racially diverse sample of individuals with chronic low back pain. *The Journal of Pain*, 20(1), pp.83-96.
  28. Weiner D.K., Gentili A., Coffey-Vega K., Morone N., Rossi M., and Perera S., 2019. Biosocial profiles and functional correlates in older adults with chronic low back pain: A preliminary study. *Pain Medicine*, 20(7), pp.1300-1310.