

Association between Types of Pain Change and Depression among Korean Older Adults

Kyu-hyoung Jeong

Department of Social Welfare, Semyung University

Hye-Gyeong Son (✉ hkprin@kosin.ac.kr)

College of Nursing, Kosin University

Sunghee Kim

Graduate School of Social Welfare, Yonsei University

Ju Hyun Ryu

Interdisciplinary Graduate Program in Social Welfare Policy, Yonsei University

Seoyoon Lee

Interdisciplinary Graduate Program in Social Welfare Policy, Yonsei University

Research Article

Keywords: Pain, Depression, older adult, Korea

Posted Date: April 13th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1525410/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: The world's population is aging faster than it did in the past and many under-represented issues in the lives of older adults have been neglected; pain is one of the issues. Older people may regard their pain as incurable and may lead to not seeking appropriate medical treatment. It is hard to manage pain efficiently when individuals or society recognize that increased pain is a typical symptom of getting older. Considering the fact that pain negatively affects older adults, an in-depth review should be undertaken by categorizing changes in pain. Hence, the purpose of this study is to identify the types of pain changes that affect older Koreans 65 years and over, as well as their effects on depression.

Methods: We analyzed the Korean Longitudinal Study of Aging (KLoSA) data collected from 2010 (3rd) to 2018 (7th). Data from a total of 1,359 participants, aged 65 or older were used to estimate the change in pain. A latent growth model was performed to estimate the overall change in pain and Growth Mixture Modeling (GMM) was performed to categorize the types of pain changes. Lastly, multiple regression analysis was performed to examine the effect of pain change types on depression among older adults.

Results: The pain changes of older adults were classified into two categories: 'low-stable' (87.9%, n=1,194), and 'high increasing' (12.1%, n=165). Depression showed a stronger relationship among the high-increasing type of pain than the low-stable type ($B=.844, p<.001$). Upon examining the differences in demographic characteristics by type, the high-increasing type had a higher percentage of women, lower-income, relatively low educational attainment, and a higher percentage of rural residents than the low-stable type.

Conclusions: The significance of this study lies in the fact that it reiterated the importance of early pain diagnosis and intervention by identifying the types of pain changes in older adults and analyzing their effects on depression. Therefore, it is especially important to pay attention to interventions that are designed to help vulnerable groups with a high risk of pain obtain effective pain management.

1. Background

Over the past few decades, the average human life expectancy has increased ever in the world. The world's population is aging faster than it did in the past, with 9.3% of the population aged 65 or older in 2020, and projected to reach 17.0% by 2050 (OECD, 2022). Increasing population aging has far-reaching consequences such as declining productivity, intergenerational inequality, and the burden of public finances, which various countries around the globe face a variety of challenges relating to the aging population (Rouzet, Sánchez, Renault & Roehn, 2019).

Many under-represented issues in the lives of older adults have been neglected due to the fact that they span multiple domains; pain is one of the issues. Sensations of pain are transmitted to the brain through the spinal cord, which is more noticeable among the aging population and can produce more pain as the older adults' nervous system adapts to these changes (Cruz-Almeida, Aguirre, Sorenson, et al., 2015). However, pain in old age is hardly understood, and it occur on a routine basis without being adequately

evaluated. Since pain is such a common issue, the idea of embracing it as a natural part of aging among people is prevalent in our society (Chakour, Gibson, Bradbeer, et al., 1996; Kumar & Allcock, 2008). Older people may regard their pain as incurable and may lead to not seeking appropriate medical treatment (Schofield, 2007). As such, it is hard to manage pain efficiently when individuals or society recognize that increased pain is a typical symptom of getting older.

With this insight, the International Association for the Study of Pain (IASP) was founded in 1973 to lead diverse pain studies (Raja, Carr, Cohen, et al., 2020). IASP defined pain as “An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage” (Revised IASP Definition of Pain, 2020), and it has been adopted by several experts, including the World Health Organization (WHO). In this revised definition after 1979, pain cannot be inferred as sensory activity alone, but it must be viewed from the perspective of the person experiencing pain, by emphasizing the negative social and psychological effects of pain. In other words, regardless of a physical injury, it was emphasized that comprehension should not be compromised for those who are experiencing subjective pain. In spite of pain appearing in all age groups, the theme of the 2019 Global year of advocacy was chosen to highlight the needs of the aging population, who are exposed to high vulnerability and potential risks.

The risk of pain in the aging population has also been reported academically. Pain is estimated to occur in 45–90% of the aging population (Brown, Kirkpatrick, Swanson & McKenzie., 2011; Ferrell, 1991; Ranjan Roy, 1986); the lack of awareness of pain (Ferrell, 1991), the age difference of the study subjects (Harkins & Price, 1992), and different measurement (Gagliese & Melzack, 1997) all contribute to the wide disparity in prevalence. However, significant evidence of pain with increasing age has been consistently reported (Badley & Tennant, 1992; Crook, Rideout & Browne, 1984). In addition to the risk of difficulty in daily living activities (Cha & Park, 2011) and disability (Soldato, Liperoti, Landi et al., 2007), pain in old age, if not properly treated, may increase the possibility of chronic pain (Molton & Terrill, 2014) and may aggravate symptoms such as depression (Casten, Parmelee, Kleban et al., 1995; Kaye, Baluch, & Scott, 2010).

Although there are significant differences in pain according to gender and marital status, it is reported that the higher the age and the longer the pain period, the greater the negative impact on life. Although there are substantial disparities in pain according to gender and marital status, it is reported that the older one gets and the longer the pain lasts, the worse the influence on one's life becomes (Cha & Park, 2011). Furthermore, since pain increases societal responsibility and burden, a thorough investigation of how pain affects and impacts older adults is required.

Growing life expectancy has resulted in increased academic interest in pain in the aging population, and epidemiology studies focused on the quality of life among older adults have been flourished. Most attention has traditionally been paid to the prevalence of depression among older individuals. It was the results of studies examining not only the effects of depression on older people, but also factors that contribute to depression among older adults, including gender (Blazer, 2003), age (Meller, Fichter &

Schröppel, 1996), socioeconomic status (Wilson, Taylor & Copeland, et al., 1999), and living alone (Blazer, 2003).

Particularly, it has been reported that there is a strong relationship between depression and pain in older adults. While the dynamics of pain and depression are similar, the fact that depression is a consequence of pain over time facilitates a better understanding of the mechanisms behind pain and depression among older adults (Fishbain, Cutler & Rosomoff, 1997; Kaye, Baluch & Scott., 2010; Williamson & Schulz, 1992). Williamson & Schulz (1995) have identified evidence of age differences and the prevalence of distinct persistent pain among older adults. This indicates that the effect of aging on an individual's pain experience is fairly complex, suggesting that a comprehensive examination of pain changes is required.

Yet, it is difficult to find studies that examine how a change in the type of pain affects depression in older adult. In spite of some studies that have examined the variability of pain (Casten, Parmelee, Kleban et al., 1995), it is surprising that studies on the correlation between pain and depression have been overlooked. The longitudinal relationship between the types of pain changes and depression in the old age will be essential when establishing long-term strategies for coping with pain-psychological effects among older adults. Furthermore, considering the fact that pain negatively affects older adults, an in-depth review should be undertaken by categorizing changes in pain. Hence, the purpose of this study is to identify the types of pain changes that affect older Koreans 65 years and over, as well as their effects on depression.

To accomplish this research purpose, the research questions set in this study are as follows. First, how do pain changes affect old people (over 65)? Secondly, how does the type of pain change in older adults affect depression?

2. Methods

2.1. Data

We analyzed the Korean Longitudinal Study of Aging (KLoSA) data collected from 2010 to 2018 to understand the effects of pain changes on depression among older adults. KLoSA is a representative panel survey of Koreans that aims to measure and understand the health and socio-economic conditions of older Koreans and to provide basic evidence for the development of effective socio-economic policies. A total of 1,359 participants, aged 65 or older at the time of the 3rd year of the study, estimated the change in pain from 2010 (3rd) to 2018 (7th) were analyzed.

2.2. Pain

The independent variable in this study was pain, which comprised 13 items (head, shoulder, arm, wrist, finger, chest, stomach, waist, hip, leg, knee, ankle, toe). The pain was rated on a 5-point scale, with 1 representing slight pain, 3 representing moderate pain, and 5 representing very severe pain; a higher score corresponds to a greater level of pain.

2.3. Depression

CES-D10 (The Center for Epidemiological Studies-Depression Scale) was used to assess depression. The CES-D scale was developed by Randolph (1977) KLoSA uses the Korean version of CES-D-10 is used to measure depression, which consists of ten shortened items. For each item, participants were asked to answer questions about feelings and behaviors they experienced during the past week, with 1 point indicating that, "I thought that for a while, but I did not feel that way (less than a day)", and "Sometimes, I felt that way (between 1 and 2 days)" was worth 2 points. 'I have thought like this often (about 3–4 days)' was considered as 3 points, and 'I have thought like that always (about 5–7 days)' indicated 4 points. As part of the KLoSA, depression scores were derived by calculating the following factors. First, if the value of each item was 1, it was recoded as a '0', and if it was '2–4', it was recoded as a '1', and the sum of each item's scores was calculated as the final depression score. Depression scores range from 0 to 10, and higher scores indicate a greater degree of depression. The CES-D-10 used in this study had a Cronbach's alpha of .824.

2.4. Covariates

For analysis, we used gender, age, household annual income, educational background, residential area, and whether the participants lived alone as covariates. The gender of each participant was divided into male and female, and age and household income were used as continuous variables. In particular, it was log-transformed for a normal distribution of household annual income. Residential areas are divided into urban and rural areas, and three levels of educational attainment are created: elementary school graduates, middle school graduates, and high school graduates.

2.5. Statistical Analysis

The data analysis of this study was conducted using SPSS 27.0 and M-plus 8.0, with the following method and procedure. First, descriptive statistical analysis was conducted to identify the demographic characteristics of the target population as well as the characteristics of major variables. Secondly, a latent growth model was performed to estimate the overall change in pain, assuming one group. We used TLI (Tucker-Lewis Index), CFI (Comparative Fit Index), and RMSEA (Root Mean Square Error of Approximation) to evaluate model fit, considering the sensitivity of the model to the sample size and the simplicity of the model. Thirdly, Growth Mixture Modeling (GMM) was used to categorize the types of pain changes. In the mixed growth model, the optimal number of types of pain changes was determined through p -values for AIC (Akaike's Information Criteria), BIC (Bayesian Information Criteria), SSABIC (Sample-Size Adjusted BIC), Entropy, and BLRT (Bootstrapped Likelihood Ratio Test). Moreover, Jung and Wickrama (2008) noted that all types should comprise at least 5% of the sample size; the analysis was conducted with the consideration that at least 5% of the total sample had to form a group in order for it to be classified as a group. To determine the demographic characteristics of each type of pain change in older adult, the χ^2 -test and Independent sample t-test were conducted. Finally, multiple regression analysis was performed to examine the effect of pain change types on depression among older adults.

3. Results

3.1. Descriptive Statistics

The study included 424 males (31.2%) and 935 females (68.8%), with a higher proportion of females, with an average age of 72.56 years (SD = 5.36). The average household income was USD \$13,093.23 (SD = 12,688.75). In terms of educational attainment, 980 people (72.1%) graduated from elementary school, 171 people (12.6%) from middle school, and 208 people (15.3%) from high school. In the residential area, there were 907 people (66.7%) in the city and 452 people (33.3%) in the rural area, 232 people (17.1%) living alone, and 1,127 people (82.9%) not living alone. The average pain score increased from 0.33 points in 2010 (SD = 0.41) to 0.45 points in 2018 (SD = 0.43) based on a descriptive statistical analysis of major variables. Depression was evaluated as an average of 2.35 points out of 10 (SD = 2.39) (Table 1).

Table 1
Descriptive statistical analysis of major variables (n = 1,359)

Variable	Min	Max	M	SD
Pain-2010yr	0	3.46	0.33	0.41
Pain - 2012yr	0	3.92	0.39	0.44
Pain - 2014yr	0	3.00	0.39	0.40
Pain - 2016yr	0	3.46	0.41	0.41
Pain - 2018yr	0	2.77	0.45	0.43
Depression - 2018yr	0	10.00	2.35	2.39

3.2. Change and typology of pain in older adult

Prior to moving forward with the growth-mixed model, a latent growth model was conducted to understand how pain within an aging population changes over time. Both the no-growth model and linear model were examined, respectively to compare their fit. The results showed that the no-growth model was not appropriate; while, the linear model with $\chi^2 = 71.389(p < .001)$, CFI = .978, TLI = .978, RMSEA = .067 was appropriate. Therefore, the linear change model was chosen (Table 2). As a result of estimating the growth-mixed model based on the linear change model, the fit of each model in 3 classes was found to be more appropriate than class 1,2,4; it was lower in AIC, BIC, and SSABIC, and the Entropy was closer to 1. In addition, BLRT was significant in 2 and 3 classes. Nevertheless, class 3 was not suitable since one group contained less than 5% of the samples. Therefore, when the model fit criteria were taken into account comprehensively, the class 2 was deemed as the most appropriate and selected as the final model (Table 3).

Table 2
Model fit of Latent Growth Modeling for Change of Pain Among Older Adult

Model	χ^2	CFI	TLI	RMSEA
No growth model	300.617***	.895	.920	.128
Linear model	71.389***	.978	.978	.067
*** $p < .001$				

Table 3
Model fit of Growth Mixture Modeling (n = 1,359)

Class	Model fit		Groups			
	AIC	BIC	SSABIC	Entropy	BLRT p-value	N (%)
1	4454.228	4506.373	4474.607	-	-	-
2	4001.865	4069.653	4028.358	.935	< .001	1,194(87.9), 165(12.1)
3	3909.209	3992.641	3941.815	.941	< .001	1,164(85.7), 145(10.7), 50(3.6)
4	4026.630	4125.706	4065.351	.885	.785	930(68.4), 281(20.7), 127(9.3), 21(1.5)

We have classified the pain changes of older adults into two categories and named each category according to the characteristics of the pain change pattern. Close to 0 percent of cases were classified as 'low-stable' in the first group from 2010 to 2018, and 1,194 of them (87.9%) represent this group. 165 cases (12.1%) were classified as the 'High increasing' group, which showed a continuous pain increase from 2010 to 2018 (Fig. 1).

3.3. Characteristics of older adults according to pain change patterns

Based on the result in Table 4, the difference in demographic attributes of older adults by the pain change type; gender ($X^2 = 19.257$, $p < .001$), annual household income ($t = 4.080$, $p < .001$), educational attainment ($X^2 = 21.492$, $p < .001$), and residential area ($X^2 = 4.566$, $p < .05$) appeared to have a statistical significance. There was a high female ratio in both low-stable type and high-increasing, but the female ratio of the high-increasing type (83.6%) was much higher than the female ratio of the low-stable type (66.8%). In the case of household annual income, the low-stable type ($M = 13,525.73$, $SD = 12,947.00$) was significantly higher than the high-increasing type ($M = 9,963.5715$, $SD = 10,129.61$). For educational attainment, it was confirmed that the low-stable type had a relatively higher level of education than the

high-increasing type, and in the residential area, it was confirmed that the low-stable type had a higher proportion of urban residence than the high-increasing type.

Table 4
Differences of Types of Pain Change Among Older Adult (n = 1,359)

Variable		Low-stable (n = 1194)		High-increasing (n = 165)		χ ² /F
		n	%	n	%	
Gender	Male	397	33.2	27	16.4	19.257***
	Female	797	66.8	138	83.6	
Age	Mean (SD)	72.51(5.37)		72.95(5.29)		-.989
Annual Household Income (USD \$)	Mean (SD)	13,525.73(12,947.00)		9,963.5715(10,129.61)		4.080***
Educational attainment	Elementary graduate or below	836	70.0	144	87.3	21.492***
	Middle school graduate	161	13.5	10	6.1	
	High school graduate or above	197	16.5	11	6.7	
Residential area	Urban	809	67.8	98	59.4	4.566*
	Rural	385	32.2	67	40.6	
Living alone	Alone	999	83.7	128	77.6	3.801
	Living with someone	195	16.3	37	22.4	

* $p < .05$, ** $p < .01$, *** $p < .001$

3.4. Association between different type of pain change and depression in older adult

In Table 5, a multiple regression analysis was performed to examine the relationship between the type of pain change and depression among older adults. The explanatory power (R^2) of the independent variable for depression was 12.7% ($R^2 = 0.127$), and the research model was confirmed to be suitable ($F = 12.974$, $p < .001$). In the results of the analysis, age ($B = .055$, $p < .001$) and residential area ($B = -.537$, $p < .001$) were

found to be significant control variables for depression. In other words, a person who is older and living in an urban area is more likely to be depressed than a person living in a rural area. On the other hand, age, household income, educational attainment, and living alone did not affect depression significantly. Depression showed a stronger relationship among the high-increasing type of pain than the low-stable type ($B = .844, p < .001$).

Table 5
Multiple Regression Analysis for depression (n = 1,359)

Variables	B	S.E.
(Constant)	-1.698	1.093
Gender (0 = male)	-.042	.154
Age	.055 ^{***}	.012
Annual Household Income (ln)	.023	.055
Educational attainment: Middle school graduates (0 = Elementary graduate or below)	-.252	.205
Educational attainment: High school graduates (0 = Elementary graduate or below)	-.099	.199
Residential area (0 = Urban)	-.537 ^{***}	.138
Living alone (0 = Living with someone)	.008	.182
Pain (0 = Low-stable)	.844 ^{***}	.198
R ²	0.127	
F(sig.)	12.974 ^{***}	
* $p < .05$, ** $p < .01$, *** $p < .001$		

4. Discussion

The purpose of this study is to categorize changes in pain in Korean older adults in the longitudinal dimension and to elucidate the effect of each type on depression. For this purpose, data from 2010 to 2018 of 1,359 65-year-olds in Korea were analyzed using KLoSA data. As the main analysis methods, latent growth and growth mixed models were used to derive types, and the impact of the pain change types on depression was confirmed by multiple regression analysis.

First, pain changes among older adults were finally classified into two types. These are the low-stable type (n = 1,194, 87.9%) and the high-increasing type (n = 165, 12.1%). Although the incidence of pain among older adults is generally reported to increase with age (Badley & Tennant, 1992; Crook, Rideout & Browne, 1984; Thomas et al., 2007), this longitudinal study showed that there are two types of pain in older adults. Upon examining the differences in demographic characteristics based on type, the high-increasing type had a higher percentage of women, lower-income, relatively low educational attainment, and a higher percentage of rural residents than the low-stable type. This is consistent with the results of previous studies that not only the prevalence of pain gradually increases but also the pain area and intensity, among female older adults than in male older adults (Jung, Park, Kim, & Park, 2015) and among older people with lower socioeconomic status (education, income, occupation) (Dorner, et al., 2011). This characteristic of the high-increasing type with a high pain-related risk indicates that the more vulnerable the group is, the more likely it is to suffer from pain.

Further, in an analysis of the effect of the finally derived types of pain change on depression, it was found that depression levels were higher in the case of the high-increasing type than in the case of the low-stable type. This supports previous studies that high pain aggravates depressive symptoms (Casten et al., 1995; Kaye, Baluch, & Scott, 2010; Williamson & Schulz, 1992). This study confirmed once again that pain affects not only physical difficulties but also deteriorates mental health such as depression.

Based on the results of this study, it is vital to take a proactive stance toward pain. Based on the results of this study that derived the pain change among older adults as a low-stable type and high-increasing type, it may be expected that the degree or scope of the pain may increase if cannot be adequately managed in old age. In addition, pain also affects people's quality of life, such as depression. However, invisible pain is often considered an inevitable part of aging (Kumar & Allcock, 2008), and older adults often show a tendency to not actively seek medical assistance (Schofield, 2007). With the recognition that pain is also a disease (Treede et al., 2019), it is necessary to approach it as an active treatment target (Price & Gold, 2018), furthermore, it is necessary to find a way to prevent the aggravation of pain. Since the causes of pain in old age are extremely diverse and complex, prevention is difficult, therefore, various efforts and discussions regarding early treatment and pain management will be required (Cha & Park, 2011). It is especially important to pay attention to interventions that are designed to help vulnerable groups with a high risk of pain obtain effective pain management.

There are several limitations to this study. This study utilized data from KLoSA's 3rd (2010) to 7th (2018) surveys, while the 1st (2006) and 2nd (2008) surveys were not included. Due to an increase in drop-out cases due to death, we excluded them to ensure a sufficient number of subjects for the longitudinal study. Also, because the data on pain and depression were obtained from self-reporting of the elderly, the data may tend to be underestimated. Due to limitations of secondary data, continuity and severity of pain, such as acute and chronic pain, could not be considered.

5. Conclusion

In conclusion, the significance of this study lies in the fact that it reiterated the importance of early pain diagnosis and intervention by identifying the types of pain changes in older adults and analyzing their effects on depression. Additionally, this study emphasizes the importance of setting a healthcare policy for vulnerable populations with a high risk of pain in older adults by integrating restorative interventions for older adults in the 'high-increasing' group. Prospective studies are needed with consideration of the severity and continuity of acute and chronic pain.

Declarations

Ethics approval and consent to participate

All methods were performed in accordance with the Declaration of Helsinki. This report was exempted from approval by the institutional review boards (IRB) of the Clinical Research Ethics Committee of Semyung University (IRB number: 2022-03-004). Every participant gave a written consent prior to their participation in the study.

Consent for publication

Not applicable

Availability of data and materials

The datasets analyzed during the current study can be found here: Korean Longitudinal Study of Aging (KLoSA) website - <https://survey.keis.or.kr/eng/klosa/klosa01.jsp>.

Competing interests

The authors declare that they have no competing interests

Author's contributions

Conceptualization: K.H. Jeong, H.G. Son; formal analysis: K.H. Jeong, H.G. Son; writing: K.H. Jeong, S.H. Kim, J.H. Ryu, S.L. Lee; all authors read and approved the manuscript

References

1. Badley, E. M., & Tennant, A. (1992). Changing profile of joint disorders with age: findings from a postal survey of the population of Calderdale, West Yorkshire, United Kingdom. *Annals of the rheumatic diseases*, 51(3), 366–371. <http://dx.doi.org/10.1136/ard.51.3.366>
2. Blazer, D. G. (2003). Depression in late life: review and commentary. *The journals of gerontology series A: Biological sciences and medical sciences*, 58(3), 249–265. <https://doi.org/10.1093/gerona/58.3.M249>

3. Brown, S. T., Kirkpatrick, M. K., Swanson, M. S., & McKenzie, I. L. (2011). Pain experience of the elderly. *Pain Management Nursing*, 12(4), 190–196. <https://doi.org/10.1016/j.pmn.2010.05.004>
4. Casten, R. J., Parmelee, P. A., Kleban, M. H., Lawton, M. P., & Katz, I. R. (1995). The relationships among anxiety, depression, and pain in a geriatric institutionalized sample. *Pain*, 61(2), 271–276. [https://doi.org/10.1016/0304-3959\(94\)00185-H](https://doi.org/10.1016/0304-3959(94)00185-H)
5. Cha, B. K., & Park, C. S. (2011). A comparison of pain, pain interference and fatigue according to the level of physical activity in the elderly with chronic pain. *Journal of Korean Academy of Community Health Nursing*, 22(2), 162–172. <https://doi.org/10.12799/jkachn.2011.22.2.161>
6. Crook, J., Rideout, E., & Browne, G. (1984). The prevalence of pain complaints in a general population. *Pain*, 18(3), 299–314. [https://doi.org/10.1016/0304-3959\(84\)90824-8](https://doi.org/10.1016/0304-3959(84)90824-8)
7. Cruz-Almeida, Y., Aguirre, M., Sorenson, H. L., Tighe, P., Wallet, S. M., & Riley III, J. L. (2015). Age differences in cytokine expression under conditions of health using experimental pain models. *Experimental gerontology*, 72, 150–156. <https://doi.org/10.1016/j.exger.2015.09.017>
8. Dorner, T. E., Muckenhuber, J., Stronegger, W. J., Ràsky, É., Gustorff, B., & Freidl, W. (2011). The impact of socio-economic status on pain and the perception of disability due to pain. *European journal of pain*, 15(1), 103–109. <https://doi.org/10.1016/j.ejpain.2010.05.013>
9. Edwards, R. R. (2005). Age-associated differences in pain perception and pain processing. In: Gibson S.J, Wiener D.K eds. *Pain in Older Persons*.
10. Ferrell, B. A. (1991). Pain management in elderly people. *Journal of the American Geriatrics Society*. 39(1), 64–73. <https://doi.org/10.1111/j.1532-5415.1991.tb05908.x>
11. Fishbain, D. A., Cutler, R., Rosomoff, H. L., & Rosomoff, R. S. (1997). Chronic pain-associated depression: antecedent or consequence of chronic pain? A review. *The Clinical journal of pain*, 13(2), 116–137.
12. Gagliese, L., & Melzack, R. (1997). Chronic pain in elderly people. *Pain*, 70(1), 3–14. [https://doi.org/10.1016/S0304-3959\(96\)03266-6](https://doi.org/10.1016/S0304-3959(96)03266-6)
13. Harkins, S. W., & Price, D. D. (1992). Assessment of pain in the elderly. In: D.C. Turk and R. Melzack (Eds.), *Handbook of Pain Assessment* (pp. 315–331). Guilford Press: New York.
14. International Association for the Study of Pain (IASP) (2022.March). Terminology. *Pain*. <http://www.iasp-pain.org>
15. Jung, C. K., Park, J. Y., Kim, N. S., & Park, H. Y. (2015). Status of chronic pain prevalence in the Korean adults. *Public Health Weekly Report*, 8(31), 728–734.
16. Jung, T., & Wickrama, K. A. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and personality psychology compass*, 2(1), 302–317. <https://doi.org/10.1111/j.1751-9004.2007.00054.x>
17. Kaye, A. D., Baluch, A., & Scott, J. T. (2010). Pain management in the elderly population: a review. *Ochsner Journal*, 10(3), 179–187.

18. Kumar, A., & Allcock, N. (2008). Pain in older people: reflections and experiences from an older person's perspective. *Help the Aged*.
19. Lautenbacher, S., Kunz, M., Strate, P., Nielsen, J. and Arendt-Nielsen, L. (2005). Age effects on pain thresholds, temporal summation and spatial summation of heat and pressure pain, *Pain*, 115, 410–18. <https://doi.org/10.1016/j.pain.2005.03.025>
20. Meller, I., Fichter, M. M., & Schröppel, H. (1996). Incidence of depression in octo-and nonagenarians: results of an epidemiological follow-up community study. *European archives of psychiatry and clinical neuroscience*, 246(2), 93–99. <https://doi.org/10.1007/BF02274899>
21. Molton, I. R., & Terrill, A. L. (2014). Overview of persistent pain in older adults. *American Psychologist*, 69(2), 197. <https://doi.org/10.1037/a0035794>
22. OECD. (2022). Elderly population (indicator). (Accessed on 05 March 2022) <https://doi.org/10.1787/8d805ea1-en>
23. Price, T. J., & Gold, M. S. (2018). From mechanism to cure: renewing the goal to eliminate the disease of pain. *Pain medicine*, 19(8), 1525–1549. <https://doi.org/10.1093/pm/pnx108>
24. Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied psychological measurement*, 1(3), 385–401. <https://doi.org/10.1177/014662167700100306>
25. Raja, S. N., Carr, D. B., Cohen, M., Finnerup, N. B., Flor, H., Gibson, S., ... Vader, K. (2020). The revised IASP definition of pain: Concepts, challenges, and compromises. *Pain*, 161(9), 1976. <https://doi.org/10.1097/j.pain.0000000000001939>
26. Ranjan Roy, M. T. (1986). A survey of chronic pain in an elderly population. *Canadian Family Physician*, 32, 513
27. Rouzet, D., Sánchez, A. C., Renault, T., & Roehn, O. (2019). Fiscal challenges and inclusive growth in ageing societies. <https://doi.org/10.1787/2226583X>
28. Schofield, P. (2007). Pain in older adults: epidemiology, impact and barriers to management. *Reviews in Pain*, 1(1), 12–14. <https://doi.org/10.1177/204946370700100104>
29. Soldato, M., Liperoti, R., Landi, F., Finne-Soveri, H., Carpenter, I., Fialova, D.,... . Onder, G. (2007). Non malignant daily pain and risk of disability among older adults in home care in Europe. *Pain*, 129, 304–310. <https://doi.org/10.1016/j.pain.2006.10.016>
30. Thomas, E., Mottram, S., Peat, G., Wilkie, R., & Croft, P. (2007). The effect of age on the onset of pain interference in a general population of older adults: Prospective findings from the North Staffordshire Osteoarthritis Project (NorStOP). *Pain*, 129(1), 21–27. <https://doi.org/10.1016/j.pain.2006.09.027>
31. Treede, R. D., Rief, W., Barke, A., Aziz, Q., Bennett, M. I., Benoliel, R., ... Wang, S. J. (2019). Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). *Pain*, 160(1), 19–27. <https://doi.org/10.1097/j.pain.0000000000001384>
32. Williamson, G. M., & Schulz, R. (1992). Pain, activity restriction, and symptoms of depression among community-residing elderly adults. *Journal of gerontology*, 47(6), 367–372.

<https://doi.org/10.1093/geronj/47.6.P367>

33. Williamson, G. M., & Schulz, R. (1995). Activity restriction mediates the association between pain and depressed affect: A study of younger and older adult cancer patients. *Psychology and Aging*, 10(3), 369–378. <https://doi.org/10.1037/0882-7974.10.3.369>
34. Wilson, K. C. M., Taylor, S., Copeland, J. R. M., Chen, R., & McCracken, C. F. M. (1999). Socio-economic deprivation and the prevalence and prediction of depression in older community residents: The MRC-ALPHA study. *The British Journal of Psychiatry*, 175(6), 549–553. <https://doi.org/10.1192/bjp.175.6.549>

Figures

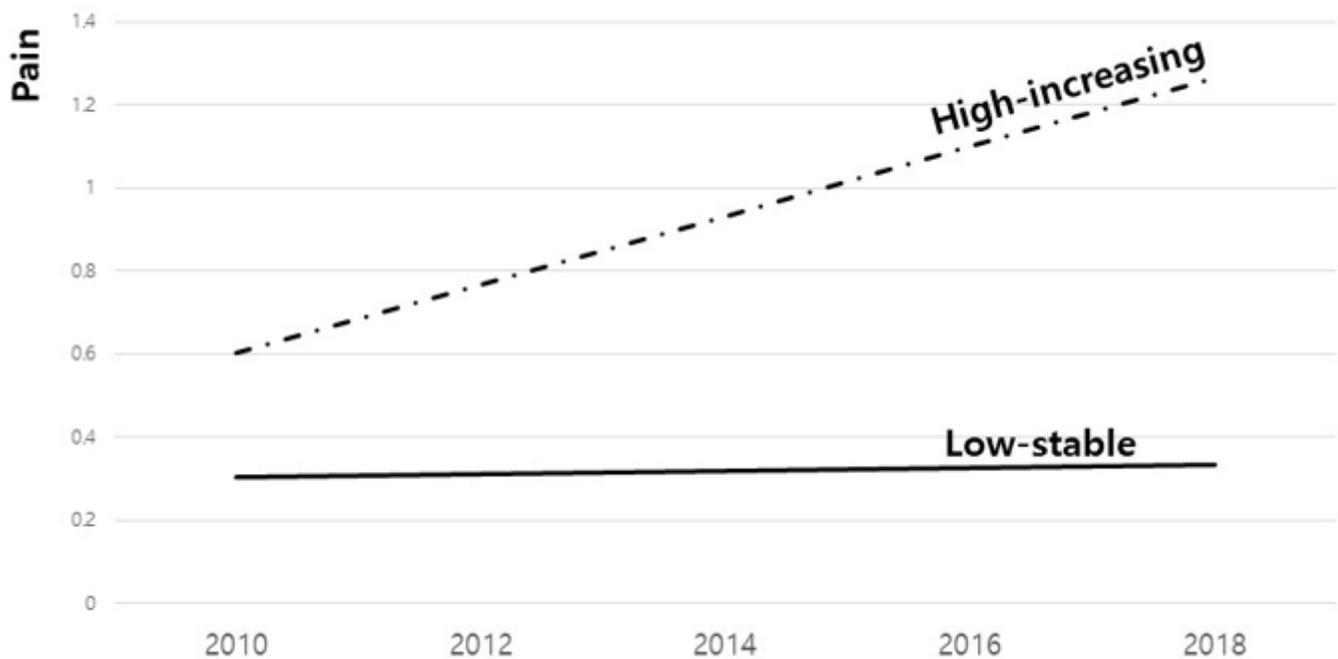


Figure 1

Change Patterns of Pain among Older Adult