

# Lifestyle Aspects As A Predictor Of Pain Among Oldest-Old Primary Care Patients – A Longitudinal Cohort Study

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**Purpose:** Dealing with the high prevalence of pain among the oldest-old (+75) is becoming a major health issue. Therefore, the aim of the study was to uncover health-related lifestyle behaviors (HLB) and age-related comorbidities which may predict, influence and prevent pain in old age.

**Patients and methods:** In this longitudinal cohort study, data were obtained initially from 3.327 individuals aged 75+ from over 138 general practitioners (GP) during structured clinical interviews in 2003. Nine follow-ups (FU) were assessed until 2017. Available data from 736 individuals scoring in FU3 and FU7 were included in this analysis. Data were assembled in an ambulatory setting at participant's homes. Associations were tested using a linear regression model (model 1) and ordered logistic regression model (model 2).

**Results:** Statistical analyses revealed increased likelihood to experience pain for participants with comorbidities such as peripheral arterial disease (PAD) (coef. 13.51,  $P > t = 0.00$ ) or chronic back pain (CBP) (coef. 6.64,  $P > t = 0.003$ ) or higher body mass index (BMI) (coef. 0.57,  $P > t = 0.015$ ) and, female gender (coef. 6.00, SE 3.0,  $t = 2.02$ ,  $P > t = 0.044$ ). Participants with medium education and former smokers showed significantly lower pain rating (coef. -5.05,  $P > t = 0.026$ ; coef. -5.27,  $P > t = 0.026$ ). Suffering from chronic back pain (OR = 2.03), osteoarthritis (OR = 1.49) or depressive symptoms (OR = 1.10) raised the odds to experience impairments in daily living due to pain. Physical activity showed no significant results.

**Conclusion:** Chronic conditions such as PAD, or CBP, female gender and higher BMI may increase the risk of experiencing more pain while successful smoking cessation can lower pain ratings at old age. Early and consistent support through GPs should be given to older patients in order to prevent pain at old age.

**Keywords:** oldest-old, health-related aspects, pain prevention, longitudinal cohort study, chronic conditions

## Plain Language Summary

Many people nowadays reach the age of 75 years and above. With old age, people often suffer from pain. To help understand how pain at old age can be prevented and what kind of a lifestyle might influence the amount of pain one experiences later in life, we used data from a large group of people aged 75+ from Germany to help us understand the situation a little better. In total, 3.327 people took part in this study which ran from 2003 until 2017. Data from 736 people were used to help answer our questions. After analysis of the data, we found that alongside being female and/or overweight, people with a chronic illness such as peripheral arterial disease or chronic back pain have a higher chance of feeling pain at old age. Also, people suffering from chronic back pain, osteoarthritis and problems with depression could have more difficulties carrying out their daily activities because of pain. People who stopped smoking or went to high school have a lower chance of feeling pain at old

age. It is therefore important that older people get help from doctors early in life, for example, with losing weight or help to stop smoking to be able to prevent pain at older age.

## Introduction

Research on healthy lifestyle behavior (HLB) found evidence for associations between HLB and the risk of morbidity, mortality and the prognosis, and prevention of chronic diseases.<sup>1–3</sup> HLB generally includes the following aspects: physical activity, healthy body weight, non-smoking, healthy diet and low level of alcohol consumption which can be considered as modifiable lifestyle factors.

Pain has been identified as a growing threat to healthy aging and is highly prevalent among the population. Numbers on the prevalence of pain among older populations (75+) range between 25% and 80% which make pain management and prevention of pain necessary.<sup>4</sup> Following our previous cross-sectional analyses on the prevalence of pain at old age, we recognized the importance of modifiable lifestyle factors which may play an important role in conjunction with preventing pain in the group of the old-old.<sup>5</sup> In our study, 63% of oldest-old participants reported mild to severe pain as well as high impairments in activities of daily living (IADL) due to pain. At higher age multimorbidity becomes more likely. Of the comorbidities common in high age, chronic low-back problems, chronic gout and depression have been identified as diseases that are related to chronic pain amongst multimorbid patients.<sup>6</sup> Regarding the aging population, aspects on HLB have not been investigated in terms of their association with pain, IADL and age-related comorbidities.

It was, therefore, our aim in this study to uncover factors that may predict, influence and prevent pain in old age. Using a longitudinal approach, we paid special attention to modifiable lifestyle factors such as physical activity, smoking, BMI, intake of alcohol as well as age-related comorbidities. We hypothesize that the HLB aspects have an influence on predicting and preventing pain at a very old age.

## Method

The large cohort of primary care patients aged 75+ from the German longitudinal cohort study on Ageing, Cognition and Dementia in Primary Care Patients (AgeCoDe) and its follow-up study on Needs, Health Service Use, Costs and Health-related Quality of Life (85+) which was based on the same cohort of patients (AgeQualiDe) provided the data for our analysis.

In 2003, 3,327 patients and 138 general practitioners (GP) in six German cities (Bonn, Düsseldorf, Hamburg, Leipzig,

Mannheim, Munich) were recruited for the AgeCoDe cohort. Written informed consent was obtained from all participants prior to their participation. The study design of AgeCoDe has been described in detail elsewhere.<sup>7</sup> In brief, AgeCoDe covered six follow-up assessments (FU) after baseline assessment with 18-month intervals in between each FU. AgeQualiDe covered three additional FU in 10-month intervals from 2014 onwards. The number of participants had decreased to 868 due to deaths or withdrawing of consent.

The AgeCoDe study inclusion criteria were the following: participants aged 75 and above, the absence of dementia, and a minimum of one contact with the GP per year. Participants were excluded if one of the following aspects applied to them: GP consultations only by home visits, lack of the German language, a severe illness with an anticipated fatal outcome within 3 months, suffering from dementia, blindness, deafness, inability to provide informed consent, residing in a nursing home and not being a patient of the participating GP.

Both studies have been approved by the ethics committees of all participating study centers and comply with the ethical standards of the Declaration of Helsinki.

In our longitudinal analysis, we use AgeCoDe/AgeQualiDe data from 2008/2009 (AgeCoDe FU 3) to predict pain in 2014 (AgeCoDe FU7/AgeQualiDe Baseline). Additionally, for each FU, GPs filled out questionnaires regarding the medical condition of each participant. For our analysis, we used data from 736 participants of the AgeQualiDe baseline assessment. Participants with scores of 19 and above in the Mini-Mental-Examination and a valid PRS were included.

## Measures

**Pain:** At FU7 each participant rated the severity of pain for the present-day during each structured clinical interview with a trained psychologist or physician. The rating was based on the validated version of the German Brief Pain Inventory using a one-dimensional numeric pain rating scale (PRS) ranging from 0 to 100 (no pain to worst pain imaginable). Additionally, participants rated IADL caused by pain within the last 24 hrs using a 5-point Likert scale, ranging from 1 (no impairment) to 5 (extreme impairment).<sup>8</sup>

We chose physical activity, smoking habits, BMI, consumption of alcohol, and the comorbidities depressive symptoms, CBP, and gout as our main predictor variable based on literature research,<sup>6,9,10</sup> and additionally included comorbidities such as osteoarthritis, CHD and PAD based on clinical reasoning and expertise from medical staff. The potential confounding variables included sociodemographic variables of gender, age, family status, body

mass index (BMI) and education. Education levels of participants have been categorized into low, medium and high according to the CASMIN criteria.<sup>11</sup>

Physical activity was assessed based on previous research on leisure activities and risk of dementia in the elderly.<sup>12</sup> We extended the list of activities with activities our study participants named regularly and included the following: riding a bike, hiking or going for longer walks, swimming, exercising or gymnastics, work in house and garden, caring for grandchildren or other relatives, other activities such as dancing, bowling, golf, or jogging. Physical activities were measured on a five-point Likert scale (every day, a few times a week, once a week, less than once a week, never within the last 4 weeks). Any activity exercised only once a week or less was rated as 0, any activity exercised at least a few times a week was rated as 1. For each participant, a sum was calculated and used for analysis.

The Geriatric Depression Scale was used to measure depressive symptoms, consisting of 15 items. A score ranging from 0 to 15 was calculated for each individual.<sup>13</sup> Smoking status was classified into never smoker, former or active smoker at baseline visit and was used as a proxy for FU3. Consumption of alcohol was assessed by the number of alcoholic drinks taken within a week and grouped into “none”, “1–2, 3–4 or 5–6 days a week” and “daily”.

## Statistical Analysis

For our analysis, we used data from the FU3 assessment of AgeCoDe and the baseline assessment from AgeQualiDe. Analysis was carried out for all individuals with available data for both time points and with ratings on the PRS ( $n = 736$ ).

A linear regression model (model 1) and an ordered logistic regression model (model 2) was calculated in order to identify the impact of our variables on the prevalence of pain at follow-up seven. Model one is based on the original pain scale and model two on IADL due to pain.

Both models were adjusted for age, sex, education, and family status, physical activity, smoking status, alcohol intake, and BMI, and comorbidities such as depressive symptoms, osteoarthritis, CBP, gout, CHD, and PAD.

Logistic regression analyses were carried out using SAS 9.3 software. Additional analyses have been conducted with SPSS Statistics. The level of statistical significance was set to alpha 0.05.

## Results

Table 1 provides the descriptives of the analytic sample. The mean age of our sample was 83 years at follow-up

**Table 1** Descriptives Of The Sample At FU3 (Mean Age 83 Years)

Variable	N	(%)	Mean (SD)
<b>Participants</b>	736	(100)	
<b>Gender</b>			–
Male	239	(32.5)	
Female	497	(67.5)	
<b>Education</b>			–
Low	407	(55.3)	
Medium	225	(30.6)	
High	104	(14.1)	
<b>Marital status</b>			–
Single	50	(6.8)	
Married	271	(36.8)	
Divorced	37	(5.0)	
Widowed	376	(51.2)	
<b>Body mass index</b>	–	–	26.12 (4.46)
<b>Smoker</b>			–
Never	411	(55.8)	
Ex-Smoker	288	(39.1)	
Smoker	37	(5.0)	
<b>Alcohol intake</b>			–
None	321	(43.7)	
<1 drink a day	223	(30.4)	
1–2 drinks a day	101	(13.8)	
≥2 drinks a day	89	(12.1)	
<b>Physical activities</b>			–
None per week	30	(4.1)	
1 per week	195	(26.7)	
2 per week	273	(37.4)	
3 per week	179	(24.5)	
4+ per week	53	(7.3)	
<b>Depressive symptoms</b>	–	–	1.99 (2.05)
<b>Comorbidities</b>			–
Coronary artery disease	203	(29.8)	
Peripheral arterial disease	54	(7.9)	
Chronic back pain	291	(42.8)	
Osteoarthritis	374	(54.9)	
Gout	125	(18.3)	

**Note:** Data are presented as number (%).

three and 89 years at follow-up seven. The average pain rating at follow-up seven was 26.2 on the PRS. Average IADL due to pain was stated by 2.31.

Table 2 provides statistical results for both measures PRS (model one) and IADL due to pain (model two). Statistical analysis for model one revealed the following factors as risk factors for a higher PRS: female gender, PAD, CBP, and

**Table 2** Results Of The Linear Regression Model For Pain Rating Scale (PRS, Scores 0–100) In Model 1 And For The Ordinal Logistic Regression For Impairment Of Daily Living Due To Pain (IDL, Scores 1–5) In Model 2 At FU7 (Mean Age 88.8 Years)

Variable	PRS	Model 1			IDL	Model 2		
	Mean (SD)	Coeff.	95% CI	p	Mean (SD)	OR	95% CI	p
<b>Participants</b>	26.16 (26.69)	–	–	–	2.31 (1.20)	–	–	–
<b>Gender</b>								
Male	20.17	–	–	–	2.05	–	–	–
Female	29.04	6.00	0.16 to 11.83	<b>0.04</b>	2.44	1.30	0.84 to 2.01	0.23
<b>Education</b>								
Low	28.47	–	–	–	2.39	–	–	–
Medium	23.03	–5.05	–9.48 to –0.62	<b>0.03</b>	2.24	0.90	0.65 to 1.24	0.50
High	23.89	1.95	–4.08 to 7.99	0.53	2.17	1.10	0.72 to 1.71	0.65
<b>Age</b>	–	–0.64	–1.32 to 0.04	0.07	–	0.96	0.92 to 1.01	0.13
<b>Marital status</b>								
Single	34.50	–	–	–	2.62	–	–	–
Married	21.35	–4.31	–13.14 to 4.52	0.34	2.08	0.77	0.40 to 1.46	0.42
Divorced	31.19	5.43	–6.11 to 16.97	0.36	2.28	0.84	0.67 to 1.91	0.67
Widowed	26.82	–2.03	–10.15 to 6.09	0.62	2.37	0.99	0.55 to 1.79	0.97
<b>Body mass index</b>	–	0.57	0.11 to 1.03	<b>0.02</b>	–	1.03	1.00 to 1.07	0.06
<b>Smoker</b>								
Never	28.94	–	–	–	2.42	–	–	–
Ex-Smoker	22.11	–5.23	–9.90 to –0.63	<b>0.03</b>	2.18	0.90	0.64 to 1.26	0.54
Smoker	26.76	–7.58	–17.18 to 2.03	0.12	2.16	0.66	0.34 to 1.28	0.22
<b>Alcohol intake</b>								
None	27.96	–	–	–	2.48	–	–	–
<1 drink a day	26.03	1.62	–3.12 to 6.39	0.50	2.25	0.90	0.64 to 1.27	0.56
1–2 drinks a day	24.60	2.27	–3.92 to 8.47	0.47	2.21	0.90	0.57 to 1.42	0.65
≥2 drinks a day	23.30	2.76	–4.51 to 10.04	0.46	2.09	0.83	0.49 to 1.41	0.50
<b>Physical activities</b>								
None per week	23.93 (24.66)	–	–	–	2.10 (1.06)	–	–	–
1 per week	29.04 (28.98)	4.98	–5.18 to 15.13	0.34	2.55 (1.33)	1.94	0.92 to 4.01	0.08
2 per week	24.94 (25.61)	1.24	–8.83 to 11.31	0.81	2.25 (1.17)	1.43	0.68 to 3.00	0.34
3 per week	25.98 (26.59)	4.60	–5.82 to 15.02	0.39	2.27 (1.13)	1.68	0.79 to 3.58	0.18
4+ per week	23.30 (24.26)	5.07	–6.99 to 17.12	0.41	2.08 (1.05)	1.41	0.59 to 3.37	0.45
<b>Depressive symptoms</b>	–	0.72	–0.30 to 1.74	0.17	–	1.10	1.02 to 1.18	<b>0.02</b>
<b>Comorbidities</b>								
Coronary artery disease (no)	24.08	–	–	–	2.21	–	–	–
Coronary artery disease (yes)	26.51	2.25	–2.18 to 6.68	0.32	2.39	1.02	0.74 to 1.40	0.92
Peripheral arterial disease (no)	24.16	–	–	–	2.26	–	–	–
Peripheral arterial disease (yes)	31.94	13.51	5.95 to 21.06	<b>0.00</b>	2.39	1.24	0.70 to 2.20	0.46
Chronic back pain (no)	18.51	–	–	–	1.94	–	–	–
Chronic back pain (yes)	32.30	6.64	2.32 to 10.97	<b>0.00</b>	2.66	2.03	1.48 to 2.79	<b>0.00</b>
Osteoarthritis (no)	19.40	–	–	–	1.99	–	–	–
Osteoarthritis (yes)	27.92	4.17	–0.17 to 8.52	0.06	2.42	1.49	1.09 to 2.04	<b>0.01</b>
Gout (no)	24.30	–	–	–	2.24	–	–	–
Gout (yes)	27.40	0.35	–4.78 to 5.50	0.89	2.42	1.06	0.72 to 1.54	0.78

**Notes:** Alpha was set to 0.05; bold values indicate significance.

higher BMI. On average female gender was associated with 6-point higher ratings on the PRS compared to the PRS of men. Ratings on the PRS when affected by CBP are 6.6 points higher and those suffering from PAD 13.5 points higher compared to individuals without these comorbidities. A weak but significant result was also shown for higher BMI. On the contrary, medium education compared to lower education and former smokers compared to never smokers showed significantly lower pain rating by five points on the PRS.

In model two, three health-related risk factors could be identified for IADL due to pain: CBP ( $p = 0.000$ ; OR = 2.03), osteoarthritis ( $p = 0.01$ ; OR = 1.49) and depressive symptoms ( $p = 0.02$ ; OR = 1.10) (see Table 2).

No significant results were found for our main predictor variables such as number of physical activities or consumption of alcohol. Suffering from gout or CHD was also not associated with pain.

## Discussion

### Summary

The longitudinal study investigated the relationship of HLB and age-related comorbidities on pain at a very old age. The results point to an association for PAD, and CBP with higher pain ratings at an older age. Furthermore, female gender is associated with higher pain ratings as well as higher BMI scores. Additionally, comorbidities such as CBP, osteoarthritis, and depressive symptoms show associations with higher IADL due to pain. Regarding the modifiable lifestyle factors, successful smoking cessation and lower BMI were significantly associated with lower pain ratings. Identifying and working on modifiable lifestyle factors with the patients towards a better HLB could help to prevent pain at old age.

### Strength And Limitations

The strengths lie in the longitudinal design of the study as well as a large number of participants aged 85+ giving extensive insight into their medical, social and psychological aspects of life. The large sample size allowed us to investigate lifestyle aspects in relation to pain at a high age which very few studies have done so far. Also, our study sample can be considered representative for general practice patients who are living by themselves and are able to consult their GP in their office.

Yet, we cannot exclude selection bias for only healthy participants who were still able to visit their GP at the practice were included. Bias due to attrition cannot be excluded because some participants have been excluded mainly due to death or refusal. Also, no further analyses have been carried

out to compare PRS and IADL due to pain for included and excluded participants for FU3. Furthermore, we did not assign the participants to a stage of chronic illnesses at the point of time. Therefore, chronic conditions could have reached a higher stage and impacted to a larger extent. Regarding physical activity, we focused on self-reported physical activity measures, which are affected by recall bias. Also, survival bias might have affected the generalizability of the results towards the healthier population.

## Comparison With Existing Literature

Participants suffering from PAD or CBP show strong associations with higher pain and higher IADL due to pain than individuals without these conditions. This could be due to the progression of the illness itself but also avoidance of movement in fear of pain. Yet, while exercising is one of the main effective non-pharmacologic therapy approaches for CBP patients in order to reduce pain research indicates a drop in physical activity levels with growing age which might be one of the reasons why in our analysis, the number of physical activities did not show any significant influence on pain.<sup>9,14–16</sup> Nevertheless, physical activity remains crucial modifiable health factor to maintain the status quo, and has been shown to reduce levels of depression and pain, increase the quality of life, self-esteem, and retain independence.<sup>17–19</sup>

Our results also show a lower risk of experiencing more pain for former smokers compared to never smokers. Research indicates a pain-related smoking behavior. Higher rates of cigarette smoking and shorter latencies between smoking cigarettes have been reported among individuals with chronic pain.<sup>20,21</sup> Smoking cigarettes may serve as a coping strategy in order to reduce pain, yet greater pain sensitivity, a larger number of pain locations and pain interference have been seen among smokers suffering from pain.<sup>22,23</sup> Furthermore, daily smokers reported more chronic pain than never smokers or former smokers.<sup>24</sup> Addressing the modifiable health factor “smoking” and breaking the hypothesized “positive feedback loop” at an early age – more pain leading to higher cigarette intake – may, therefore, play a crucial role. According to our findings, former smokers are still at risk of pain at old age but may experience less when smoking cessation is successful.

In accordance with existing literature, female gender and higher BMI are associated with higher pain ratings. Research found evidence for increased pain sensitivity in women and obese individuals, as well as greater pain-related distress and differences in responsivity to pharmacological and non-pharmacological pain interventions among women.<sup>25–27</sup> While gender differences may be caused by biopsychosocial



mechanisms, the BMI presents an important modifiable health factor.<sup>28</sup> There is great evidence that obese patients profit from weight reduction with lower pain rating and less pain-related functional impairment.<sup>29</sup>

Concepts of healthy living suggest little consumption of alcohol as one of the main healthy lifestyle factors.<sup>2,3</sup> However, in our study, the consumption of alcohol as well as the comorbidities gout or CHD do not show significant results.

We interpret our findings that a different focus may be needed for pain at old age due to the increase in comorbidities and physical restraints yet, promoting HLB throughout any age group can impact positively on patients.

## Implications For Research And Practice

We could identify successful smoking cessation and reducing obesity as a potentially positive HLB in terms of reducing and preventing pain at old age. Current smokers should be motivated and supported in successful smoking cessation in earlier stages of life. Similarly, support should be given to overweight patients in order to reduce weight to lower the BMI. Empowering the patients to actively change for a healthier lifestyle should be in the center of attention besides promoting preventive programs. Yet, while other research showed evidence that physical activity can impact on pain at a younger age,<sup>5</sup> we could not show associations for our large study population. Given the high age of our participants maintaining the current health status could be more realistic than improving it.

As we did not investigate to what extent GPs address HLB which can be influenced by the patients themselves such as BMI, physical activity, or smoking further research should focus on GPs attitude towards these aspects in relation to the age of the patients. Identifying and developing approaches with a focus on empowering patients on HLB which also connect to the special needs of the aging population could add a positive prospect on dealing with pain at old age.

## Ethics Approval And Consent To Participate

Data were derived from the AgeCoDe (study part one: Baseline until FU2, and two: FU3 until FU6) and AgeQualiDe (study part three: FU7 until FU9) study. All GP patients who participated in the study provided written informed consent prior to their participation. The study has been approved by the local ethics committees of all participating study centers and comply with the ethical standards of the Declaration of Helsinki.

- Ethics Commission of the Medical Association Hamburg (reference number: OB/08/02, 2817/2007, and MC-390/13)
- Ethics Committee of the Medical Faculty of the Rheinische Friedrich-Wilhelms-University of Bonn (reference number: 050/02, 258/07, and 369/13)
- Medical Ethics Commission II of the Medical Faculty Mannheim/Heidelberg University (reference number: 2026.4/2002, 2007-253E-MA, and 2013-662N-MA)
- Ethics Committee of the Faculty of Medicine of the University of Leipzig (reference number: 143/2002, 309/2007, and 333-13-18112013)
- Ethical Committee of the Medical Faculty of the Heinrich-Heine-University Düsseldorf (reference number: 2079/2002, 2999/2008, and 2999)
- Ethics Committee of the Faculty of Medicine of the Technical University of Munich (reference number: 713/02, and 713/02 E)

## Data Sharing

Due to ethical restrictions involving patients' data, underlying data are only available on reasonable request. Interested parties may contact the Working Group Medical Statistics and IT-Infrastructure, Institute for General Practice, Hannover Medical School, Hannover, Germany (Birgitt Wiese; [wiese.birgitt@mh-hannover.de](mailto:wiese.birgitt@mh-hannover.de)).

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## Author Contributions

Members of the AgeCoDe/AgeQualiDe research study group have been involved in the following matters: Analyzing and interpreting data and drafting the manuscript: TM, BW, ME. Substantial contribution to the analysis and interpretation of the data and drafting of the manuscript: TM, ME, BW. Substantial acquisition of data: KH, AF, TM, JW, SW, DW, CB, SR, AP, EM, MP, LK, MW. Substantial contribution to the conception and design of the study: BW, HB, HHK, SW, MW, MS, WM, SGRH. Revised the manuscript critically for important intellectual content: all authors. All authors (TM, ME, HHK, CB, SR, AP, SW, JW, EM, DW, AF, MP, KH, BW, LK, MW, SGRH, WM, MS) read and approved the final version of the manuscript and accept direct responsibility for the manuscript. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or

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## Disclosure

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