General Section
Research Paper

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PAIN REPORTS

Graded chronic noncancer pain distribution using the Graded Chronic Pain Scale-Revised framework: a cross-sectional study

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Abstract

Introduction: Chronic noncancer pain affects approximately one-fourth in population-based studies calling for more nuanced insights by applying the Graded Chronic Pain Scale-Revised (GCPS-R) framework for classifying graded chronic noncancer pain distribution in national disease surveillance.

Objectives:
The GCPS-R framework was included in the comprehensive questionnaire repeatedly used in the Danish National Health and Morbidity Surveillance program to provide more distinct measures for chronic non-malignant pain disease manifestation in Denmark.

Methods: A cross-sectional study inviting randomly 25,000 adults 16 years and older to self-report questionnaires comprising the GCPS-R framework as part of the nationwide Danish National Health Survey 2023. Prevalences (%) and multivariate-adjusted odds ratios (ORs) with 95% confidence intervals (95% CI) by ordinal logistic regression were calculated for GCPS-R by sex, area of living, age, country of origin, socioeconomic factors, body mass index, and Charlson Comorbidity Index.

Results: The prevalence of chronic noncancer pain was overall 28.1% (95% CI 27.2%–29.0%) in 8,643 included individuals without cancer diagnosis counting 7.4% (6.9%–8.0%) with mild-impact, 7.1% (6.6%–7.6%) with bothersome-impact, and 13.6% (12.9%–14.4%) with high-impact chronic noncancer pain. Women had 66% (odds ratio (OR) 1.66; 95% CI 1.50–1.84) elevated odds of more severely graded chronic noncancer pain referenced to men. Socioeconomic factors influenced odds inversely. Body mass index was related to GCPS-R by dose-response effects of more than doubled elevated odds in World Health Organization obese class II (2.42; 1.92–3.06) and obese class III (4.43; 3.30–5.93) referenced to normal body mass index individuals. Comorbidity elevated odds of more severely graded chronic noncancer pain by 86% (1.86; 1.57–2.19) referenced to individuals without comorbidity.

Conclusions: More than one-quarter individuals reported chronic noncancer pain characterized particularly by high-impact graded chronic noncancer pain when applying the GCPS-R framework for classifying graded chronic noncancer pain distribution in national disease surveillance for rational health care administration.

Keywords: Body mass index, Chronic pain, Comorbidity, GCPS-R, Risk factors, Surveillance

1. Introduction

Noncancer chronic pain has a profound disease burden in Western populations with reported high prevalences of more than one-fourth individuals affected by noncancer chronic pain in national survey-based studies.[5,7,16,21] Chronic pain, as classified by the International Association for the Study of Pain (IASP) as pain lasting more than 3 months duration, is a multifactorial disease

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.painrpts.com).

PR9 10 (2025) e1277

http://dx.doi.org/10.1097/PR9.0000000000001277

associated with diverse multisite symptoms graded in mild to high-impact chronic pain.[26] The distribution of measures for graded chronic noncancer pain in the general population is unknown for most countries because of lack of data. However, large cross-sectional American studies have reported prevalences of approximately 18.0% to 20.0% affected by chronic pain and approximately 5.0% to 8.0% affected by high-impact chronic pain.[4,21]

Noncancer chronic pain has leading public health implications for societies worldwide with profound consequences in lost earnings, reduced productivity, and diminished quality-adjusted life years.[26] Noteworthy, the immense health care costs for both medical and nonmedical treatments are substantial as chronic pain is the most frequent reason for seeking professional health assistance.[26] The perception of chronic pain has evolved profoundly over the past decades from being perceived merely as a symptom of other diseases to being recognized as an independent disease classification associated with significant emotional distress and functional disability as classified in the 11th revision of the International Classification of Diseases.[25,26] Accordingly, epidemiologic research on noncancer chronic pain increasingly focuses on the more nuanced consequences of distinct impact levels of graded chronic noncancer pain on the health and wellbeing of the affected individuals for an improved understanding about the related disease mechanisms and public health implications.[21]

An ongoing public health surveillance of nationwide measures for graded chronic noncancer pain distribution is vital for health care decision makers enabling a more agile planning of targeted treatment and preventive strategies. In a Danish nationwide survey-based cross-sectional study, the validated Graded Chronic Pain Scale-Revised (GCPS-R) framework was applied to explore national distinct estimates for graded chronic noncancer pain distribution.

2. Methods

2.1. Procedure and participants

The study was based on self-reported survey data collected in Danish as part of the Danish National Health Survey 2023.[10] A random sample of 25,000 Danes aged 16 years or older with permanent residence in Denmark on January 1, 2023, were invited by official mailbox with up to 4 consecutive reminders to nonresponders.[10] The survey is part of the repeated cross-sectional Danish National Health Survey managed by the Danish National Institute of Public Health in collaboration with the Danish Regions and the Danish Health Authority.[10]

The study complies with the 1975 Declaration of Helsinki and the Strengthening the Reporting of Observational Studies in Epidemiology guideline.[28,32] Informed consent was ensured by the Danish National Institute of Public Health.[10] The study adheres to all disclosure requirements and was approved (Reg.No. 23/71934) and registered as an original research protocol by the legal department of University of Southern Denmark on November 30, 2023, before commencing data management. No deviations from the registered research protocol were decided upon during the data management process. An ethical committee approval in survey-based register studies is not required in Denmark.

2.2. Pain measurement characteristics

Graded chronic noncancer pain was measured using the GCPS-R framework translated into Danish in accordance with clinical practice by the Danish National Clinical Pain Registry.[27,29] The GCPS-R comprises (1) a 2-item framework identifying the presence of chronic pain followed by the impact on daily life and work activities on an ordinal scale (never, some days, most days, or every day) by self-reported recall over the most recent 3 months; (2) the 3-item Pain, Enjoyment, and General Activities continuous 0 to 10 self-assessed numerical rating scale within the past 7 days; and (3) a dichotomous (yes or no) identification of work capacity due to pain conditions.[29] The latter is not used in classifying chronic pain impact distribution within the GCPS-R framework.[29] An ordinal outcome variable for graded chronic noncancer pain distribution was hierarchically structured in levels of no, mild-impact, bothersome-impact, and high-impact chronic noncancer pain in accordance with the GCPS-R framework.[29]

2.3. Risk factor measurement characteristics

Information on sex, area of living, age, country of origin, and marital status was obtained from the Danish Civil Registration System, and highest attained education nationally and abroad was obtained from the Danish Education Register adhering to the Lisbon Convention on the Recognition of Qualifications concerning Higher Education in the European Region (ETS No. 165) to account for academic mobility.[9,19] Employment status was obtained from the Danish Employment Classification Module enabling yearly information on primary occupation by the main source of income throughout the year from automized digital reports by Danish companies and public payroll systems.[20]

Information on clinically diagnosed comorbidity as defined by somatic diagnoses from inpatient and outpatient contacts 10 years before the date of survey invitation on January 1, 2023, was obtained from the Danish National Patient Register holding nationwide information on somatic diagnoses since 2007.[15] Comorbidity was classified in accordance with the Charlson Comorbidity Index score based on the International Classification of Diseases 10th revision disease codes obtained from the National Danish Patient Register (Supplementary Table 1, http://links.lww.com/PR9/A305).[3] The cut-off for exposure status in the Danish nationwide registers was defined on December 31, 2022, to ensure exposure status before the GCPS-R measurement.

The variables were a priori included as categorical variables in the analyses: sex: men or women; area of living: capital: capital and metropolitan city municipalities of >100,000 inhabitants; country: country and upland city municipalities of <30,000 inhabitants; and province: province city municipalities of 30,000 to 100,000 inhabitants; age in 10-year age groups: 16 to 25, 26 to 35, 36 to 45, 46 to 55, 56 to 65, 66 to 75, and older than 75 years; country of origin: Danish, Western, or non-Western following definitions used by Statistics Denmark founded on the United Nations definitions of developed countries; marital status: married/in registered partnership, unmarried, divorced, widowed; highest attained education: basic school, vocational school, upper secondary school, short theoretical school, long theoretical school, and unknown; employment: employed, non-employed, and unknown; body mass index (BMI) according to the World Health Organization classification: underweight: <18.5, normal weight: 18.5 to 24.9, overweight: 25.0 to 29.9, obese class I: 30.0 to 34.9, obese class II: 35.0 to 39.9, obese class III: ≥40.0; Charlson Comorbidity Index score dichotomized due to small cell counts: no comorbidity: 0 diagnosis or comorbidity: 1+ diagnosis.

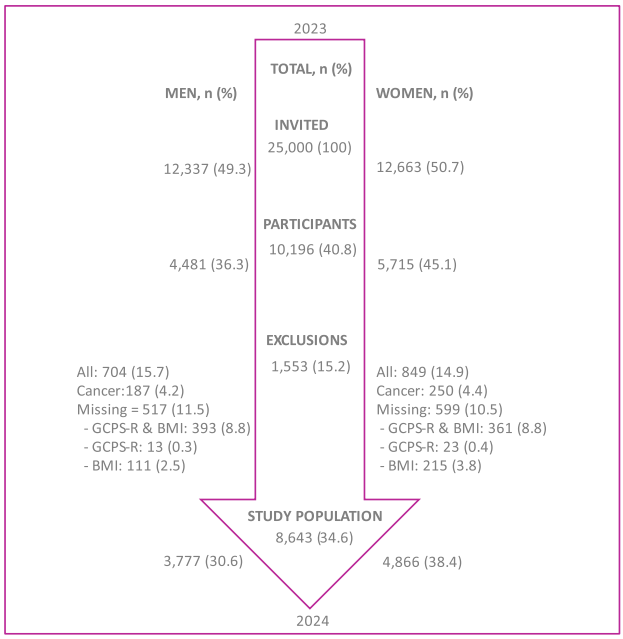

Figure 1. Study flow diagram for the included 8,643 noncancer participants in the Danish National Health Survey 2023. A flow diagram showing the analytic response proportion included in the study among the invited individuals to the Danish National Health Survey 2023. BMI, body mass index; GCPS-R, Graded Chronic Pain Scale-Revised.

2.4. Statistical analysis

The variables were presented as mean (SD) for continuous variables and prevalences ($\hat{p}$, %) with 95% confidence intervals (95% CI) for categorical variables. Ordinal logistic regression modeling generating odds ratios (OR) with 95% CI were applied using a 5% statistical significance level. The graded chronic noncancer pain distribution was used as the outcome variable in the ordinal logistic regression models. An OR higher than 1 indicated higher odds of being more severely affected by graded chronic noncancer pain. Model estimates from 3 binary logistic regression models were compared to evaluate the proportional odds assumption showing no clear violations (Supplementary Tables 2–4, http://links.lww.com/PR9/A305). Analyses were restricted to chronic noncancer pain to ensure homogeneity in the analyses excluding individuals with clinically verified cancer diagnoses in the Danish Patient Register before January 1, 2023. Analyses were a priori adjusted for effects of sex, area of living, age, country of origin, marital status, highest attained education, BMI, and comorbidity in a main model. Associations of employment with GCPS-R were not included in the main model to avoid spurious effects on age but were analyzed in a second nested subanalysis on a subset of the responders aged 26 to 65 years to approximate homogeneity of an adult work force. Calibration sample weighting was applied to reduce the impact of non-response bias on the estimates.[10] The sample weights were computed by Statistics Denmark based on information such as sex, age, country of origin, marital status, highest attained education, and income obtained from the Danish national administrative registers. Data management was progressed in SAS 9.4 (SAS Institute, Cary, NC) for data modeling and R statistics 4.2.1 (R Core Team, R Foundation for Statistical Computing, Vienna, Austria) for graphics in the secure remote server environment of Statistics Denmark.

3. Results

3.1. Description of the study sample

An overall response proportion of 40.8% resulted in 10,196 eligible individuals of which 1,553 (15.2%) were excluded due to a cancer diagnosis or missing values (**Fig. 1**). The analytic study population therefore included a total of 8,643 individuals (34.6% of total invited) of which 4,866 (56.3%) were women (**Table 1**). The mean age (SD) was 54.5 (18.4) years with most (92.7%) being of Danish country of origin (**Table 1**). Most were married (55.5%), had a highest attained nonacademic education (63.5%), and were employed (52.8%) (**Table 1**). Overweight (34.8%) and obesity (18.5%) were prevalent in both sexes but predominantly in men, who were also more likely to be exposed to comorbidity (10.4%) than women (7.7%) (**Table 1**).

Table 1

Baseline characteristics by sex in 8,643 noncancer Danish participants of the Danish National Health Survey 2023.

	Total, N (%)	Men, n (%)	Women, n (%)
All	8643 (100)	3777 (43.7)	4866 (56.3)
Area of living			
Capital	3326 (38.5)	1440 (38.1)	1886 (38.8)
Country	3285 (38.0)	1461 (38.7)	1824 (37.4)
Province	2032 (23.5)	876 (23.2)	1156 (23.8)
Age (y)			
Mean (SD)	54.5 (18.4)	55.6 (18.4)	53.7 (18.5)
16–25	803 (9.2)	337 (8.9)	466 (9.6)
26–35	787 (9.1)	311 (8.2)	476 (9.8)
36–45	1037 (12.0)	404 (10.7)	633 (13.0)
46–55	1471 (17.0)	613 (16.2)	858 (17.6)
56–65	1705 (19.7)	783 (20.7)	922 (19.0)
66–75	1740 (20.1)	811 (21.4)	929 (19.1)
>75	1100 (12.7)	518 (13.7)	582 (11.9)
Country of origin			
Danish	8012 (92.7)	3518 (93.1)	4494 (92.3)
Western	314 (3.6)	135 (3.6)	179 (3.7)
Non-Western	317 (3.7)	124 (3.3)	193 (4.0)
Marital status			
Married	4800 (55.5)	2239 (59.2)	2561 (52.6)
Unmarried	2253 (26.1)	1016 (26.9)	1237 (25.4)
Widowed	561 (6.5)	135 (3.6)	426 (8.8)
Divorced	1029 (11.9)	387 (10.3)	642 (13.2)
Education			
Basic school	1758 (20.3)	794 (21.0)	964 (19.8)
Vocational school	3134 (36.3)	1549 (41.0)	1585 (32.6)
Upper secondary	594 (6.9)	247 (6.5)	347 (7.1)
Short theoretical	1873 (21.7)	585 (15.4)	1288 (26.5)
Long theoretical	1112 (12.8)	519 (13.7)	593 (12.2)
Unknown	172 (2.0)	83 (2.2)	89 (1.8)
Employment			
Employed	4567 (52.8)	2110 (55.9)	2457 (50.5)
Nonemployed	3891 (45.0)	1603 (42.4)	2288 (47.0)
Unknown	185 (2.0)	64 (1.7)	121 (2.5)
BMI, WHO classification			
Mean (SD)	26.1 (5.1)	26.6 (4.5)	25.7 (5.5)
Underweight	197 (2.3)	33 (0.9)	164 (3.4)
Normal weight	3836 (44.4)	1448 (38.3)	2388 (49.1)
Overweight	3008 (34.8)	1609 (42.6)	1399 (28.8)
Obese class I	1128 (13.1)	516 (13.7)	612 (12.5)
Obese class II	306 (3.5)	121 (3.2)	185 (3.8)
Obese class III	168 (1.9)	50 (1.3)	118 (2.4)
Comorbidity			
No	7875 (91.1)	3385 (89.6)	4490 (92.3)
Yes	768 (8.9)	392 (10.4)	376 (7.7)

BMI, body mass index; WHO, World Health Organization.

3.2. Prevalence distribution of graded chronic pain

The prevalence of chronic noncancer pain was overall 28.1% (95% CI 27.2%–29.0%) (**Table 2**). The graded chronic noncancer pain prevalences using the GCPS-R distribution showed 7.4% (6.9%–8.0%) with mild-impact, 7.1% (6.6%–7.6%) with bothersome-impact, and 13.6% (12.9%–14.4%) with high-impact chronic noncancer pain (**Fig. 2** and **Table 2**).

The graded chronic noncancer pain prevalences varied by sex showing lower prevalences of chronic noncancer pain in men compared with women on the GCPS-R distribution (**Fig. 3**). Approximately 7.0% (6.2%–7.8%) of men vs 7.8% (6.9%–8.6%) of women had mild-impact, 5.8% (5.1%–6.6%) of men vs 8.1% (7.2%–8.9%) of women had bothersome-impact, and 11.3% (10.2%–12.3%) of men vs 15.5% (14.3%–16.6%) of women had high-impact chronic noncancer pain (**Fig. 3** and **Table 2**).

A positive relationship of age with GCPS-R distribution showed peaking prevalences particularly during midlife ages (**Table 2**). The prevalences for graded chronic noncancer pain in middle aged 46 to 55 years showed 7.7% (6.3%–9.0%) affected by mild-impact, 7.7% (6.3%–9.0%) by bothersome-impact, and 14.4% (12.6%–16.2%) by high-impact chronic noncancer pain (**Table 2**).

The graded chronic noncancer pain prevalences using the GCPS-R distribution did not differ markedly by area of living or country of origin but inverse associations for socioeconomic factors were found (**Table 2**). Furthermore, positive associations of BMI with GCPS-R distribution showed peaking prevalences of high-impact chronic noncancer pain of 27.8% (22.8%–32.8%) for obese class II and 34.5% (27.3%–41.7%) for obese class III as compared with 9.6% (8.7%–10.5%) for normal weight individuals (**Table 2**).

Table 2

Prevalences with 95% confidence intervals for adult Graded Chronic Pain Scale-Revised distribution by risk factor characteristics in 8,643 noncancer participants of the Danish National Health Survey 2023.

	GCPS-R							
	No		Mild		Bothersome		High	
	p̂	95% CI	p̂	95% CI	p̂	95% CI	p̂	95% CI
GCPS-R	71.9	70.9–72.8	7.4	6.9–8.0	7.1	6.6–7.6	13.6	12.9–14.4
Exposure								
Sex								
Men	75.9	74.6–77.3	7.0	6.2–7.8	5.8	5.1–6.6	11.3	10.2–12.3
Women	68.7	67.2–70.2	7.8	6.9–8.6	8.1	7.2–8.9	15.5	14.3–16.6
Area of living								
Capital	76.0	74.5–77.4	6.7	5.8–7.5	6.6	5.7–7.4	10.8	9.7–11.8
Country	69.0	67.5–70.6	7.5	6.6–8.4	7.4	6.5–8.3	16.1	14.8–17.3
Province	69.5	67.6–71.6	8.5	7.3–9.7	7.5	6.3–8.6	14.4	12.8–15.9
Age (y)								
16–25	85.4	83.0–87.9	5.4	3.8–6.9	4.4	2.9–5.8	4.9	3.4–6.3
26–35	79.7	76.9–82.5	6.0	4.3–7.6	6.2	4.5–7.9	8.1	6.2–10.0
36–45	74.7	72.1–77.4	7.3	5.7–8.9	7.2	5.7–8.8	10.7	8.8–12.6
46–55	70.2	67.9–72.6	7.7	6.3–9.0	7.7	6.3–9.0	14.4	12.6–16.2
56–65	65.9	63.7–68.2	8.8	7.5–10.1	8.3	7.0–9.6	17.0	15.2–18.8
66–75	70.1	67.9–72.2	7.8	6.5–9.0	7.0	5.8–8.2	15.2	13.5–16.9
>75	67.8	65.1–70.6	7.1	5.6–8.6	7.1	5.6–8.6	18.0	15.7–20.3
Country of origin								
Danish	71.9	70.9–72.9	7.6	7.0–8.2	7.2	6.6–7.8	13.3	12.6–14.1
Western	73.2	68.4–78.1	7.6	4.7–10.6	3.5	1.5–5.5	15.6	11.6–19.6
Non-Western	69.7	64.7–74.8	3.2	1.2–5.1	7.6	4.7–10.5	19.6	15.2–23.9
Marital status								
Married	71.9	70.6–73.2	7.6	6.8–8.3	6.9	6.2–7.7	13.6	12.6–14.5
Unmarried	77.2	75.5–78.9	6.3	5.3–7.4	6.6	5.5–7.6	9.9	8.7–11.1
Widowed	63.8	59.8–67.8	9.4	7.0–11.9	6.6	4.5–8.6	20.1	16.8–23.5
Divorced	64.2	61.3–67.2	8.0	6.3–9.6	9.2	7.5–11.0	18.6	16.2–20.9
Education								
Basic school	67.9	65.7–70.1	6.4	5.2–7.5	8.2	6.9–9.5	17.5	15.7–19.3
Vocational school	67.3	65.7–68.9	8.2	7.2–9.1	8.3	7.4–9.3	16.2	14.9–17.5
Upper secondary	77.6	74.3–81.0	5.4	3.6–7.2	5.9	4.0–7.8	11.1	8.6–13.6
Short theoretical	74.6	72.7–76.6	8.2	6.9–9.4	6.3	5.2–7.4	10.9	9.5–12.3
Long theoretical	82.3	80.0–84.5	7.4	5.8–8.9	4.1	3.0–5.3	6.2	4.8–7.6
Employment								
Employed	75.9	74.7–77.1	8.2	7.4–9.0	6.9	6.2–7.6	9.0	8.2–9.9
Nonemployed	67.0	65.5–68.5	6.6	5.8–7.4	7.3	6.5–8.1	19.1	17.8–20.3
BMI								
Underweight	72.6	66.4–78.8	6.6	3.1–10.1	5.1	2.0–8.1	15.7	10.7–20.8
Normal weight	78.5	77.2–79.8	6.8	6.0–7.5	5.2	4.5–5.9	9.6	8.7–10.5
Overweight	71.6	70.0–73.2	7.8	6.9–8.8	7.7	6.8–8.7	12.9	11.7–14.1
Obese class I	59.8	57.0–62.7	8.2	6.6–9.8	9.9	8.2–11.7	22.1	19.7–24.5
Obese class II	54.2	48.7–59.8	6.5	3.8–9.3	11.4	7.9–15.0	27.8	22.8–32.8
Obese class III	36.3	29.0–43.6	13.7	8.5–18.9	15.5	10.0–20.9	34.5	27.3–41.7
Comorbidity								
No	73.2	72.3–74.2	7.4	6.8–8.0	6.9	6.3–7.4	12.5	11.7–13.2
Yes	57.7	54.2–61.2	7.4	5.6–9.3	9.4	7.3–11.4	25.5	22.4–28.6

BMI, body mass index; CI, confidence interval; GCPS-R; p̂, prevalences; Graded Chronic Pain Scale-Revised.

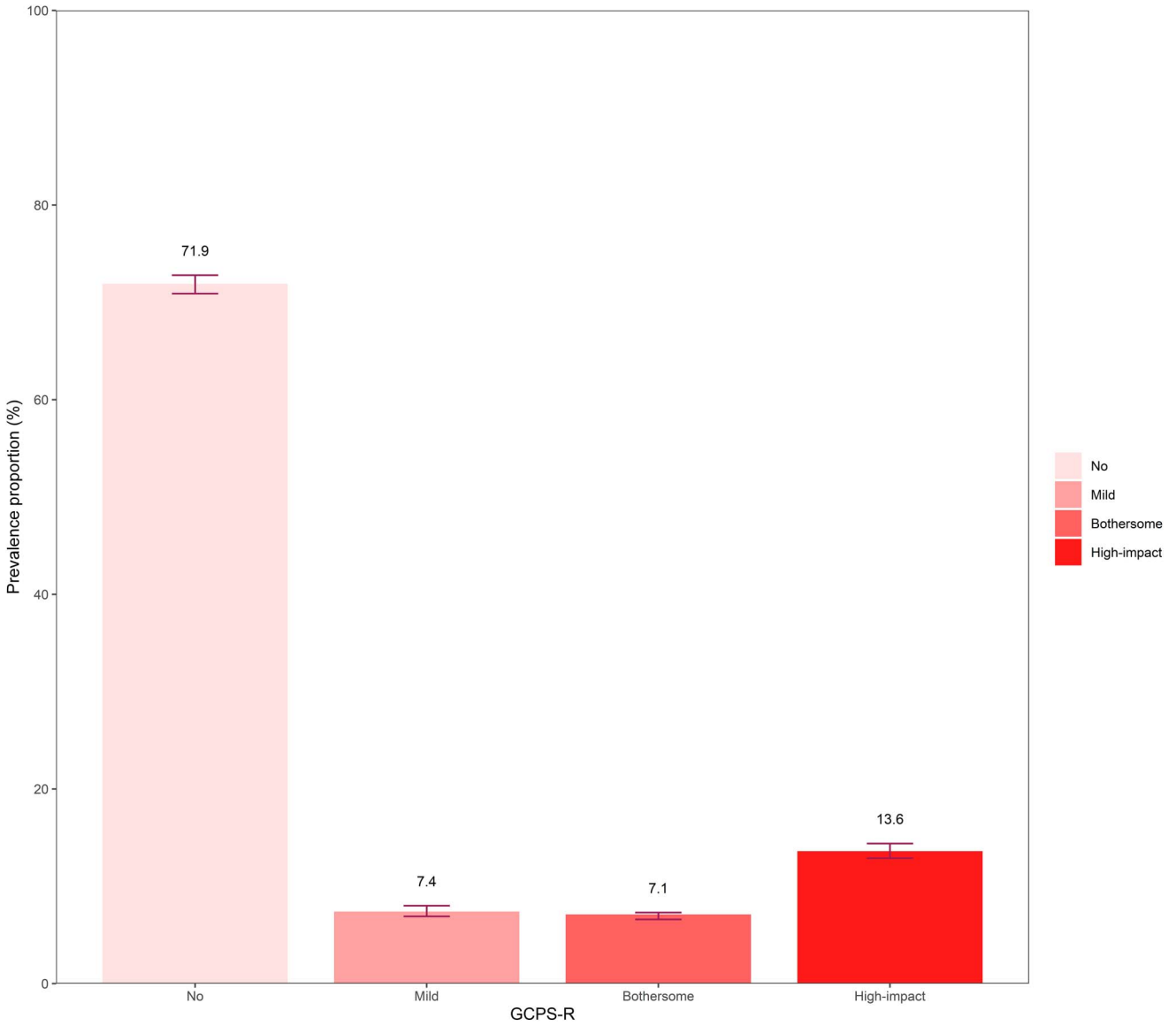

Figure 2. Adult GCPS-R distribution in 8,643 noncancer Danes, Danish National Health Survey 2023. Results figure showing the overall GCPS-R distribution among the included responders to the Danish National Health Survey 2023. GCPS-R, Graded Chronic Pain Scale-Revised.

The GCPS-R distribution was further modified by comorbidity showing elevated prevalences of higher-impact graded chronic noncancer pain in individuals diagnosed with comorbidity compared with individuals without comorbidity (**Fig. 4**). The prevalence of high-impact chronic noncancer pain was 25.5% (22.4%–28.6%) in individuals diagnosed with comorbidity compared with 12.5% (11.7%–13.2%) in those without comorbidity (**Fig. 4** and **Table 2**).

3.3. Ordinal logistic regression

Women had an elevated multivariate-adjusted OR 1.66 (95% CI 1.50–1.84) for more severely graded chronic noncancer pain on the GCPS-R distribution referenced to men (**Table 3**). Moderate variations by area of living were found with country-site residents showing multivariate-adjusted OR 1.15 (1.03–1.29) referenced to capital-site residents (**Table 3**).

The odds of more severely graded chronic noncancer pain were particularly elevated in middle aged individuals with multivariate-adjusted ORs 2.91 (2.29–3.71) and 3.33 (2.62–4.24) for those aged 46 to 55 and 56 to 65 years, respectively, referenced to the youngest individuals aged 16 to 25 years (**Table 3**). The effects of age attenuated in a sensitivity analysis excluding the youngest individuals aged 16 to 26 years (Supplementary Table 5, http://links.lww.com/PR9/A305).

Socioeconomic factors were inversely related to the GCPS-R distribution such that lower educated individuals had a multivariate-adjusted elevated OR 2.22 (1.79–2.76) for basic school education referenced to those with long theoretical highest attained education. Furthermore, nonemployed individuals had an elevated multivariate-adjusted OR 2.40 (2.04–2.82) for more severely graded chronic noncancer pain on the GCPS-R distribution referenced to employed individuals in a subset of 5,000 responders in workforce ages 26 to 65 years (**Table 3**).

A dose–response relationship across self-reported obesity with odds of more severely graded chronic noncancer pain on the GCPS-R distribution showed elevated multivariate-adjusted ORs 2.42 (1.92–3.06) and 4.43 (3.30–5.93) in the highest obese class II and obese class III categories, respectively, referenced to normal weight BMI. BMI had a greater impact on the odds of more severely

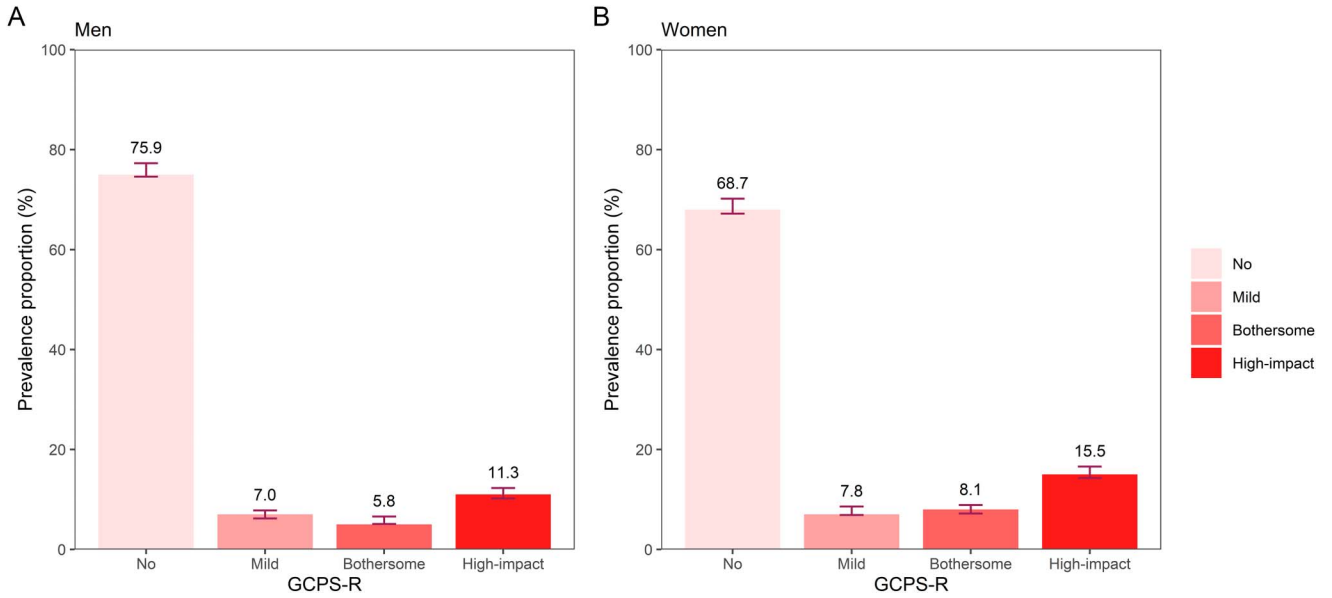

Figure 3. Adult GCPS-R distribution by sex in 8,643 noncancer Danes, Danish National Health Survey 2023. Results figure showing the overall GCPS-R distribution stratified by sex among the included responders to the Danish National Health Survey 2023. GCPS-R, Graded Chronic Pain Scale-Revised.

graded chronic noncancer pain than comorbidity, which showed an elevated multivariate-adjusted OR 1.86 (1.57–2.19) in individuals diagnosed with comorbidity referenced to those without comorbidity. The covariate adjustments in the ordinal regression analyses had a moderate impact on the OR estimates. The differences between group were statistically significant ($P < 0.05$).

4. Discussion

This study found a prevalence of 28.1% for chronic noncancer pain with 7.4% of mild-impact, 7.1% of bothersome-impact, and 13.6% of high-impact chronic noncancer pain. The odds of more severely graded chronic noncancer pain were elevated in women as compared with men as well as in individuals of older age, low socioeconomic status, obese BMI, and having a health record of previously diagnosed somatic comorbidity.

Heterogeneity in measuring population-based graded chronic pain distribution in current evidence[1,4,6,11–14,17,18,21–23,30,31,33] hinders to some degree direct comparisons. For example, differences in the data sources, cut-offs for self-reported pain duration of 3 months or 6 months, and whether cancers were included in the study population may result in elevated effect

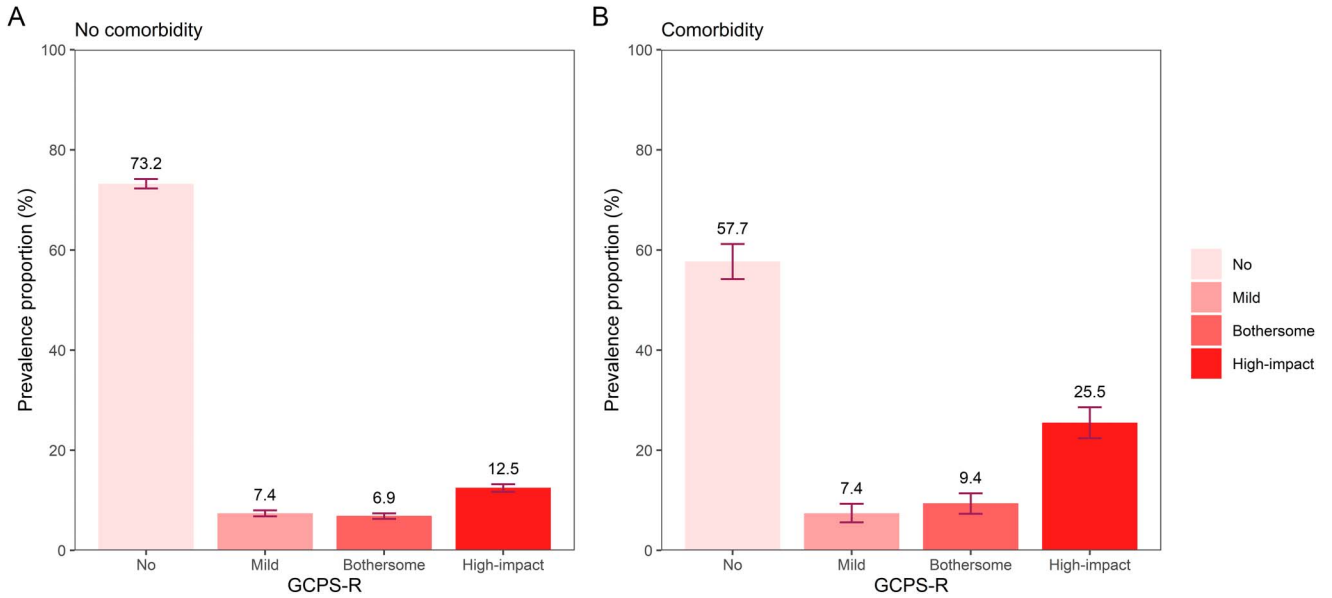

Figure 4. Adult GCPS-R distribution by comorbidity in 8,643 noncancer Danes, Danish National Health Survey 2023. Results figure showing the overall GCPS-R distribution stratified by comorbidity among the included responders to the Danish National Health Survey 2023. GCPS-R, Graded Chronic Pain Scale-Revised.

Table 3

Odds ratios with 95% confidence intervals by ordinal logistic regression modeling for adult graded chronic noncancer pain risk using the Graded Chronic Pain Scale-Revised (GCPS-R) distribution by risk factor characteristics in 8,643 noncancer participants of the Danish National Health Survey 2023.

Odds GCPS-R	OR (95% CI)*	OR (95% CI)†	OR (95% CI)‡
Exposure			
Sex			
Men	1.00	1.00	1.00
Women	1.58 (1.43–1.73)	1.59 (1.45–1.76)	1.66 (1.50–1.84)
Area of living			
Capital	1.00	1.00	1.00
Country	1.46 (1.31–1.62)	1.30 (1.16–1.45)	1.15 (1.03–1.29)
Province	1.32 (1.17–1.50)	1.24 (1.09–1.41)	1.11 (0.97–1.27)
Age (y)			
16–25	1.00	1.00	1.00
26–35	1.53 (1.24–1.88)	1.54 (1.25–1.89)	1.80 (1.43–2.26)
36–45	1.96 (1.59–2.42)	1.92 (1.55–2.37)	2.22 (1.73–2.84)
46–55	2.51 (2.06–3.05)	2.51 (2.06–3.05)	2.91 (2.29–3.71)
56–65	3.09 (2.54–3.75)	3.17 (2.61–3.85)	3.33 (2.62–4.24)
66–75	2.57 (2.11–3.13)	2.59 (2.13–3.15)	2.60 (2.03–3.34)
>75	3.06 (2.48–3.77)	3.01 (2.44–3.72)	2.89 (2.20–3.78)
Country of origin			
Danish	1.00	1.00	1.00
Western	0.93 (0.77–1.12)	0.98 (0.81–1.19)	1.20 (0.98–1.47)
Non-Western	1.14 (0.97–1.36)	1.32 (1.11–1.57)	1.39 (1.15–1.67)
Marital status			
Married	1.00	1.00	1.00
Unmarried	0.73 (0.65–0.81)	1.21 (1.05–1.38)	1.15 (1.00–1.33)
Widowed	1.58 (1.32–1.90)	1.25 (1.02–1.52)	1.19 (1.00–1.45)
Divorced	1.40 (1.22–1.62)	1.25 (1.09–1.45)	1.19 (1.03–1.38)
Education			
Basic school	2.32 (1.91–2.83)	2.99 (2.43–3.67)	2.22 (1.79–2.76)
Vocational school	2.31 (1.90–2.79)	2.16 (1.77–2.62)	1.79 (1.47–2.19)
Upper secondary	1.34 (1.05–1.71)	1.99 (1.54–2.56)	1.66 (1.28–2.14)
Short theoretical	1.42 (1.15–1.76)	1.28 (1.03–1.59)	1.13 (0.91–1.41)
Long theoretical	1.00	1.00	1.00
Employment§			
Employed	1.00	1.00	1.00
Nonemployed	3.02 (2.62–3.49)	3.02 (2.60–3.50)	2.40 (2.04–2.82)
BMI			
Underweight	1.38 (1.01–1.90)	1.44 (1.05–1.99)	1.36 (0.98–1.88)
Normal weight	1.00	1.00	1.00
Overweight	1.44 (1.28–1.61)	1.36 (1.21–1.53)	1.30 (1.16–1.47)
Obese class I	2.65 (2.30–3.05)	2.47 (2.14–2.85)	2.22 (1.92–2.57)
Obese class II	2.75 (2.19–3.44)	2.73 (2.17–3.44)	2.42 (1.92–3.06)
Obese class III	5.37 (4.04–7.13)	5.23 (3.92–6.98)	4.43 (3.30–5.93)
Comorbidity			
No	1.00	1.00	1.00
Yes	2.31 (1.98–2.70)	2.02 (1.71–2.37)	1.86 (1.57–2.19)

* Univariate.
† Bivariate-adjusted: sex and age.
‡ Multivariate-adjusted: sex, area of living, age, country of origin, marital status, education, BMI, and comorbidity.
§ ORs for effects of employment were calculated in a nested population of 5,000 responders aged 26 to 65 years to approximate homogeneity of an adult work force.
BMI, body mass index; CI, confidence interval; GCPS-R, Graded Chronic Pain Scale-Revised; OR, odds ratio.

sizes.[13,21] The prevalences for self-reported chronic pain and high-impact chronic pain duration using 3 months and 6 months cutoff strategies varied from rounded 17.0% to 21.0% and 7.0% to 19.0%, respectively, for 3 months cutoff[12,17,18,21–23,31,33] compared with 19.0% to 35.0% and 9.0% to 25.0%, respectively, for 6 months cut-off.[1,4,7,11,13,14,17,30] A 3-month cutoff strategy for classifying chronic pain was recommended in the most recent international guideline outlined by the IASP in accordance with our analytic strategy.[26] We further restricted the analyses to chronic noncancer pain by excluding individuals diagnosed with cancers before survey response to avoid nonviable results. Our findings are overall in line with the large American National Health Interview Survey studies using 3 months cut-off for pain duration and defined (ordinal) outcome measures, not strictly within the GCPS-R framework, for classifying graded chronic pain distribution.[12,18,21,23,33] In these American studies,[12,18,21,23,33] an estimated prevalence of approximately 20.0% adult responders self-reported being affected by chronic pain of which approximately 7.0% by high-impact chronic pain.[23,33] Across-studies, higher prevalences of more severely graded chronic pain were generally found in individuals of female sex, midlife ages, rural residence, low socioeconomic status, and obese BMI in line with our findings.[1,4,7,14,18,21–23,31,33] Scarce evidence is generally available on effects of BMI and comorbidity on distributions of graded chronic pain, confirming our results of positive associations with the GCPS-R distribution.[11,13,21]

Few studies[18,23] reported longitudinal measures for graded chronic pain. Nahin et al.[18] found in a longitudinal study including 10,415 Americans incidence rates of chronic pain and high-impact chronic pain of 52.4 (95% CI 44.9–59.9) and 12.0 (8.2–15.8) cases per 1000 person years, respectively. The incidence rates of persistent chronic pain and persistent high-impact chronic pain were found to be 462.0 (439.7–484.3) and 361.2 (265.6–456.8) cases per 1000 person years, respectively.[18] A noteworthy study by Pitcher et al.[21] found furthermore high-impact chronic pain to be a much stronger predictor for functional daily life disability of OR 4.43 (95% CI 3.73–5.26) than other morbidities such as stroke or kidney failure.[21] These above findings stress collectively the possible implications associated with chronic pain disease on public health and thus the importance of implementing more strategic national surveillance internationally of graded chronic noncancer pain distribution.

The higher prevalences of high-impact chronic noncancer pain in our study as compared with the American population-based studies are likely caused by methodological differences. Our study is the first strictly applying the validated GCPS-R framework in a representative nationwide survey-based study sample. The GCPS-R framework facilitates a validated easy-to-score scale for improved specificity, particularly for high-impact chronic pain, in classifying graded chronic pain.[29] The GCPS-R framework used a similar 3 months cut-off for recalled high-impact chronic pain as did the American National Health Interview Survey but enabled higher specificity by grading chronic pain further into mild-impact and bothersome-impact chronic pain using the Pain, Enjoyment, and General Activities rating scale for recalled functional disability within the past 7 days.[29] Additional reasons for the differences found could also be an influence of a more pronounced healthy worker effect in the American data from, among others, fundamental structural differences in health care access compared with the Danish health care system of universal health care coverage.[2,24] Furthermore, self-reported measures for graded chronic noncancer pain might be reinforced in societies with universal health care access from a general higher societal acceptability toward disabilities related to chronic pain.[4]

A possible limitation of our study is the risk of selection bias from a rounded 41.0% response proportion possibly affecting the generalizability of our results. A nonresponse analysis (Supplementary Table 6, http://links.lww.com/PR9/A305) showed elevated nonresponse in individuals of male sex, older ages, and lower socioeconomic status confirming the socioeconomic disparities in response patterns found elsewhere.[1,8,14,21] Effects of selection bias from nonresponse in population-based studies on graded chronic noncancer pain are generally sparsely explored but were in a longitudinal study population of American adults older than 51 years mainly driven by socioeconomic disparities rather than graded chronic pain distribution.[8] The overall chronic noncancer pain prevalences found in our study

were furthermore aligned with previous findings implying minor skewed effects from a selection bias. An interpretation of our results should also acknowledge the inherent limitations of cross-sectional analysis precluding causal inferences including mechanisms of reverse causation. In addition, the GCPS-R framework has not, to the best of our knowledge, been implemented previously in nationwide health surveys on graded chronic noncancer pain distribution, and more evidence is therefore needed before any firm conclusions can be made.[29] Contrary, strengths are the large random population-based study sample and incorporated calibration sample weighting in the analyses to address effects of nonresponse bias, empowering the external validity of our results. Furthermore, the GCPS-R framework was validated in adults showing favorable ability to differentiate graded severity of chronic pain in mild, bothersome, and high-impact chronic pain for several health indicators and thus to be a functional method for a standardized assessment of graded chronic pain.[29] Cancers were excluded from the analyses, and the results were adjusted for important objective confounders of personal characteristics, socioeconomic factors, and comorbidity obtained from representative nationwide health and social welfare registers of very high precision adding importantly to current evidence.

National surveillance of graded chronic noncancer pain distribution is imperative for facilitating targeted treatment strategies and prioritization of scarce health care resources. Our study extends previous evidence by mapping graded chronic noncancer pain as a function of the validated GCPS-R distribution. However, for simplicity, focus was not on specific pain sites, modifiable risk factors, work-related disability, or use of health care services, which should be priorities in future research. Nationwide survey-based epidemiologic studies implementing the validated GCPS-R framework might substantially improve current evidence enabling important future cross-country comparisons and international surveillance of distinctly graded chronic noncancer pain distribution.

Disclosures

The authors have no conflicts of interest to declare.

Acknowledgements

The authors express our gratefulness to all survey participants as well as TrygFonden foundation for nonprofit economic support enabling this important research in nationwide surveillance of graded chronic noncancer pain distribution in Denmark.

The authors express our gratitude to the Danish nonprofit foundation TrygFonden for financial support without influencing any part of this original research: design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, and approval of the manuscript; or decision to submit the manuscript for publication.

The study follows the analytic plan outlined in the pre-registered (Reg.No. 23/71934) research protocol "A health- and wellbeing study of Danes with chronic pain: a novel perspective on chronic pain impact risk distribution" approved in the independent institutional registry of the legal department of University of Southern Denmark on November 30, 2023. The study adheres to all disclosure requirements.

L. C. Thygesen, O. Ekholm, and S. S. Hellmann were granted authorized access to the sensitive health data and data management codes base for the study in the data secured remote server environment of Statistics Denmark. The data and data management codes are strictly protected by Danish law for the personal integrity of the study participants, prohibiting public sharing of sensitive data. A permission to access to the data and data management codes is regulated by Statistics Denmark by strict authorization criteria. G. P. Kurita has received a research grant from the Novo Nordisk Foundation for an independent different study without relevance to the current research.

Author contributions: All authors agree to have contributed substantially to the conception, design, and drafting of the study; acquisition of the data, analysis, and interpretation of the results; critical revision for important intellectual content; and approval for the final submitted version to be published. G. Handberg, H. B. Vaegter, L. C. Thygesen, O. Ekholm, and S. S. Hellmann managed the design and drafting of the study, funding, and acquisition of the data. S. S. Hellmann managed data management, graphics, and drafted the first versions of the manuscript. The authors agree to be accountable for all aspects of the work in ensuring accuracy and integrity of any part of the work appropriately investigated and resolved.

Supplemental digital content

Supplemental digital content associated with this article can be found online at http://links.lww.com/PR9/A305.

Article history:
Received 9 December 2024
Received in revised form 30 January 2025
Accepted 24 February 2025
Available online 27 May 2025

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