

# Patients' Assessment of Care for Type 2 Diabetes: Results of the Patient Assessment of Chronic Illness Care Scale in A Danish Population

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## Research article

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## Abstract

**Background:** The Patient Assessment of Chronic Illness Care (PACIC) scale is the most appropriate for assessing self-reported experience in chronic care. However, it has yet to be validated in a Danish diabetes population. We aimed to validate the PACIC, assess the quality of care for Danish patients with type 2 diabetes, and identify factors associated with quality of care.

**Methods:** A survey of 7,745 individuals randomly selected from the National Diabetes Registry. Descriptive statistics inter-item and item-rest correlations and factor analysis assessed the PACIC properties. Quality of care was analysed with descriptive statistics; linear and multiple regression assessed the effect of forty-nine covariates on total and subscale scores.

**Results:** In total, 2,696 individuals with type 2 diabetes completed  $\geq 50\%$  of items. The floor effect for individual items was 8.5–74.5%; the ceiling effect was 4.1–47.8 %. Cronbach's alpha was 0.73–0.86 for the five subscales. The comparative fit index (CFI) and the Tucker–Lewis index (TLI) were 0.87, and 0.84, respectively. Mean PACIC score was 2.44 ( $\pm 0.04$ ). Respondents receiving rehabilitation and reporting primary of diabetes care had higher total mean scores; those 70 years or older had lower mean total and subscale scores. A higher number of diabetes visits were associated with higher total scores; higher number of emergency department visits were associated with lower total scores. The effect of healthcare utilisation on subscale scores varied.

**Conclusions:** Floor effects suggest a need for further evaluation of the PACIC questionnaire in Danish settings. Total PACIC scores were lower than in other healthcare systems, possibly being a result of different contexts and cultures, and of a need for improving diabetes care in Denmark.

## Background

Disease management programmes for type 2 diabetes patients have been implemented in the Capital Region of Denmark to support evidence-based care. Programmes cover diagnosis, treatment, rehabilitation, and follow-up. Self-management and team-based care inspired by the Chronic Care Model (CCM) are imperative programme elements [1, 2]. The effectiveness of diabetes care increases by improving self-management associated with behaviours, such as treatment adherence, a healthier diet and physical activity [3–5].

The twenty-item Patient Assessment of Chronic Illness Care (PACIC) questionnaire considers whether patients receive patient-centred care in alignment with the CCM. It focuses on five essential dimensions of chronic care measured as subscales: patient activation, delivery system design/decision support, goal setting/tailoring care, problem-solving/contextual counselling, and follow-up/coordination [6, 7]. The PACIC has been translated into Danish and applied in a primary care setting in Denmark to assess data quality, internal consistency, and factorial structure [8]. The psychometric properties were satisfactory, apart from floor and ceiling effects. Also, the subscales showed good model fit and could be used for separate sum scores. Later, the PACIC was applied in a Danish diabetes population to assess perceptions of care when receiving intensive multifactorial treatment. Intensive diabetes care did not affect perceptions of care and, thus, diabetes care still needed improvements [6]. Conversely, a German study comparing patients receiving usual care to those enrolled in a usual diabetes disease management programme found that patients receiving structured evidence-based care scored significantly higher on all scales [9]. A Dutch study reviewing 37 instruments to measure self-reported experience in chronic care concluded PACIC to be the most appropriate [10]. Until now, the PACIC has not been validated in a diabetes population in Denmark. Our objective was twofold: 1) to assess if the PACIC is useful for assessing the quality of care that diabetes patients receive in Denmark, and 2) to assess patients' perspectives on the quality of diabetes care and identify factors important to the quality of care.

## Methods

### Population

In 2013, we randomly selected 8,000 individuals aged 40 years or older with diabetes living in the Capital Region from the National Diabetes Registry [11]. Of these, 255 had died or moved out of the region, and the PACIC was subsequently mailed to 7,745 individuals, along with a link to an identical electronic version. Three weeks later, we sent a reminder to non-respondents. In total, 4190 patients completed the PACIC, yielding a response rate of 54.1%.

## PACIC scoring and additional variables

Each item was scored on a five-point scale ranging from one (no/never) to five (yes/always). Each subscale was scored by averaging scores for completed items, and the total score was calculated by averaging scores across all twenty items. In the Danish version, the wording of a few items was updated in collaboration with Judith Schaefer, a developer of the PACIC [8]. The Danish version also includes items about diabetes type, the primary location of diabetes care and rehabilitation, and type(s) of received rehabilitation: diabetes education, smoking cessation, physical training, and dietitian counselling. The Danish version can be provided by request to the authors.

PACIC scores were linked to national registers and health registers to obtain information on gender, age, education, occupation, cohabitation status, socioeconomic area, multimorbidity status, number of visits with a general practitioner (GP), annual diabetes control visits, planned and acute hospital admissions and bed days, and readmissions. The socioeconomic area was identified by proximity to one of five hospital planning areas that differ socioeconomically. Chronic conditions included allergy, depression, stroke, dementia, chronic heart disease, hypertension, chronic pulmonary disease, high cholesterol, cancer, arthritis, osteoporosis, chronic back pain, and schizophrenia. Comorbidity status was based on algorithms as described in Robinson [12]. Multimorbidity was defined as the presence of two or more chronic conditions.

## Statistical analyses

Of all 4190 respondents, 1380 (32.9%) did not have diabetes or had type 1 diabetes and were excluded. Of the remaining 2,810 respondents, 114 respondents completed fewer than ten items and were excluded. Thus, 2,696 respondents, who completed more than ten items, were included in the analysis. We used the expectation-maximisation (EM) algorithm to impute item values for 259 respondents who answered more than 50% but less than 100% of the items [13]. Comparative analyses without imputation were carried out.

Data quality was evaluated with standard summary statistics. Floor and ceiling effects were presented and analysed. Internal consistency was evaluated with correlation studies within and between subscales using Cronbach's alpha. Additionally, confirmatory factor analysis was carried out, investigating the fit of a latent class for each of the 5 PACIC subscores to data. This factor structure was assessed by the model  $\chi^2$  test, the Root Mean Square Error of Approximation (RMSEA), the Standardized Root Mean Square Residual (SRMR), the Tucker-Lewis Index (TLI) and the Comparative Fit Index (CFI). We considered a value of Cronbachs alpha of 0.7 or above as satisfactory [14]. Descriptive analyses included means, standard deviations, floor and ceiling effects for the total score, for each of the five subscales, and means and standard deviations for the twenty individual items.

To identify factors affecting total PACIC scores, we used linear regression analysis; the nature of the PACIC score as an average of twenty scores across five subscales invited continuous modelling. Multiple regression analysis was used to examine the total PACIC score and each subscale score for relationships with the variables listed above, a total of forty-nine different factors. The factors of education, occupation, and socioeconomic area were multi-level factors, while the remaining factors were binary or numeric. We used the following formula for modelling:

$$Y_i = \alpha_{\text{education}(i)} + \alpha_{\text{occupation}(i)} + \alpha_{\text{area}(i)} + \sum_{j=1}^{46} \beta_j X_{ij} + \varepsilon_i, i = 1, \dots, n. \quad (1)$$

In formula (1),  $Y_i$  denotes either the total PACIC score or one of the five subscale scores, while  $X_{ij}$  denotes the value of the  $j$ th of the forty-six binary or numeric factors for the  $i$ th patient. The model was applied separately for the total PACIC score and each of the five subscale scores. The model reduction was done with a Likelihood Ratio method with a significance level of 5%. Subsequently, the forward selection procedure was applied to detect statistical significance obscured by the top-down model reduction. The forward selection procedure did not result in any alteration of the top-down reduced models. Analyses were performed with the software R, version 3.1.0 [15].

## Results

## **Respondent characteristics**

Of the 2,810 respondents, 59.1% (1,662) were men (Table 1), 78.4% (2,200) were older than 60 years, and 65.4% (1,840) were retired. The educational level of respondents was lower than the general Danish population; 80.7% (2,268) of respondents had no education or education of short duration, compared to 73% of the general population [16]. 70.5% (1,980) of respondents received diabetes care from their GP, 21.8% (612) received care at an outpatient clinic, and 0.4% (12) received care from a private specialist. A small proportion (1.7%, 49) did not identify a care location.

**Table 1.** Characteristics of 2,810 respondents with type 2 diabetes

	N (%)
Gender	1,662 (59.1)
Men	1,148 (40.9)
Women	
Age in years	
40-49	135 (4.8)
50-59	475 (16.9)
60-69	1,064 (37.9)
70-79	811 (28.0)
≥ 80	325 (11.6)
Education level (total years of education)	
None ( $\leq 10$ )	890 (31.7)
Short (11-14)	1,378 (49.0)
Medium (15-16)	299 (10.6)
Long ( $\geq 17$ )	160 (5.7)
Not reported	83 (3.0)
Occupation	
Working or in school	827 (29.4)
Unemployed	30 (1.1)
Long-term disability	72 (2.6)
Early retirement	237 (8.4)
Retirement	1,603 (57.0)
Not reported	41 (1.5)
Cohabitation status	
Living alone	1,099 (39.1)
Living with spouse	1,711 (60.9)
Primary location of diabetes care	
General practitioner	1,980 (70.5)
Outpatient clinic	612 (21.8)
Private specialist	12 (0.4)
Not reported	49 (1.7)

## Quality of PACIC data

In total, 2434 respondents (86.7%) answered all twenty questions. Only 74 respondents (2.6%) did not answer any of the questions. Response rates were similar for all items, and the distributions of answered and unanswered questions were even for

the five subscales. The rate of answered questions decreased with increasing age, and women had a lower rate of answered questions.

The floor effect was 8.5-74.5%, with nineteen items higher than 15%. The ceiling effect was 4.1-47.8%, with eleven items of more than 15%. Cronbach's alpha varied between 0.73 and 0.86 for the 5 subscales. The mean inter-item correlation in the five subscales varied between 0.45 and 0.60. The inter-item correlation range was 0.34-0.73, and the item-rest correlation range was 0.47-0.79. Confirmatory factor analysis showed factor loadings for the twenty items ranging from 0.51 to 0.72.

The factor structure assessment characteristics are listed in Table 2.

**Table 2.** The factor structure assessment characteristics

Statistic	$\chi^2$	df	p	CFI	TLI	RMSEA	SRMR
Value for model fit with 5 subscales	3908	160	<0.001	0.866	0.841	0.098	0.062

#### PACIC score

The overall mean PACIC score was 2.44 ( $\pm 0.04$ ). Subscale mean scores varied with the highest value of 3.26 ( $\pm 0.04$ ) for delivery system design/decision support and the lowest value of 1.99 ( $\pm 0.04$ ) for follow-up/coordination (Table 3).

**Table 3.** Total, subscale, and item scores among respondents with type 2 diabetes (N=2,696\*\*)

	n	Mean (SD)	Median	Missing (%)	Floor (%)	Ceiling (%)
Total score	2,696*	2.44 (0.02) *				
<b>Patient activation scale</b>	2,696*	2.66 (0.03) *				
Item 1	2,680	3.21 (0.03)	4	4.6	27.6	33.1
Item 2	2,647	2.19 (0.03)	1	5.8	52.4	13.1
Item 3	2,663	2.69 (0.03)	2	5.2	40.7	23.3
<b>Delivery system</b> design/decision support scale	2,696*	3.26 (0.02) *				
Item 4	2,670	2.45 (0.03)	2	5.0	45.0	16.4
Item 5	2,695	4.03 (0.03)	4	4.1	8.5	47.8
Item 6	2,678	3.43 (0.03)	4	4.7	19.7	35.0
<b>Goal setting scale</b>	2,696*	2.29 (0.02) *				
Item 7	2,673	2.87 (0.03)	3	4.9	32.2	22.4
Item 8	2,672	2.63 (0.03)	3	4.9	37.6	16.1
Item 9	2,661	1.83 (0.03)	1	5.3	69.9	12.0
Item 10	2,671	1.61 (0.02)	1	4.9	74.4	5.8
Item 11	2,695	2.63 (0.03)	3	4.1	36.2	15.6
<b>Problem solving/contextual counselling scale</b>	2,696*	2.40 (0.02) *				
Item 12	2,667	3.16 (0.03)	4	5.1	27.4	28.1
Item 13	2,671	2.05 (0.03)	1	4.9	59.0	11.0
Item 14	2,663	2.17 (0.03)	1	5.2	54.0	12.6
Item 15	2,677	2.33 (0.03)	2	4.7	48.1	14.3
<b>Follow-up/ coordination scale</b>	2,696*	1.99 (0.02) *				
Item 16	2,682	1.62 (0.02)	1	4.6	74.5	6.9
Item 17	2,675	1.57 (0.02)	1	4.8	74.0	4.1
Item 18	2,673	1.78 (0.03)	1	4.9	66.5	6.6
Item 19	2,677	2.82 (0.03)	3	4.7	37.8	25.4
Item 20	2,671	2.28 (0.03)	1	4.9	53.9	16.5

\* Based on imputed data

\*\* Out of 2,810 respondents, 114 respondents were excluded due to missing completed items, resulting in 2,696 respondents, who completed more than ten items.

The effect parameters for variables with a statistically significant effect on total and subscale scores are shown in tables 4 and 5.

**Table 4.** Effect parameter estimates for total PACIC score in linear regression models

	Estimate (SD)	P value
Intercept	0.20 (0.56)	0.71
Age	0.042 (0.017)	0.01
Age squared	-3.8e-4 (1.3e-4)	0.002
Annual control visits	0.058 (0.024)	0.02
Emergency department visits	-0.083 (0.030)	0.005
Primary diabetes care location		
General practitioner	0.64 (0.09)	< 0.001
Outpatient clinic	0.93 (0.10)	< 0.001
Private specialist	0.65 (0.27)	0.02
Rehabilitation program location		
Patient education		
Municipality	0.15 (0.07)	0.04
General practitioner	0.62 (0.05)	< 0.001
Outpatient clinic	0.34 (0.05)	< 0.001
Physical training		
Municipality	0.18 (0.06)	0.004
General practitioner	0.24 (0.08)	0.004
Outpatient clinic	0.40 (0.08)	< 0.001
Dietary advice		
Municipality	0.50 (0.07)	< 0.001
General practitioner	0.36 (0.05)	< 0.001
Outpatient clinic	0.31 (0.05)	< 0.001

Table 5  
Effect parameters for PACIC subscale scores in linear regression models (N = 2,696\*)

	Patient activation		Delivery system design/decision support		Goal setting		Problem solving/contextual counselling		Follow-up/coordination	
	Estimate	P value	Estimate	P value	Estimate	P value	Estimate	P value	Estimate	P value
Intercept	-0.13	0.88	-0.17	0.81	1.52	< 0.001	1.37	< 0.001	-0.17	0.77
Age	0.065	0.007	0.068	< 0.001					0.048	0.006
Age squared	-5.7e-4	0.002	-5.5e-4	< 0.001	-8.2e-05	< 0.001	7.5e-05	< 0.001	-4.1e-4	0.002
Male gender	-0.12	0.02								
Living alone	-0.12	0.02								
Planning area		0.04	0.008							
2	-0.069	0.32	-0.11	0.07						
3	-0.19	0.02	-0.24	< 0.001						
4	-0.12	0.09	-0.13	0.02						
5	-0.33	0.02	-0.13	0.28						
Education					0.009				0.009	
Short					-0.066	0.12			-0.10	0.009
Medium					-0.079	0.35			-0.077	0.33
Long					-0.24	< 0.001			-0.21	< 0.001
Comorbidities										
Stroke	-0.23	0.04	-0.26	0.005						
Heart disease			-0.13	0.02						
Multimorbidity					0.22	0.04	0.29	0.03		
Utilization										
Annual control visits	0.09	0.01								
Planned hospitalization			-0.013	0.04						
Emergency department visits							-0.10	0.01	-0.09	0.002
GP visits									0.0045	0.009
Unplanned hospitalizations					0.062	0.007				

\* Out of 2,810 respondents, 114 respondents were excluded due to missing completed items, resulting in 2,696 respondents, who completed more than ten items.

Patient activation		Delivery system design/decision support		Goal setting		Problem solving/contextual counselling		Follow-up/coordination	
Outpatient contacts		-0.0048		0.04					
Readmissions	-0.14	.009							
Primary location of diabetes care									
General practice	0.66	< 0.001	1.13	< 0.001	0.48	< 0.001	0.58	< 0.001	0.45 < 0.001
Outpatient clinic	1.06	< 0.001	1.30	< 0.001	0.83	< 0.001	0.86	< 0.001	< 0.001 < 0.001
Private specialist			0.77	0.02	0.72	< 0.001	0.63	0.05	
Location of rehabilitation program									
Education									
Municipality				0.23	0.005		0.19		0.01
General practice	0.61	< 0.001	0.59	< 0.001	0.62	< 0.001	0.80	< 0.001	0.50 < 0.001
Outpatient clinic	0.43	< 0.001	0.34	< 0.001	0.37	< 0.001	0.35	< 0.001	0.28 < 0.001
Physical training									
Municipality	0.32	< 0.001	0.17	0.02	0.17	0.01	0.21	0.008	0.15 0.02
General practice	0.34	0.004	0.24	0.02	0.31	< 0.001	0.24	0.03	
Outpatient clinic	0.42	< 0.001	0.43	< 0.001	0.43	< 0.001	0.50	< 0.001	0.29 < 0.001
Dietary advice									
Municipality	0.42	< 0.001	0.56	< 0.001	0.57	< 0.001	0.51	< 0.001	0.53 < 0.001
General practice	0.34	< 0.001	0.46	< 0.001	0.38	< 0.001	0.44	< 0.001	0.26 < 0.001
Outpatient clinic	0.37	< 0.001	0.32	< 0.001	0.27	< 0.001	0.31	< 0.001	0.30 < 0.001

\* Out of 2,810 respondents, 114 respondents were excluded due to missing completed items, resulting in 2,696 respondents, who completed more than ten items.

## Age and gender

Total PACIC scores and subscale scores were inversely correlated with age and declined with increasing age from the age of approximately 70 years (Figure 1). The effect was nonlinear for the total score and all subscales. A similar pattern was found for the five subscales.

Gender did not affect the total PACIC score. Men tended to have a lower score than women on the patient activation subscale, although the p-value of 0.02 did not indicate strong statistical significance.

Figure 1 should be placed here

## **Sociodemographic variables**

Educational level, occupation, and socioeconomic area did not affect the total PACIC score (Table 4). Educational level affected subscale scores to a significantly negative degree for goal setting and follow-up/coordination ( $p = 0.009$  for both). For both subscales, patients with the most education scored significantly lower than those with less education (Table 5). Occupation did not affect any subscales. Socioeconomic area affected patient activation ( $p = 0.04$ ) and delivery system design/decision support ( $p = 0.008$ ). For the latter, respondents living in planning area three had markedly lower scores than respondents living in the other areas; compared to a composite of all other areas, the estimated mean subscale score for respondents in planning area three was 0.16 lower ( $p = 0.005$ ).

## **Diabetes treatment and rehabilitation**

Respondents whose primary setting for diabetes care was a GP or hospital outpatient clinic scored significantly and consistently higher for the total PACIC score on all subscales than respondents who did not attend a primary setting for care (Tables 4 and 5). Only twelve respondents reported a private specialist as the primary place for their diabetes care; their total PACIC scores were significantly higher than respondents who did not report a primary setting for diabetes care, but the effect was inconsistent across the subscales. Patients who reported receiving diabetes care at the hospital clinic had total PACIC scores that were an estimated 0.29 higher than patients who received diabetes care at their GP or a private specialist. However, the difference is of borderline significance ( $p = 0.05$ ). Patients who received diabetes care primarily at their GP or a specialist had an estimated 0.64 higher total PACIC scores than respondents who replied no primary setting for diabetes care or indicated "other" ( $p < 0.0001$ ).

Participation in rehabilitation programmes was associated with increased total and subscale scores except for smoking cessation (Tables 4 and 5). However, the effect varied according to the programme location. Diabetes education with a GP showed the highest effect on the total PACIC score of all rehabilitation types, with an estimated rise in the total PACIC score of 0.62 ( $\pm 0.10$ ). The effect on the total PACIC score from physical training was highest in the outpatient clinic, while dietary counselling yielded the highest increase in total PACIC score when it occurred in the municipality (Table 4).

## **Contact with the healthcare system**

The total PACIC score increased with the number of annual GP visits ( $p = 0.02$ ) and decreased with the number of emergency department visits ( $p = 0.005$ , Tables 3 and 4). No consistent pattern occurred for the subscales. The patient activation subscale score decreased with the number of readmissions ( $p = 0.009$ ) and for patients with a stroke diagnosis ( $p = 0.04$ ) but increased with the number of annual GP visits ( $p = 0.01$ ). Delivery system design/decision support subscale scores were lower for patients with a stroke diagnosis ( $p = 0.005$ ) or a chronic heart condition ( $p = 0.02$ ) and decreased with the number of outpatient contacts ( $p = 0.04$ ) and planned hospitalisations ( $p = 0.04$ ). Goal setting subscale scores decreased with the number of acute hospitalisations ( $p = 0.007$ ) and increased with multimorbidity status ( $p = 0.04$ ). Problem-solving/contextual counselling subscale scores decreased with the number of emergency department visits ( $p = 0.01$ ) and increased with multimorbidity status ( $p = 0.04$ ). Follow-up/coordination subscale scores increased with the number of GP visits ( $p = 0.009$ ) and decreased as emergency department visits increased.

## **Discussion**

The study showed that central factors important to the quality of care are having a GP or hospital outpatient clinic as the primary organization for diabetes care, participating in a rehabilitation programme, and having an increased number of GP visits. Compared to other healthcare systems, the low total PACIC score on 2.44 suggests a potentially lower quality of diabetes care in Denmark from the patients' perspective. The validation of the PACIC scale in a Danish context showed an acceptable ceiling effect and inter-item correlation, but floor effects persist for several items.

### ***Study population***

The gender distribution in our study population is consistent with earlier reports that men represent a higher proportion of the population with type 2 diabetes, with the standardised proportion ratio ranging from 1.1 to 1.4 in 1999-2011 [17]. The comparable

ratio in our study population was 1.4, which differed significantly from 1.0 ( $p < 0.0001$ ). The study population, in which 78.4% were older than 60 years, was much older than the general population in Denmark, where 20% are older than 65 years [18]. The proportion of individuals with less than a high school education in the study population was 80.7%, and thus higher than the 73% in the general population [16]. The lower educational level in the diabetes population is as expected and like other clinical studies, making the representativeness acceptable.

#### ***Quality of diabetes care and factors important to the quality of care***

The lower total PACIC scores in all five subscales from patients receiving care primarily from their GP or a private specialist, compared to those receiving it at the hospital outpatient clinic, may result from patients perceiving hospitals to provide a higher level of specialist care. Also, patients with severe complications primarily receive hospital care and thus may receive more attention to their health status, which may result in a higher total PACIC score.

Participation in a rehabilitation programme was, in general, associated with higher both total and subscale PACIC scores. The organisations receiving the highest mean total PACIC scores varied with the type of diabetes rehabilitation provided. GP-generated patient education scored highest, 0.47 higher than patient education in the municipality. Patients receiving physical training in the hospital scored 0.22 higher than patients training in the municipality. Dietician advice in the municipality scored 0.14 higher than in the GP setting. The varying total scores for sites and types of rehabilitation may point to opportunities for inter-organisational learning and improvement.

The PACIC score decreased significantly with an increasing number of emergency department visits and has not been previously reported. Experiencing an acute event in and of itself may cause a negative perception of the healthcare system. Also, declining health might cause more contacts with the healthcare system, which increases the risk of receiving insufficient care and getting a negative view of the general healthcare system. An increasing number of readmissions is followed by a decreasing mean score for the patient activation subscale and might be related to respondents interpreting readmissions as low-quality care.

Longer education negatively impacted the mean score for the goal setting and follow-up/coordination subscales, possibly due to well-educated patients not perceiving goal setting as relevant. The mean score for the delivery system design/decision support subscale was significantly lower for respondents living in planning area three, but with no differences between mean subscale scores for patients living in the other planning areas after covariate adjustments. This may be explained by the characteristics of planning area three, which includes some of the most affluent communities. The healthcare utilisation pattern in area three differs from the other areas in the region; there is greater use of specialists in private practice and less use of outpatient visits and bed days. The impact of age on the total PACIC score was nonlinear, with no significant effect up to 60-70 years, where a steep decline occurred, and the estimated score dropped to approximately 2.2 at the age of 85 years (Figure 1). To our knowledge, this effect has not previously been reported [6, 8]. Potential explanations include the possibility of treatment being perceived as less effective and failing to meet expectations due to age-related increases in disease severity and comorbidity. Also, as patients develop additional age-related conditions, they encounter more healthcare professionals. All subscales except follow-up/coordination were significantly related to age.

#### ***Assessment of PACIC questionnaire – imputation ceiling and floor effect and CFI and TLI estimates***

With an increase in the study population of 10.6% after imputation, the relevance of imputation is debatable. However, analyses comparing PACIC scores as a whole and stratified by sociodemographic variables revealed a consistent tendency towards lower PACIC scores for respondents with imputed values, compared to respondents completing all items. This introduces an upward bias in the population consisting of respondents answering all twenty items. A potential explanation is that the number of items answered decreased with age, which was also associated with lower total PACIC scores beginning around age 70 (Figure 1). However, other characteristics of partial non-respondents may affect the PACIC scores. Thus, using imputed values was considered an appropriate improvement in the representativeness of the dataset.

The levels of floor and ceiling effects call for further investigation on specific items, particularly for those with high floor effects. The inter-item correlation is acceptable according to a lower limit of 0.15 [19], just as the item-rest correlation for fifteen of twenty items was higher than the maximum correlations with other scales, indicating item convergence within subscales. The values of

Cronbach's alpha met acceptability criteria according to McDowell [20] and Sitzia [21]. Factor loadings from the confirmatory factor analysis were high. The model  $\chi^2$  test was strongly significant (Table 5). While undesirable, it is commonly seen in studies with large sample sizes (as ours and lower), even if the model is appropriate [22]. CFI and TLI estimates were slightly below the lower limit of 0.90 for acceptable fits [23], while RMSEA and SRMR appeared below upper the upper limits, 0.10 and 0.08, respectively, for acceptable fits [23, 24]. The evaluation of the PACIC questionnaire in this setting is thus consistent with a similar evaluation in Maindal [8] and surpasses it with respect to inter-item and item-rest correlation. In summary, while challenges persist in the form of floor effects for several items, the data characteristics indicate that PACIC is a relevant tool for assessing patient-centred chronic care in Danish settings.

## Limitations

The statistical significance should be interpreted cautiously due to many investigated effects; the significance levels of  $p > 0.01$  possibly arose from numerous comparisons. However, some of these findings with significant but high p-values are supported by patterns across the subscales, e.g. the effect of physical training in the municipality. Statistical significances with  $p < 0.001$  are not questionable as this corresponds to a full Bonferroni correction.

## Conclusion

In conclusion, the PACIC questionnaire has potential as a tool measuring regular assessment of patient's perspectives on the quality of care in a diabetes population. The PACIC questionnaire can document areas that need to be improved in the three healthcare organizations; hospitals, communities, and general practice offices.

## Abbreviations

PACIC: The Patient Assessment of Chronic Illness Care; CCM: the Chronic Care Model; GP: general practitioner; EM: the expectation-maximisation; RMSEA: the Root Mean Square Error of Approximation; SRMR: the Standardized Root Mean Square Residual; TLI: the Tucker-Lewis Index; CFI: the Comparative Fit Index.

## Declarations

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### Authors' contributions

AF and AS conceptualized, designed, and led the study. AS designed and analysed the data. AF, AS, CG, HB, CUE, and AS interpreted the results, wrote, revised, and critically reviewed the manuscript. CG and AF drafted and performed the data collection by sending emails to the selected patients. All authors have read and approved the manuscript.

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## Availability of Data and Materials

The data used to support the findings of this study are available from the corresponding author upon request.

## Ethics approval and consent to participate

According to The Danish National Committee on Health Research Ethics, (section 14(2) of the Committee Act), no formal ethics approval is needed when using questionnaires that do not involve human biological material [25]. According to the Helsinki Declaration [1], the participants received information about the study. They were informed about the possibility to withdraw from the study; that their participation was voluntary; and that their anonymity would be maintained. After agreeing to participate, the participants provided written informed consent.

## Consent for publication

Not applicable for this study

## Competing interests

The authors have no conflicts of interest to declare.

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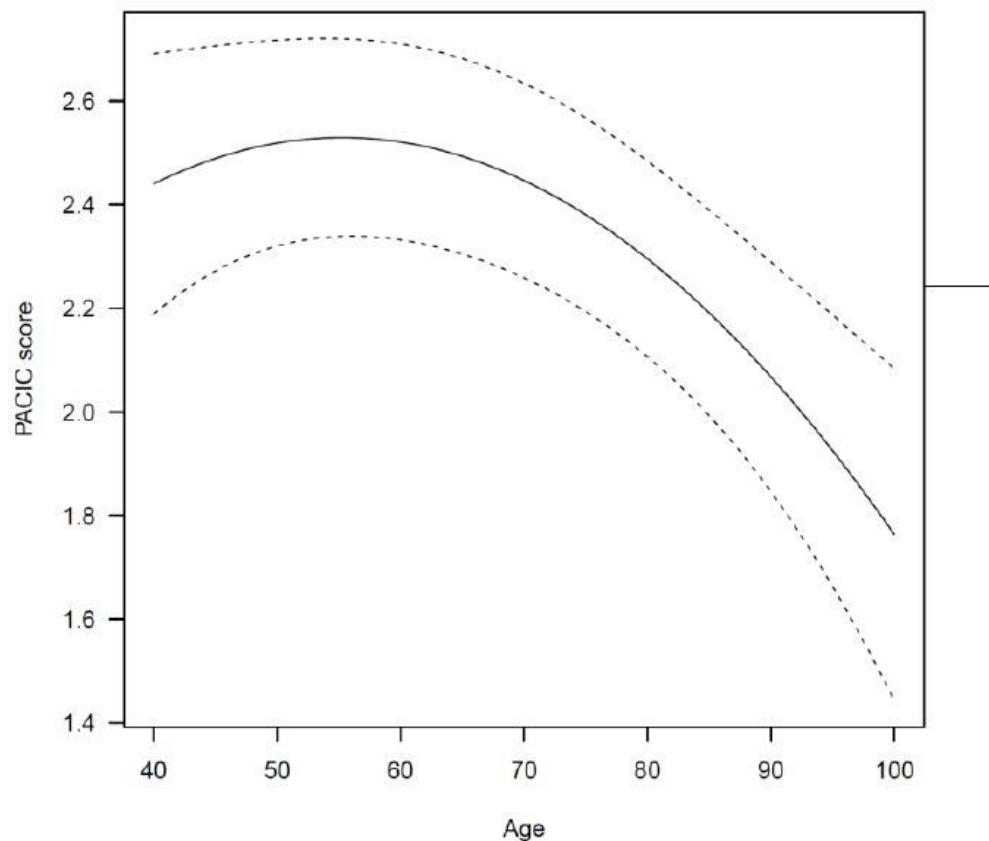
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## Figures



Upper and lower bounds of  
95% confidence interval

**Figure 1**

The effect of age on total PACIC score after adjusting for all other covariates

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [supplementaryfigure1.pdf](#)