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ORIGINAL RESEARCH

Non-Attendance in Hospital Appointments Based on Data From the Entire Region of Southern Denmark: Descriptive Analyses and Predictive Factors

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Purpose: We aimed to analyse the characteristics related to non-attendance at general outpatient hospital clinics in patients aged ≥18 years. An increased focus has been directed towards patient non-attendance at hospital appointments as it is related to patient risk and waste of resources in the healthcare system.

Patients and Methods: In this cohort study, we retrieved data from the entire Region of Southern Denmark on i) non-attendance from the electronic medical journals from January 1, 2021 until December 31, 2022, and ii) data on all attended appointments from Danish health registries in the same period. We analysed the overall proportion of non-attendance, and characteristics of patients with non-attendance, relative to those who attended an appointment. We examined hospital type and patient demographics (age, sex, comorbidity, socioeconomic factors).

Results: Included were 614,157 patients, of which 12,244 were patients with a first non-attendance and 601,913 patients with a first attended appointment. The overall non-attendance proportion was 2.0%. The most prevalent type of underlying disease among non-attendant patients was musculoskeletal/connective tissue diseases (10%), which was also the most prevalent group of diseases among patients who attended hospital appointments (11%). In the regression model, compared to those who attended, the two strongest associations for non-attendance were patients aged 18–34 years, aOR=2.69 (95% CI 2.52–2.85), and patients diagnosed with mental/behavioral disorders, aOR=2.60 (95% CI 2.39–2.82). Other sociodemographic factors were associated with non-attendance including male sex (aOR=1.90 (95% CI 1.82–1.96)), patients aged 35–54 years (aOR=1.89 (95% CI 1.78–2.01)), living alone (aOR=1.72 (95% CI 1.65–1.79)), and not Danish nationality (aOR=1.65 (95% CI 1.57–1.74)).

Conclusion: Based on data from the Region of Southern Denmark (corresponding to 20% of the Danish population), the non-attendance proportion was low (2.0%). More research is needed, including other data-sets validating our findings, validation of registration practices, and qualitative research aspects of non-attendance.

Keywords: hospital appointments, specialized hospital, regional hospitals, non-attendance, cancellation, organization, failed appointments

Introduction

The extent of the problem related to failed scheduled outpatient hospital appointments is not well described. Neither the reasons for failed appointments nor the consequences for the patients are detailed.[1–3] The reasons for failed scheduled hospital appointments are beyond doubt complex, and may include a variety of reasons including misunderstandings

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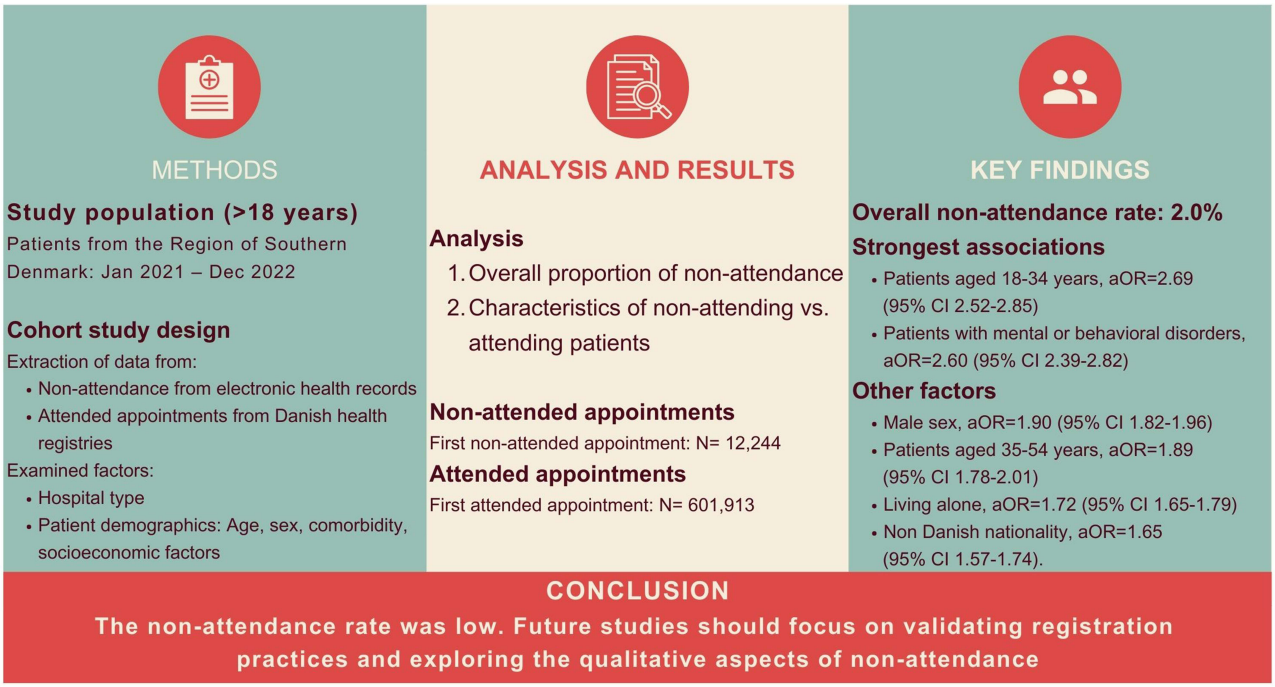
Graphical Abstract



between the staff from the departments and the patients, cancellation of appointments from the health provider, misunderstandings due to language barriers, organisational shortcomings (eg failures in the booking system and invitations that are received by the patients so late that it is impossible for them to comply with the appointment), non-attendance, etc.[1,4,5] Non-attendance is thus one of many reasons for failed scheduled hospital appointment, and this study only focuses on non-attendance. An appointment is defined as "non-attendance" when a patient does not show up for a scheduled appointment without prior notification.

Beginning in the 2000s, Danish hospitals started reporting on the challenges caused by patient non-attendance. In the 2010s, non-attendance became part of a larger political and media debate, with the Danish media and regional authorities increasingly publishing data on missed appointments, highlighting the economic consequences and wasted resources in the healthcare system.[1,4–6] It is suggested that up to 25–35% of all scheduled appointments in outpatient clinics are failed appointments.[6,7] When accounting for cancellation from the provider or the user, studies have suggested that non-attendance accounts for 5–10% of appointments in general hospitals in Western countries.[6–10] However, it has been shown in international literature that there is a large diversity in reported non-attendance rates.[5]

In Denmark, the problem related to non-attendance has often been framed as a problem caused by patients, with the majority of interventions targeting the patient (eg, fines, compensation fees, text message reminders, etc).[6] Other interventions included the introduction of online booking systems. However, some studies have emphasized that non-attendance from hospital appointments in the healthcare system is caused by errors on behalf of the hospital and/or is related to technical/communicative challenges (eg invitations in booking systems that do not reach the patient or invitations that are misinterpreted). These studies have suggested that up to 40% of non-attendances are caused by errors from the hospital side or technical challenges.[11–13]

Despite numerous interventions aimed at preventing non-attendance among patients, we still lack knowledge about the patient characteristics associated with non-attendance on a large scale. Several of the existing studies are based on small study populations and selected data from specific departments or hospitals.[7–9,13] Therefore, based on a large unselected study population, we aimed i) to estimate the overall non-attendance proportion among patients scheduled to

attend an outpatient visit at general hospital wards, and ii) to study the influence of patient characteristics related to non-attendance and attendance of scheduled appointments. Our data are based on information from an entire region of Denmark, the Region of Southern Denmark, covering one-fifth of the Danish population.

Materials and Methods

Setting and Design

Denmark follows the Nordic welfare model, providing its citizens with financial safety, welfare, and health services. All citizens (population approximately 5.9 million inhabitants, >90% Caucasians) have free and equal access to a uniform organized, and tax-supported, healthcare system.[14] In Denmark, it is mandatory to report all activities in the healthcare system into the national health registers, and this allowed us to perform a cohort study.[7,15–18] All Danish residents are assigned a civil registration number from birth, which allows a unique linkage across Danish registries on an individual level. The Central Personal Registration system includes information on civil registration number, and information on residency, sex, death, nationality, and emigration/immigration.[19]

Digital communication between Danish citizens and the healthcare sector has become increasingly important. The Electronic/Digital Mail System is a key platform for communication between the healthcare system and citizens and is mandatory for everyone over the age of 15. It was introduced in Denmark in 2001 as a digital mailbox for citizens and businesses. Since 2010, the Digital Mail System has increasingly been used by public authorities (including healthcare) for digital communication with citizens, becoming an integral part of communication and appointment management in the healthcare sector. If the appointment is inconvenient for the patients, they can reschedule or cancel it by contacting the hospital department by phone. Rescheduling, canceling, and non-attendance do not incur any additional fees.

Study Population and Study Period

The study population was based on all adult persons (≥18 years of age), who were residents in the Region of Southern Denmark in the region from January 1, 2021 until December 31, 2022 (study period). Among these we included those who had at least one non-attendance, or one attended scheduled outpatient hospital appointment at a general hospital ward (the term "general" is used for visits at all non-psychiatric wards). We, thus, excluded appointments that were categorized as failed unless they had non-attendance as a cause (for instance, we excluded appointments cancelled by the patient and appointments cancelled by the hospital) (Supplementary Figure 1). The inclusion of non-attending and attended scheduled appointments was independent of the underlying reason for an appointment.

Data Sources

The structure of the data and the cohort assessments is shown in Figure 1. We obtained data from the following registries/databases. Information on all attended appointments (ie the patients showed up for the appointment) was retrieved from the National Patient Registry (NPR). Since 1977, the NPR has included key information on dates of hospital admission and discharge, and disease diagnoses.[18]

The NPR does not provide information on failed appointments and, therefore, also not on non-attendance. Consequently, we obtained data from the Electronic Patient Journal (EPJ) in the Region of Southern Denmark to collect information on failed scheduled appointments. From these failed appointments, we only included data on non-attendance (please see Supplementary Figure 1 for an overview of variables regarding non-attendance from the EPJ system). The occurrence of non-attendance is registered on a daily basis into the EPJ, as the health providers construct a schedule based on whether a patient has attended an appointment or not.

Covariates

Covariates were calculated based on information on the date of first appointment in the study period, and information on covariates was retrieved from several Danish nationwide registries. We included data on socioeconomic variables from the Income Statistics Register,[20] and from the Population Education Register.[21] Information on patient's employment

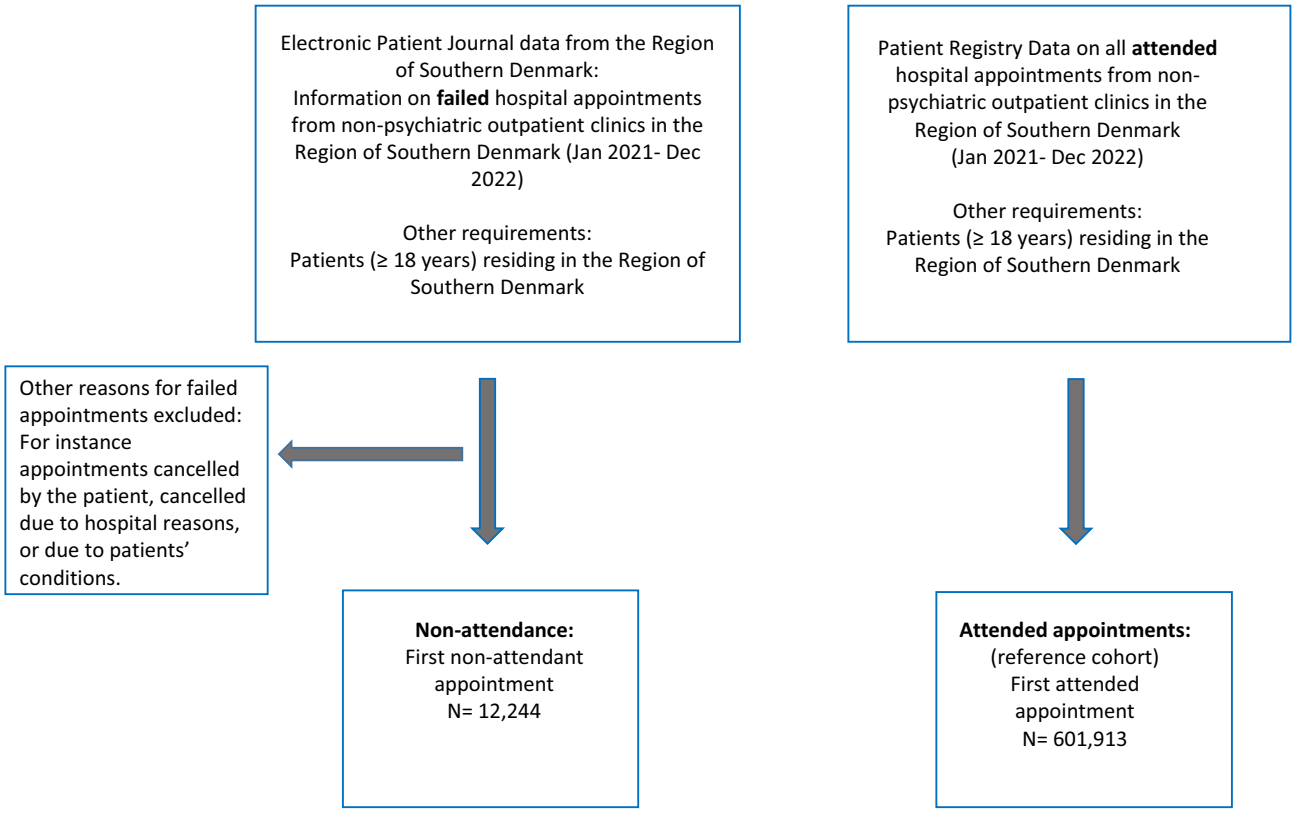


Figure 1 Data structure, collection of data, and assessment of study cohorts of non-attendance and attended appointments.

status was retired from the Danish Register for Evaluation of Marginalization (DREAM), and this registry contains weekly updated information on all tax-financed social benefits paid to Danish residents from 1991.[22]

From the NPR, we obtained discharge diagnoses that were classified according to the International Classification of Disease System 10th revision (ICD-10). Based on these, we defined the following variables: type of hospital (largest hospital in the region with specialty functions or other regional hospitals), patient age at time of first appointment in the study period, sex, and nationality (Danish, not Danish), cohabitation status, children in the household, working status, economic status, and education level. The variable on economic status was defined as 0 - "low" if the patient's income, based on age groups and sex, was lower than the median of persons income for that patients group, and 1 – high if the income was equal to or higher than the median. Information on the patient's highest completed education was defined by three categories: low (municipal primary and lower secondary school), medium (upper secondary school), and high (higher education including bachelor, masters, and doctoral levels). Information on patient's employment status was classified according to four categories: working, on a pension, on a sick leave, unemployed. Regarding comorbidity we included information on hospital diagnosed diseases one year prior to the date of first appointment according the following categories: Infections (ICD-10: A*-B*), tumors (ICD-10: C*-D*), diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (ICD-10: D*), endocrine diseases (ICD-10: E*), psychiatric diseases (F*), diseases of the nervous system (ICD-10: G*), diseases of the cardiovascular system (ICD-10: I*diseases of the respiratory system (ICD-10: J*), diseases of the gastrointestinal tract (ICD-10 K*), diseases in bone, muscles, and connective tissue (ICD-10 M*), diseases in the urinary tract and sex organs (ICD-10: N*), where * indicates that all subgroups are included.

Statistical Analyses

In all main analyses, each patient was included according to their first non-attendant appointment or their first attended appointment in the study period. A descriptive table including baseline characteristics was constructed for patients with

non-attendance and those who attended an appointment. We also stratified, and presented, the baseline variables according to hospital type, i) one large hospital with specialized functions in the Region of Southern Denmark and ii) other four hospitals in the region.

Using univariable and multivariable logistic regression models, we computed crude and adjusted odds ratios (ORs), with 95% confidence intervals (95% CI), for the potential predictive factors associated with non-attendance, relative to patients who attended their appointment. The model was exploratory in nature and was not designed to assess causal questions. In the multivariable logistic regression models, we performed a forward stepwise selection based on significance including following variables in the model: hospital type, age, sex, nationality, cohabitation status, number of children in household, working status, family's economic status, education level, number of appointment with the hospital within one year prior to the date of first appointment, and type of hospital diagnosed diseases within one year prior to date of first appointment. All these factors were thus mutually adjusted in the model. For all variables, the category with the highest number served as the reference.

We had complete and updated data from the Income Statistics Register, Population Education Register, and NPR, and there were only negligible per mille of missing data on a few of our key variables. Data from DREAM were available up to November 7, 2022. The missing information on covariates was independent of the patient characteristics and therefore performed complete case analyses were unbiased.

We examined whether interaction occurred between the variables by fitting different logistic regression models, adjusting for combinations of factors. We did not find interactions. For each model, we calculated the Area Under the Receiver Operating Characteristic Curve (AUC) to assess the model fit.

In a sub-analysis, we included all appointments in the study period. Many patients had several appointments in the study period, and to give an overview of all appointments, and not only the first appointment in the study period, we calculated overall numbers and non-attendance proportion.

All analyses were performed in Stata (version 18, Stata Corp LLC, College Station, TX, USA).

Results

Table 1 shows the patient characteristics for the first appointment (non-attendance or attended appointments) for each patient in the study period, and these characteristics are presented overall, and stratified according to hospital type. Overall, there were 614,157 first appointments, of which 12,244 were non-attendance and 601,913 were attended

Table 1 Patients Characteristics for the Study Cohort of Those With Non-Attendance and Those With Attended Appointments Based on Data From the Region of Southern Denmark, January 1, 2021 Until December 31, 2022

	Total N=614,157		**Hospital with Specialized Functions N=284,965**		**Other Regional Hospitals N=329,192**	
	Non-attendance	**Attended**	**Non-attendance**	**Attended**	**Non-attendance**	**Attended**
Number of patients	12,244	601,913	6,070	278,895	6,174	323,018
Age, year						
18–34	3,991 (32%)	109,244 (18%)	2,134 (35%)	47,423 (17%)	1,857 (30%)	61,821 (19%)
35–54	3,972 (32%)	168,172 (27%)	1,851 (31%)	76,231 (27%)	2,121 (34%)	91,941 (29%)
55–74	2,888 (23%)	234,130 (38%)	1,410 (23%)	121,154 (43%)	1,478 (24%)	112,976 (35%)
75-	1,393 (11%)	90,367 (15%)	675 (11%)	34,087 (12%)	718 (11%)	56,280 (17%)
Sex						
Men	6,917 (56%)	247,775 (42%)	3,358 (55%)	95,545 (34%)	3,559 (57.6%)	152,230 (47%)
Women	5,327 (43%)	354,138 (58%)	2,712 (45%)	183,350 (66%)	2,615 (42.4%)	170,788 (53%)
Danish nationality						
Yes	9,839 (80%)	544,026 (90%)	4,905 (81%)	253,742 (91%)	4,934 (79.9%)	290,284 (90%)
No	2,405 (19%)	57,887 (9.6%)	1,165 (19%)	25,153 (9.1%)	1,240 (20.1%)	32,734 (10%)

(*Continued*)

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Table 1 (Continued).

	Total N=614,157		Hospital with Specialized Functions N=284,965		Other Regional Hospitals N=329,192	
	Non-attendance	Attended	Non-attendance	Attended	Non-attendance	Attended
Cohabitation status						
Living alone	5,874 (48%)	187,168 (31%)	2,970 (49%)	86,587 (31%)	2,904 (47.0%)	100,581 (31%)
Living with a partner	6,370 (52%)	414,745 (69%)	3,100 (51%)	192,308 (69%)	3,270 (53.0%)	222,437 (69%)
Children in household						
Yes	3,285 (26%)	134,748 (22%)	1,585 (26%)	54,646 (20%)	1,700 (27.5%)	80,102 (25%)
No	8,959 (73%)	467,165 (78%)	4,485 (74%)	224,249 (80%)	4,474 (72.5%)	242,916 (75%)
Working status[a]						
Working	6,870 (56%)	325,412 (54%)	3,435 (57%)	157,296 (56%)	3,435 (55.6%)	168,116 (52%)
On pension	3,701 (30%)	219,271 (36%)	1,840 (30%)	96,373 (35%)	1,861 (30.1%)	122,898 (38%)
On sick leave	728 (5.9%)	35,019 (5.8%)	335 (5.5%)	14,446 (5.2%)	393 (6.4%)	20,573 (6.4%)
Unemployed	945 (7.7%)	22,211 (3.7%)	460 (7.6%)	10,780 (3.9%)	485 (7.9%)	11,431 (3.5%)
Economic status						
Low	4,613 (37%)	113,547(19%)	2,330 (38.4%)	50,599 (18%)	2,283 (37.0%)	62,948 (19%)
High	7,631 (62%)	488,366 (81%)	3,740 (61.6%)	228,296 (82%)	3,891 (63.0%)	260,070 (81%)
Education level						
Low	4,705 (38%)	156,158 (26%)	2,219 (36.6%)	66,423 (24%)	2,486 (40.3%)	89,735 (28%)
Medium	4,815 (39%)	260,320 (43%)	2,417 (39.8%)	118,826 (43%)	2,398 (38.8%)	141,494 (44%)
High	2,402 (19%)	177,686 (29%)	1,280 (21.1%)	90,366 (32%)	1,122 (18.2%)	87,320 (27%)
Unknown	322 (2.6%)	7,749 (1.3%)	154 (2.5%)	3,280 (1.2%)	168 (2.7%)	4,469 (1.4%)
Number of appointments with hospital in a year before						
0	6,042 (49%)	251,874 (42%)	3,008 (50%)	129,040 (46%)	3,034 (49%)	122,834 (38%)
1–5	4,450 (36%)	261,621 (43%)	2,200(36%)	113,602 (41%)	2,250 (36%)	148,019 (46%)
>5	1,752 (14%)	88,418 (15%)	862 (14%)	36,253 (13%)	890 (14%)	52,165 (16%)
Certain infectious and parasitic diseases (A-B)						
Yes	357 (2.9%)	7,663 (1.3%)	236 (3.9%)	3,612 (1.3%)	121 (2.0%)	4,051 (1.3%)
No	11,887 (97%)	594,250 (99%)	5,834 (96%)	275,283 (99%)	6,053 (98%)	318,967 (99%)
Neoplasms (C-D4)						
Yes	431 (3.5%)	28,553 (4.7%)	233 (3.8%)	12,819 (4.6%)	198 (3.2%)	15,734 (4.9%)
No	11,813 (96%)	573,360 (95%)	5,837 (96%)	266,076 (95%)	5,976 (97%)	307,284 (95%)
Diseases of the blood and blood-forming organs (D5-D8)						
Yes	104 (0.9%)	3,631 (0.6%)	47 (0.8%)	1,595 (0.6%)	57 (0.9%)	2,036 (0.6%)
No	12,140 (99%)	598,282 (99%)	6,023 (99%)	277,300 (99%)	6,117 (99%)	320,982 (99%)
Endocrine, nutritional and metabolic diseases (E)						
Yes	865 (7.1%)	21,660 (3.6%)	499 (8.2%)	9,295 (3.3%)	366 (5.9%)	12,365 (3.8%)
No	11,379 (92%)	580,253 (96%)	5,571 (92%)	269,600 (97%)	5,808 (94%)	310,653 (96%)
Mental and behavioral disorders (F)						
Yes	920 (7.5%)	17,788 (3.0%)	406 (6.7%)	6,886 (2.5%)	514 (8.3%)	10,902 (3.4%)
No	11,324 (92%)	584,125 (97%)	5,664 (93%)	272,009 (97%)	55,660 (92%)	312,116 (97%)
Diseases of the nervous system (G)						
Yes	587 (4.8%)	19,761 (3.3%)	217 (3.6%)	7,667 (2.8%)	370 (6.0%)	12,094 (3.7%)
No	11,657 (95%)	582,152 (97%)	5,853 (96%)	271,228 (97%)	5,804 (94%)	310,924 (96%)
Diseases of the eye or ear (H)						
Yes	692 (5.7%)	34,573 (5.7%)	397 (6.5%)	14,516 (5.2%)	295 (4.8%)	20,057 (6.2%)
No	11,552 (94%)	567,340 (94%)	5,673 (93%)	264,379 (95%)	5,879 (95%)	302,961 (94%)

(*Continued*)

Table 1 (Continued).

	Total N=614,157		Hospital with Specialized Functions N=284,965		Other Regional Hospitals N=329,192	
	Non-attendance	Attended	Non-attendance	Attended	Non-attendance	Attended
Diseases of the circulatory system (I)						
Yes	736 (6.0%)	33,446 (5.6%)	339 (5.6%)	12,546 (4.5%)	397 (6.4%)	20,900 (6.5%)
No	11,508 (94%)	568,467 (94%)	5,731 (94%)	266,349 (95%)	5,777 (94%)	302,118 (93%)
Diseases of the respiratory system (J)						
Yes	465 (3.8%)	14,520 (2.4%)	227 (3.7%)	6,301 (2.3%)	238 (3.8%)	8,219 (2.5%)
No	11,779 (96%)	587,393 (98%)	5,843 (96%)	272,594 (98%)	5,936 (96%)	314,799 (97%)
Diseases of the digestive system (K)						
Yes	833 (6.8%)	30,110 (5.0%)	410 (6.7%)	12,824 (4.6%)	423 (6.8%)	17,286 (5.4%)
No	11,411 (93%)	571,803 (95%)	5,660 (93%)	266,071 (95%)	5,751 (93%)	305,732 (95%)
Diseases of the skin and subcutaneous tissue (L)						
Yes	380 (3.1%)	10,682 (1.8%)	268 (4.4%)	5,864 (2.1%)	112 (1.8%)	4,818 (1.5%)
No	11,864 (97%)	591,231 (98%)	5,802 (96%)	273,031 (98%)	6,062 (98%)	318,200 (98%)
Diseases of the musculoskeletal system and connective tissue (M)						
Yes	1,238 (10.1%)	64,067 (10.6%)	478 (7.9%)	25,565 (9.2%)	760 (12.3%)	38,502 (11.9%)
No	11,006 (90%)	537,846 (89%)	5,592 (92%)	253,330 (91%)	5,414 (88%)	284,516 (88%)
Diseases of the genitourinary system (N)						
Yes	682 (5.6%)	25,455 (4.2%)	352 (5.8%)	10,895 (3.9%)	330 (5.3%)	14,560 (4.5%)
No	11,562 (94%)	576,458 (96%)	5,718 (94%)	268,000 (96%)	5,844 (95%)	308,458 (95%)

Notes: [a]Data are available only up to 7th November 2022. The letters in the disease categories refer to the chapters in the International Classification System (ICD-10).

appointments. The overall non-attendance proportion was thus 2.0% (12,244/614,157). The overall proportions of non-attendance at the largest hospital with specialized functions and at the other regional hospitals were 2.1% and 1.9%, respectively. More men than women had non-attendance (56% versus 43%). Among those with non-attendance, 20% did not have Danish nationality, compared to 9.6% in patients who had attended hospital appointment. In patients with non-attendance, 38% had low economic status, compared to 20% in patients who attended an appointment. In those with non-attendance, 38% had low educational level, compared to 26% in patients who attended an appointment. These overall patterns applied to both the largest hospital in the region with specialized functions and the other regional hospitals. Regarding types of underlying disease, the three most prevalent types among non-attendant patients were musculoskeletal/connective tissue diseases (10%), mental/behavioral disorders (7.5%), and endocrine/nutritional/metabolic diseases (7.1%) (Table 1). The three most prevalent types of underlying diseases among patients with attended hospital appointments were musculoskeletal/connective tissue diseases (11%), diseases of the eye/ear (5.7%), and diseases of the circulatory system (5.6%).

Table 2 shows the results from the univariate and the multivariate regression model. In the model, several factors were associated with an increased risk of non-attendance, relative to patients who attended. For the largest hospital with specialty functions, there was an increased risk of non-attendance (aOR=1.27 (95% CI 1.22–1.32), and we also found an increased risk of non-attendance among those who had 1–5 prior hospital appointments (aOR=2.24 (95% CI 2.14–2.35). Regarding sociodemographic factors, the five strongest associations for non-attendance were the following: i) patients aged 18–34 years was aOR=2.69 (95% CI 2.52–2.85), relative to patients aged 55–74 years, ii) male sex was aOR=1.90 (95% CI 1.82–1.96), relative to female, iii) patients aged 35–54 years was aOR=1.89 (95% CI 1.78–2.01), relative to patients aged 55–74 years, iv) living alone was aOR=1.72 (95% CI 1.65–1.79), relative to living with a partner, and v) not Danish nationality was aOR=1.65 (95% CI 1.57–1.74), relative to Danish nationality. Regarding types of underlying diseases, the two strongest predictors for non-attendance were the presence of diagnoses of mental and behavioral

Table 2 Crude and Adjusted Odds Ratios (OR) for Non-Attendance Based on Data From the Region of Southern Denmark, January 1, 2021 Until December 31, 2022

		Univariate	Multivariate[a]
		OR (95% CI)	OR (95% CI)
Hospitals type	Hospital with specialized functions	1.14 (1.10;1.18)	1.27 (1.22; 1.32)
	Other regional hospitals	1 (reference)	1 (reference)
Age	18–34	2.96 (2.82; 3.11)	2.69 (2.52; 2.85)
	35–54	1.91 (1.82; 2.01)	1.89 (1.78; 2.01)
	55–74	1 (reference)	1 (reference)
	75-	1.24 (1.17; 1.33)	0.97 (0.90; 1.04)
Sex	Women	1 (reference)	1 (reference)
	Men	1.86 (1.79; 1.92)	1.90 (1.82; 1.96)
Danish nationality	No	2.30 (2.20; 2.40)	1.65 (1.57; 1.74)
	Yes	1 (reference)	1 (reference)
Cohabitation status	Living with a partner	1 (reference)	1 (reference)
	Living alone	2.04 (1.97; 2.12)	1.72 (1.65; 1.79)
Children in household	No	1 (reference)	1 (reference)
	Yes	1.27 (1.22; 1.32)	1.30 (1.24; 1.37)
Working status	Working	1 (reference)	1 (reference)
	On a pension	0.80 (0.77; 0.83)	1.17 (1.10; 1.25)
	On a sick leave	0.98 (0.91; 1.06)	0.94 (0.86; 1.01)
	Unemployed	2.02 (1.88; 2.16)	1.30 (1.20; 1.40)
Family's economic status	High	1 (reference)	1 (reference)
	Low	2.60 (2.51; 2.70)	1.52 (1.45; 1.59)
Education level	Low	1.63 (1.56; 1.70)	1.42 (1.36; 1.49)
	Medium	1 (reference)	1 (reference)
	High	0.73 (0.70; 0.77)	0.78 (0.75; 0.83)
Number of appointments with hospital in a year before	0	1.41 (1.36; 1.47)	2.24 (2.14; 2.35)
	1–5	1 (reference)	1 (reference)
	>5	1.16 (1.10; 1.23)	0.54 (0.50; 0.58)
Infectious and parasitic diseases (A-B*)	No	1 (reference)	
	Yes	2.33 (2.09; 2.59)	1.97 (1.75; 2.22)
Neoplasms (C-D4*)	No	1 (reference)	
	Yes	0.73 (0.67; 0.81)	1.30 (1.17; 1.45)
Diseases of the blood and blood-forming organs (D5-D8*)	No	1 (reference)	
	Yes	1.41 (1.16; 1.72)	1.35 (1.09; 1.66)
Endocrine, nutritional and metabolic diseases (E*)	No	1 (reference)	
	Yes	2.04 (1.90; 2.19)	2.54 (2.35; 2.75)
Mental and behavioral disorders (F*)	No	1 (reference)	
	Yes	2.67 (2.49; 2.86)	2.60 (2.39; 2.82)
Diseases of the nervous system (G*)	No	1 (reference)	
	Yes	1.48 (1.36; 1.61)	1.91 (1.74; 2.09)
Diseases of the eye or ear (H*)	No	1 (reference)	
	Yes	0.98 (0.91; 1.06)	1.64 (1.50; 1.78)

(*Continued*)

Table 2 (Continued).

		Univariate	Multivariate[a]
		OR (95% CI)	OR (95% CI)
Diseases of the circulatory system (I*)	No Yes	1 (reference) 1.09 (1.01; 1.17)	 1.67 (1.54; 1.82)
Diseases of the respiratory system (J*)	No Yes	1 (reference) 1.60 (1.45; 1.75)	 1.71 (1.55; 1.90)
Diseases of the digestive system (K*)	No Yes	1 (reference) 1.39 (1.29; 1.49)	 1.65 (1.53; 1.78)
Diseases of the skin and subcutaneous tissue (L*)	No Yes	1 (reference) 1.77 (1.60; 1.97)	 2.03 (1.81; 2.26)
Diseases of the musculoskeletal system and connective tissue (M*)	No Yes	1 (reference) 0.94 (0.89; 1.00)	 1.53 (1.43; 1.63)
Diseases of the genitourinary system (N*)	No Yes	1 (reference) 1.34 (1.24; 1.44)	 1.69 (0.11; 0.13)

Notes: *Refers to ICD-10 groups (classification of diseases). [a]In the multivariate model the factors are mutually adjusted.

disorders (aOR=2.60 (95% CI 2.39–2.82)) and the presence of diagnoses of endocrine/nutritional/metabolic diseases (aOR=2.54 (95% CI 2.35–2.75)). The AUC for univariate analyses was very similar, and only varied from AUC=0.50 (95% CI 0.49–0.50) for comorbidity "Diseases of the eye or ear" to AUC=0.59 (95% CI 0.58–0.60) for economic status. The final model that includes all the examined factors had the best fit with AUC=0.74 (95% CI 0.73–0.74).

In the sub-analyses, where we included all appointments in the study period (and not only the first contact), we recorded a total of 80,351 registrations of non-attendance (39,890 occurred at the hospital with specialized functions (50%), and 40,461 (50%) occurred at other regional hospitals). The total number of attended appointments in the region constituted 3,806,042, of which 1,647,014 (43%) attended appointments at the hospital with specialized functions, and 2,159,028 (57%) were at other regional hospitals. When we analysed all appointments, instead of the first appointment for each patient as in the main analyses, the overall proportion of non-attendance in the region was 2.1%, and the corresponding proportion for the hospital with specialized functions was 2.4% and for other regional hospitals 1.8%.

Discussion

Based on data from the entire Region of Southern Denmark (corresponding to 20% of the Danish population), we present results on patient non-attendance from general outpatient hospital clinics. The overall non-attendance proportion was low (2.0%). The most prevalent type of underlying disease among non-attendant patients was musculoskeletal/connective tissue diseases (10%), which was also the most prevalent underlying disease in those who attended hospital appointments (11%). Compared to patients who attended a hospital appointment, several factors were statistically significantly associated with an increased risk of non-attendance, and the two strongest associations were found for patients aged 18–34 years (2.69-fold increased risk), and for patients with underlying diagnoses of mental/behavioral disorders (2.60-fold increased risk). Other sociodemographic factors predicting non-attendance were male sex, patients aged 35–54 years, patients living alone, and non-Danish nationality.

To the best of our knowledge, this is the first time that large scale Danish data on patient non-attendance have been presented and compared to patients who attended an appointment. The overall proportion of non-attendance appointment in the region was lower than reported in other studies.[5,7,8] Comparison of our results with other studies is complicated by the lack of published data based on an entire region. In recent years, the proportion of non-attendance may have declined because an increased focus has been directed towards reducing the number of non-attending patients. Still, our proportion of non-attendance may be erroneously low if healthcare providers are not meticulous in recording patients with non-

attendance in the EPJ. Possible reasons for differences in other reported non-attendance proportions may include variations in registration practices, differences in the definition of non-attendance, and the fact that our study includes all general departments, rather than focusing on specific departments that may already receive particular attention.

Non-attendance proportions have been examined in other settings in Denmark, but based on smaller study populations and restricted to specific departments. Data from 2013 to 2015, from an orthopaedic and a radiologic outpatient clinic, showed that 4–5% had non-attendance.[8] Based on data from a region hospital (2013–2015), on patients undergoing hospital outpatient treatment for chronic diseases, showed a non-attendance proportion of 5%.[7] The latter study found that young age (particularly patients aged 18–29 years), the male sex, an unmarried status, low education level, and receipt of long-term welfare payments were all predictors of non-attendance. These predictors were overall consistent with the findings in our study. Vaeggemose et al performed an interesting questionnaire study on 71 patients, based on data from 2015 to 2017, and examined the reasons for non-attendance.[13] The most striking result was that the main reasons for non-attendance were due to unawareness that the appointment was sent through the Digital Mail System not checking the Digital Mail System or miscommunication with the hospital about cancelation.[13]

Former studies have shown that there is a large difference in non-attendance across countries, due to demographic composition, country culture, organization of healthcare system and degree of digitalization, among other factors.[4,5] In a comprehensive review from 2018, Dantas et al tried to synthesize the literature in this area, and among 727 articles, 105 were selected for analysis.[5] According to this study, the overall non-attendance proportion was 23%, being highest in the African continent (43%) and lowest in Oceania (13.2%).[23] Our results on non-attendance are very different from the proportions reported by Dantas et al in 2018, which highlights the difficulties when comparing non-attendance across various continents and countries. These dissimilar results can also be caused by studies applying different methodologies, as the definition of non-attendance is inconsistent, and applied to non-comparable study populations, for instance, are data from both primary care and hospitals included? Are psychiatric patients, and other very vulnerable groups, included?[5] A new review by Alturbag was published in 2024 and was based on articles across the world examining several sociodemographic factors.[4] The review concluded that various study designs, different study sizes, and many different statistical methods were utilized. In general, however, younger patients and male patients were more prone to non-attendance, married patients were less likely to have non-attendance, and patients referred by general practitioners had greater tendency to non-attendance than those referred by specialists.[4] Several of these findings concur with our results. The reason for different proportions of non-attendance across published studies may also be due to the fluctuating quality of data in this area. Data may be subject to problems related to non-validated data from patient records and may be highly dependent on how, and to what extent, non-attendance is registered in a consistent manner into the EPJ systems. Despite challenges with comparability across studies in the area of non-attendance, attempts to identify factors associated with non-attendance point to younger age, male sex, patients living alone, and vulnerability among certain populations.[4,5]

This study has several strengths. The main strength is that we have included data on an entire region in Denmark, and we have complete data on all patients with residency in the Region of Southern Denmark, which minimize the risk of selection bias. Due to the size of the conducted study, we have results with very high statistical precision. Given the high quality of nationwide health registries in Denmark, it is a major strength that we could link all patients to health registries and retrieve information on several sociodemographic variables.[18,19,21]

There are several limitations to address. The validity of study results depends on the quality of data, including data from central health registries and non-attendance data from the EPJ system. In particular, registrations in the EPJ system may be subject to variability in registration practices, and studies on their validity and consistency are lacking. Also, we cannot rule out that other predictive factors, than those included in our model, could have an impact on non-attendance, but we were limited to the available information retrieved from the health registries. We thus expect that unknown factors, which are not collected in the health registries, may also have an influence on non-attendance. Lastly, qualitative data on patients and healthcare professionals' experiences and challenges with non-attendance would be beneficial, and could cast light on some of the underlying factors related to non-attendance. It was beyond the scope of this study to perform interviews with healthcare professionals and patients on the reasons for non-attendance, or to perform qualitative supplementary data collections, but it will be addressed in a future parallel study.[1] Regarding the generalizability of our results, our finding may not apply to healthcare systems very different from the Danish healthcare system.

Conclusion

Comprehensive data, based on data from the Region of Southern Denmark, showed that the overall proportion of non-attendance is lower than other studies have previously reported. Consistent with other studies, we found that non-attendance was associated with younger age, and vulnerability among certain populations (for instance patients diagnosed with mental/behavioral disorders and patients living alone). Initiatives targeted at sub-populations should be considered, but additional qualitative and quantitative data are needed before appropriate interventions can be applied. It would be beneficial to have analyses on non-attendance among the most vulnerable patients, particularly examining whether there are specific challenges faced by patients with mental or behavioral issues when attending appointments in general hospital wards.

Data Sharing Statement

We are not allowed to share patient data with others. The authors of this paper do not have special access privileges to the data used here. Other researchers can apply for access to the Danish data through an application to the Region of Southern Denmark and to the Research Service at Statistics Denmark. Access to Danish data requires approval from the Danish Data Protection Agency.

Approvals and Ethics

The study is approved in the Region of Southern Denmark/the Danish Data Protection Agency (journal number 22/54791). The study follows all currently applicable Danish laws regarding scientific research. In Denmark, no ethical approvals for register-based studies are necessary. There was no contact with the patients included in this study, and the study was non-interventional.

Patient and Relative Involvement

Patient and relative representatives are part of the research council at the Center for Clinical Epidemiology, and at the Centre for Research in Patient Communication, Odense University Hospital. These members have been involved in the discussion of the ideas of the study and of the study results. Patient and public representatives have not been part of the design of the study, data analyses, nor in the writing of the manuscript.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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