Is increased primary health care use associated with lower outpatient specialist clinic use? A cross-sectional study

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2012-002041
Article Type:	Research
Date Submitted by the Author:	31-Aug-2012
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Primary Subject Heading:	Health services research
Secondary Subject Heading:	General practice / Family practice, Health policy
Keywords:	PRIMARY CARE, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Rationing < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

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Is increased primary health care use associated with lower outpatient specialist clinic use? A cross-sectional study

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Key words: General Practice, Primary Health Care, Small-Area Analysis, Health Services Research, Health Policy.

Word count: 3444

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ARTICLE SUMMARY:

Article focus:

- The majority of ecological studies suggests that indirect measures of PHC accessibility is associated with lower hospital use.
- Studies on the association between direct PHC utilization measures and secondary health care utilization are lacking.
- The present cross-sectional study examines the direct association between utilization of general practice and secondary care outpatient clinics among elderly.

Key messages:

- Higher accessibility to general practice is associated with more outpatient secondary care use in a public financed health care system with low out-of pocket expenses.
- Legal and practical access to existing individual-level and system-level health care unit data is needed to examine the full role of PHC for secondary care utilization.

Strengths and limitations:

- Complete national age and sex stratified data of all GP and secondary care out-patient clinic consultations among elderly 65.
- Analyses adjusted for mortality, geographical, socioeconomic, and demographic variables.
- Aggregated data allowing for analysis and conclusions to be drawn at the municipal level where primary health care is administered.

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ABSTRACT:

Objective: To examine if increased general practice activity is associated with lower outpatient specialist clinic use.

Design: Cross-sectional population based study.

Setting: All 430 Norwegian municipalities in 2009.

Participants: All Norwegians aged ≥65 years (n = 721 915; 56% women – 15% of the total population)

Main outcome measure: Specialised care outpatient clinic consultations per 1000 inhabitants (OPC rate). Main explanatory: GP consultations per 1000 inhabitants (GP rate).

Results: In total, there were 3339 031 GP consultations (57% women) and 1757 864 OPC consultations (53% women). The national mean GP rate was 4625.2 GP consultations per 1000 inhabitants (standard deviation [SD] 1234.3) and the national mean OPC rate was 2434.3 per 1000 inhabitants (SD 695.3). Crude analysis showed a statistically significant positive association between GP rates and OPC rates. In regression analyses, we identified three effect modifiers; age, mortality, and the municipal composite variable of 'hospital status' (present/not present) and 'population size' (small, medium and large). We stratified manually by these effect modifiers into five strata. Crude stratified analyses showed a statistically significant positive association for three out of five strata. For the same three strata, those in the highest GP consultation rate quintile had higher mean OPC rates compared to those in the lowest quintile after adjustment for confounders (p<0.001). People aged ≥85 in small municipalities had approximately 30% lower specialist care use compared to their peers in larger municipalities, although the association between GP-rates and OPC-rates was still positive.

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Conclusions: In a universal health insurance system with high GP-accessibility, a health policy focusing solely on a higher activity in terms of GP consultations will not likely decrease out-patient clinic use among elderly.

Key words: Primary Health Care, Health Services Research, Health Policy, Small-Area Analysis, Care Utilization.

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INTRODUCTION

Future health care utilization might escalate as a consequence of biomedical innovations, more informed patients, and population ageing, which leads to a higher proportion of chronically ill individuals. Specialist health care (SHC) uses a major and increasing proportion of health care budgets, so rationing of these services is a priority in most countries. Governments,[1,2] the World Health Organization (WHO),[3] and US employers[4] argue for a strengthening of primary health care (PHC) to enhance chronic care and to better control health care expenditure.

Historically, Norway has a well-developed primary health care in a universal health insurance system.[5] Nevertheless, variations in hospital use,[6] general practitioner (GP) referral rates,[7] and consultation costs[8] are reported at physician, municipality, and regional levels. A patient list system was introduced in 2001, partly to strengthen access to primary care and to ease pressure on the hospitals. Early detection of disease, and improved monitoring, care, and treatment in general practice, may decrease or increase the patient need for outpatient clinic or private specialist appointments.[9] This depends on GPs' threshold for referrals, reflecting the diagnostic, organizational and therapeutic armamentarium in their local primary care setting.

The Norwegian coordination reform assumes that care for chronically ill, elderly people can be less fragmented and less costly through the substitution of hospital use by enhanced primary care.[10] The main measures are increase in GP capacity and reorganisation of the cooperation both within and between the levels of health care.

An outpatient clinic (OPC) is by far the most frequent form of contact between GPs and hospitals in Norway, because the OPC consultations outnumber the hospital admission rate by a factor close to five.[11] Findings, mostly from American ecological, macro-level studies, indicate that in large geographical areas (countries and states) indirect measures of PHC accessibility, is associated with better overall access to health care, lower health care expenses

and hospital use, and improved health outcomes.[12,13] However, primary care seems to have more impact in societies with higher social inequalities and at higher levels of aggregation.[13-15] We have not identified any previous studies investigating the association of direct measures of GP activity on secondary care utilization. Thus the question of whether GP-consultation rates are associated with lower OPC-consultation rates, which is the most common entry into secondary care, is currently unknown.

In the current study we had access to a national database including all GP consultations and all OPC consultations in Norway in 2009, which was the first year with almost complete data from private specialists.

The aim of this cross-sectional study was to examine the hypothesis that more general practice visits are associated with reduced use of specialised care by 1) exploring the association between rates of GP and OPC consultations among people aged >65 in Norway and 2) studying the effect modification of case-mix factors (age, sex, and mortality) and barriers to secondary care (travel time to hospital and municipal hospital status).

METHODS

Materials

This one year, total population based, cross-sectional study included all Norwegians aged ≥65 years (n = 721 915; 56% women – 15% of the total population) in 2009. We had access to aggregated data which was grouped according to Norwegian municipality of residence (n=430), sex, and the following age groups: 65–69, 70–74, 75–79, 80–84, 85–89, and ≥90. This was the highest data granularity available from public registries. One of the principal aims of the research was to examine the effect of age on associations. Hence rather than calculate age-standardised rates, a dataset was generated of 5145 units of observation, based on the 430 municipalities multiplied by 12 age/sex groupings. Analysis of the data using this structure allowed us to examine the effect modification of age- and sex, something which is

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not possible with age- and sex- standardized data which is common in this field. Information on GP consultation rates was missing for 46 rows (706 individuals). We linked data from the following:

1. The Norwegian Patient Registry: OPC rate defined as the total number of both public and private OPC consultations in 2009 per 1000 inhabitants for each unit of analysis

2. Statistics Norway: mortality, socioeconomic variables

3. The Norwegian Health Economics Administration (HELFO): GP rate defined as the total number of GP office and out-of- hours casualty clinic consultations per 1000 inhabitants in 2009, in each unit of analysis.

The data were checked by hospitals and the Norwegian Patient Registry and underwent an internal quality check mainly based on comparisons with the previous year's data and internal consistency. The different data from Statistics Norway are derived from national public registries of all the citizens living in Norway.

Statistical methods

The outcome variable (OPC rate) had a Poisson distribution that approximates a normal distribution when the probability for the outcome is high (>5%). Thus, we manually built a linear regression model in SPSS (Statistical Package for Social Sciences) v.16 and SAS (Statistical Analysis System) v.9.2. To obtain as many percentile groups as possible to visualise threshold effects, while avoiding unstable results due to small numbers in each group, we classified our main explanatory variable, GP rate into quintiles. GP quintile 1 represented the lowest 20% and GP quintile 5 the highest 20% of the GP rate within each age group, thereby making age adjustment in analyses unnecessary. Table 1 describes the exact operationalization and impact of several variables known to influence health care use.[16]

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Table 1: Description and role in analyses of explanatory variables

Explanatory variable	Variable description	Relationship to OPC rate?	Included in final model?
Sex		OPC rates in men > women	Adjustment variable
Age	Five-years age groups 65–69;70–74 up to 90+	OPC rates at 65–84years of age higher than in those aged 85+	Stratifying variable
Composite variable: municipal population size and hospital status	1. No hospital, small (municipal population <5000) 2. No hospital, medium (municipal population >5000 to <20 000) 3. No hospital, large (municipal population >20 000) 4. Hospital and small and medium (municipal population < 20 000) 5. Hospital and large (municipal population > 20 000)	OPC-rates (from high to low) large hospital municipalities; Large municipalities without hospital; Small or medium municipalities with hospital; Small or medium municipalities without hospital	Stratifying variable
Mortality	Five-year age group and sex specific all cause mortality at the municipality level	Linear positive at age 65–84. Non-linear positive at age 85+	Stratifying variable
Travel time to hospital	Travel time in minutes from municipality town hall to closest hospital (source 2). Four travel time groups: 0–19 min, 20–59 min, 60–119 min, ≥120 min	Four travel time groups; linear negative in both age groups	Adjustment variable
Municipality education	Age and sex specific average proportion of the municipal population with primary school as highest education for the years 2002–6[a]	Linear negative in both age groups	Not included
Municipality relative poverty level	Average proportion of the population for the years 2005–8 with a disposable household income <60% of the median value[a,]	Non-linear positive in both age groups	Not included
Municipality unemployment	Average proportion of the population aged 16–66 years that was unemployed for the years 2000–9	Non-linear positive in both age groups	Not included

[a]From Eurostat.[16]

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Where bivariate correlation between the adjustment variables had a Pearson correlation coefficient ≥0.7, the variables were included as a joint composite variable. In the final model trends in the outcome across GP quintiles were tested by comparing the difference in annual Least Square means between the first and last quintiles using independent samples t-test.

The number of individuals (n) falling within the 5145 units of analysis varied between 1 and 10414 (mean 140.5). To ensure that those units containing few individuals did not have an unduly large influence on the results, all analyses were weighted by n. We did the analysis using a formalised evaluation of effect modification based on both statistical significance and policy relevance, in line with previous work.[17] Policy relevance was a priori defined as a more than 15% change (365 OPC consultations per 1000 inhabitants) compared with the reference. Confounding was defined as a change in the predicted least square means of the relationship between the main explanatory and outcome variable of >10%.[18]

The estimates of both GP and OPC rates in the 12 sex and age groups were expected to correlate within each municipality. To account for this, we adjusted for municipality by adding it to the model as a random effect variable. Finally, we checked that the distribution of the standardised residuals for both the intermediate model (main variables, age and sex) and the final model were normally distributed.

RESULTS

In total, there were 3339 031 GP consultations (56% women) and 1757 864 OPC consultations (53% women) over the 12 month period. The mean GP rate was 4625.2 GP consultations per 1000 inhabitants (standard deviation [SD] 1234.3) and the mean OPC rate was 2434.3 per 1000 inhabitants (SD 695.3). The national distribution of population, GP rates, and OPC rates by five GP quintiles and strata is given in Table 2.

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Table 2: Descriptives of outcome, explanatory, and stratifying variables

Age and municipality type	GP quintile						
	1	2	3	4	5	All	p value
Rate of OPC consultations (visits/1000 inhabitants)							
Men							
65–84, small & medium + large non-hospital	2130	2306	2286	2353	2420	2276	<0.000[1]
65–84, large, w/ hospital	2839	3015	2924	3229	3138	3050	<0.000
85+, small	1607	1644	2019	1890	2071	1873	<0.000
85+, medium & large	2024	2153	3029	2772	2946	2761	<0.000
85+, medium & large, highest mortality	1929	3209	3230	2624	2693	2754	<0.000
All	2022	2237	2310	2390	2352	2230	<0.000
Women							
65–84, small & medium + large non-hospital	1938	1979	1997	2025	2113	2014	<0.000
65–84, large, w/ hospital	2562	2461	2788	2655	2696	2658	<0.000
85+, small	1175	1288	1424	1294	1456	1282	<0.000
85+, medium & large	1688	1872	1977	2147	2094	1935	<0.000
85+, medium & large, highest mortality	1941	1759	2097	1938	1931	1899	<0.000
All	1680	1814	1923	1894	1988	1836	<0.000
Rate of GP consultations (visits/1000 inhabitants)[#]							
Men							
65–84, small & medium + large non-hospital	3006	4216	4599	5089	6738	4675	<0.001
65–84, large, w/ hospital	3720	4303	4450	5330	5809	4798	<0.000
85+, small	2793	3966	4724	5110	7704	5525	<0.000
85+, medium & large	3167	4175	4664	5208	6703	5552	<0.000
85+, medium & large, highest mortality	3443	4221	4888	5427	6521	5700	<0.000
All	2977	4174	4626	5135	7052	4963	<0.000
Women							
65–84, small & medium + large non-hospital	3195	4386	4611	5101	6257	4655	<0.000
65–84, large, w/ hospital	3965	4442	4684	5113	5237	4755	<0.000
85+, small	2856	4034	4756	5096	6828	4307	<0.000
85+, medium & large	3534	4137	4599	5257	6268	4579	<0.000
85+, medium & large, highest mortality	3335	3998	4614	4580	5192	4040	<0.000
All	3107	4270	4653	5105	6343	4551	<0.000
Population (n)							
Men							
65–84, small & medium + large non-hospital	45 699	29 714	23 547	25 621	43 105	167 686	
65–84, large, w/ hospital	19 961	38 927	18 477	23 246	12 197	112 808	
85+, small	2 757	1 196	1 733	1 364	6 678	13 728	<0.000[2]
85+, medium & large	611	617	2 641	8 024	6 191	18 084	
85+, medium & large, highest mortality	308	215	355	431	733	2 042	
All	69 336	70 669	46 753	58 686	68 904	314 348	
Women							
65–84, small & medium + large non-hospital	42 513	30 253	32 049	35 683	49 572	190 070	
65–84, large, w/ hospital	12 931	24 016	51 299	34 447	17 959	140 652	
85+, small	9 821	4 357	4 769	4 606	5 887	29 440	<0.001[2]
85+, medium & large	6 816	15 261	9 439	7 557	2 342	41 415	
85+, medium & large, highest mortality	18 14	2 168	1 225	422	361	5 990	
All	73 895	76 055	98 781	82 715	76 121	407 567	
Travel time between municipality and hospital (minutes)							
All							
65–84, small & medium + large non-hospital	63	52	56	53	58	58	<0.000
65–84, large, w/ hospital	3	4	4	6	3	4	<0.000
85+, small	74	57	51	64	59	64	<0.000
85+, medium & large	5	7	7	9	10	8	<0.000
85+, medium & large, highest mortality	4	7	8	5	7	6	<0.000
All	63	47	47	48	54	55	<0.000
All cause mortality rates (total deaths/ 1000 inhabitants)							
All							
65–84, small & medium + large non-hospital	33	34	37	32	42	36	<0.000
65–84, large, w/ hospital	36	36	28	40	32	35	<0.000
85+, small	181	192	178	182	235	201	<0.000
85+, medium & large	137	153	150	164	165	156	<0.000
85+, medium & large, highest mortality	243	258	220	260	377	285	<0.000
All	81	81	80	81	110	90	<0.000

[#]Absolute rates of GP consultations in each defined strata. [1] Tested with one-way ANOVA. [2] Tested with chi-square test.

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In crude analysis, there was a statistically significant positive relationship between GP rates and OPC rates (data not shown).

The association between the GP rate and the OPC rate was modified by age, mortality, and the composite variable of municipal 'hospital status' (present/ not present) and 'population size' (small, medium, large). We stratified manually by these effect modifying variables, resulting in five strata (Figure 1). Crude stratified analyses showed (Figure 2), a statistically significant positive t for the 'Age group 65–84 Small to medium & large non-hospital municipalities'-stratum, the 'Age group 85+ small, no hospital-stratum, and for the 'Age-group 85+ medium-large'-stratum. For the remaining two strata, the association was also positive, but not statistically significant.

We then identified two significant confounders: (1) sex and (2) travel time to hospital. In the fully adjusted model (Figure 3 and Table 3), the three strata with statistically significant positive association in crude stratified analysis showed a statistically significant positive trend comparing top and bottom quintiles ($p<.0001$).

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Table 3: Outpatient consultation rate per 1000 inhabitants (OPC rate) by GP quintiles, stratified by age and municipality type[#]. Norway 2009. Least Square (LS) means with 95%-confidence intervals (95% CI). Adjusted model[##].

		Age 65-84		Age 85+		
Municipality type		Small & medium + large non-hospital	Large, w/ hospital	Small	Medium & large	Medium & large, highest mortality
GP quintile	1	1960	2609	1601	2171	2707
		(1904 - 2015)	(2354 - 2865)	(1526- 1676)	(1944 - 2398)	(2434 - 2980)
	2	2067	2658	1587	2601	2715
		(2008 - 2126)	(2467 - 2849)	(1483 - 1691)	(2406 - 2795)	(2450 - 2980)
	3	2094	2865	1751	2319	2948
		(2035 - 2153)	(2682 - 3049)	(1656 - 1846)	(2138 - 2500)	(2653 - 3243)
	4	2166	2858	1658	2522	2240
		(2108 - 2224)	(2677 - 3039)	(1562 - 1755)	(2363 - 2681)	(1860 - 2620)
	5	2308	2731	1864	2684	2284
		(2252 - 2364)	(2491 - 2971)	(1790 - 1938)	(2488 - 2879)	(1947 - 2621)
	Diff 1-5	-348***	-122	-263***	-512***	-423
		(-427- -269)	(-474 - -231)	(-368- -157)	(-811- -213)	(-29-875)

[#] See Figure 1. [##] adjusted for travel time and sex. *** p-values<0.0001; independent samples t-test,

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The 85+ stratum with medium and large municipalities and the highest mortality now became a negative but still non-significant association (p<.07). The 85+ stratum for small municipalities without a hospital had a considerably lower OPC rate than all the other groups. This was between 24% and 39 % lower than the OPC-rates of the stratum aged 85+ living in medium/ larger municipalities.

DISCUSSION

The principal finding was a moderate positive association between GP consultation rates and rates of OPC use among elderly people in Norway in 2009. The main explanatory variable showed effect modification with age, mortality, and the composite of hospital status and municipality population size. The positive association remained when the analysis was adjusted for the two confounding variables – sex and travel time to hospital – except in the oldest age group with the highest mortality in medium–large municipalities. Socioeconomic variables did not influence the association, and were not included in the final analysis.

Strengths and limitations

In Norway, the gate keeping principle requires that GPs send most referrals, in the first instance, to an OPC or private specialist for a specialist evaluation, where further decisions about diagnostic procedures, treatments, follow-up, and referrals to other specialised personnel are made. About 90% of referrals to public OPCs and most referrals to private specialists are non-urgent, and the large OPC volume shows geographical variation.[11] Consequently, the use of OPCs and specialists is a reliable indicator of the total health care use resulting from GP activities. Our comprehensive and high quality, one year dataset offers a suitable base to study associations between explanatory factors and OPC use for older people in a universal health care system. By developing regression models using municipality, age, and sex specific strata, we were able to examine age and sex effect modification in the age group most in focus – elderly people. Available geographical, socioeconomic, and

demographic variables known to influence health care use made it possible to adjust for municipality and population characteristics.

As the Norwegian health care system has given PHC a high priority over the last decade, the findings have relevance for other countries planning to strengthen their PHC. Norway's 430 municipalities (2009) are well defined administrative units, most frequently used in public statistics and responsible for the provision of PHC, including GPs. The municipalities are responsible for- and provide the financial and organizational framework for primary care in Norway. Thus the municipality level of aggregation allows us to draw conclusions at the health care unit level, but not at the individual level. GPs send their consultation data to the Norwegian Health Economics Administration (HELFO) for financial reimbursement. As 99.6% of the population are registered by a GP as list patients, data on GP consultations are considered complete and of acceptable quality. In addition, the dataset comprises the total number of consultations from almost all casualty clinics.

In Norway, specialist care is offered within a hospital setting that is both publicly funded and organised ('public'), and among private specialists that is privately organised but predominately publicly funded ('private'). The hospital OPC data include both 'public' and 'private' specialist consultations.

Due to data restrictions we undertook this analysis at an aggregate level, and therefore our results might by limited by the ecological fallacy if the area based associations were observed do not hold at the individual level. Nevertheless the hypothesis that we were testing is area-based in nature as we are interested in exploring associations at system level that equates to that at which policies are implemented, so we argue that such aggregate analysis is appropriate in this case. A further limitation is that we only had data for a single time point,

and hence interpretation of our findings should be made in light of the limitations of cross sectional analyses for the determination of causality.

As no information of morbidity was available, we utilized all-cause mortality as a proxy for morbidity. This has limitations, as have other studies in this field,[13] while some present only crude analyses.[19] Some authors who have adjusted for morbidity in their analyses found little or no effect of morbidity adjustment on the association between GP volume and utilization measures.[8,20,21] We therefore believe that further adjustment of morbidity in our analyses would not have materially changed our findings.

Except for the highest GP quintile, mortality did not increase with GP quintiles, which is perhaps surprising. Nevertheless, whilst mortality was an effect modifier, the fact that it did not confound the associations we observed suggests that its use in place of information on morbidity is unlikely to have introduced any significant bias into our analysis.

Over 90% of the 'private' specialists have delivered their consultation data for 2009. As 30% of all OPC consultations are 'private' in the dataset, the total OPC rates are slightly under-estimated. We have no reason to believe that non-reporting of private OPCs is in any way related to GP consultation rates. Thus, we believe that this data error is random, although it may cause an underestimate of the observed positive relationships.

Overall, we believe that the limitations listed above do not threaten the conclusions in this study.

Previous research

Two American studies found a non-significant negative association between OPC use and the primary care physician:specialist ratio (PCP-ratio) or primary care physician density respectively.[14,15] In the US several specialists (internists, family practitioners [GPs], paediatricians, obstetricians, and gynaecologists) work as primary care physicians. About

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44% of the consultations inside US PHC in 2007 were estimated to take place at specialists in family medicine/general practice, who are shown to have different values and goals from other specialists inside PHC.[22,23] Hence, the US studies on the association between PHC and hospital use might be difficult to translate into European or Norwegian contexts, where GPs are the only primary care physicians. The PCP-ratio and "physician density", used mostly in the American studies as explanatory variables for hospital use, are indirect primary care measures. Whether they are reliable proxies for the primary care activity is unclear. As variations in geography and demography influence both the coverage of GPs and the PCP-ratio, we have instead used a direct measure of the primary care delivered, namely the GP consultation rate (GP rate). Other studies have rarely focused specifically on the use of OPCs, which is the measure that we believe is the 'gate' leading to most of the other non-urgent specialist care activities in the Norwegian setting.

A Danish study, including referrals from 141 GPs to specialists, showed that a higher consultation rate was associated with more overall hospital use.[24] Contrary to this, a Swedish cross-sectional study from 4 hospital districts including 52 health centres showed that high rates of GP visits were associated with reduced hospitalisation.[25] These studies were undertaken in health systems that have many similarities with the Norwegian system, but the sample sizes were small. Kronman et al showed, in an American study of end of life primary care visits, that six or more GP visits had a possibly preventive effect on hospital use, thus indicating a GP effect above a certain threshold.[26]

Interpretation of the results

The major finding is that higher GP activity is associated with higher OPC activity among people 65 years and older. This contradicts studies from other countries where GPs are gatekeepers to specialised health care, demonstrate an overall more efficient health care system than countries in which GPs do not have this role.[27] Whether the strengthened bond

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between GPs and patients due to the patient list system has led to an even stronger GP emphasis on the patient advocate role at the expense of the gate keeper role is currently under debate.[8, 28, 29] A study from Danish health care, highly comparable to the Norwegian health care system, reports an significant higher GP propensity to refer to secondary care in 2009 compared to 1993, mostly to out- patient clinics.[30]

Probably, both medical and technical development, increased co-morbidity with age[31], a stronger population risk awareness,[32,33] a growing tendency towards disease mongering[34] and defensive medicine,[35,36] indicating more intensive therapeutic examinations and/ or follow-up[37] are all factors that probably influence both the GP and the OPC activity and hence the studied association.

Strengthening the supply of and access to a GP may replace specialist care in societies with deficits and inequalities in health care. However, above a certain level, e.g. in Norway with relatively high rates for both GPs and OPCs, there might be no further substitution effect of increasing GP availability without more clearly defining the organization and content of the services, i.e where and how chronic ill patients should be followed up.

The absolute level of OPC use is substantially lower in the smaller and more distant municipalities (mean travel time approximately 1 hour) for all age groups (Table 2). We hypothesize that distance may be a barrier to secondary care. Whether this reflects an adequate pattern of use is unknown, but it is likely that these municipalities organize and integrate the total PHC system for elderly people differently. Two Canadian studies support such an interpretation.[38,39] One Canadian qualitative study indicated that lower referral rates from distant municipalities can mostly be explained by access to local resources and corresponding practice styles that influence the local ecology of total health care use.[40]

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The OPC utilization differences between the highest and lowest GP percentiles are between 10% and 15%, highest for the oldest groups. The difference is close to what we a priori defined as relevant to policy, although we are not able to define the optimal level of the OPC-rate. Whether this reflects a quality improvement potential among some general practitioners, is outside the scope of the study. However, a recently published English report states that albeit a general good quality, wide variation in performance and quality of care indicate an opportunity for quality improvement in general practice.[41]

The negative association found for the 85+ group with the highest mortality might illustrate that a higher GP presence meets the patient needs in this group better when in cooperation with municipal long term care. Also, patients with a high morbidity might be referred directly to hospital inpatient care instead of an OPC. As the 85+ group with high mortality consists of 1.1% of the population of the dataset, we cannot exclude that the finding is a result of unstable data (Table 2).

Further research

Characteristics of the health care system, case-mix, and living conditions (geographical, cultural, and socioeconomic) have an impact on the small area variations in health care use.[42] In Norway, with moderate socioeconomic and mortality inequalities, we find that, varying use of specialist care is explained by both differences in case-mix and variations at the municipal and health care level. There is a need for data that allow the analysis of individuals and higher level units simultaneously, preferably over time. This analysis necessitates adequate statistical frameworks, such as multilevel modelling. In addition we need legal and practical access to existing data sources at the individual and GP level, including information on multi-morbidity and referrals that facilitates research on patient trajectories.

We conclude that, more of the same GP service will hardly ease the pressure on secondary care in a setting with universal health care coverage and high GP-accessibility. A reduction in

secondary care utilization may be a joint product of both high GP access and a re-organization of care, according to new principles of chronic care management. If so, health workers, including GPs and specialists, should consider to reorganize, redistribute and delegate some of their clinical work[43] and participate or take the lead in collaborative care networks in partnership with some of their patients. However, implementing models for integrated chronic care is hard work,[44] and might suffer from single disease-orientated rather than a person-focused models, as many patients are multimorbid.[45-46] Complex daily practices,[47] interprofessional attitudes,[48] and insufficient management skills,[49] are challenges which need to be focused both in development of such teams and in education and continued training for health personnel in the future.[50] As such models are not necessarily transferable, they have to be developed and evaluated multidimensionally in a Scandinavian setting. How this will influence the utilization and costs of primary and secondary care is a subject for research.

CONCLUSIONS

A high GP consultation rate in Norway is associated with increased use of specialised outpatient health care. This finding suggests that, in a universal health insurance system with high GP-accessibility, it is unlikely that a health policy focusing only on a higher volume of GP consultations will decrease pressure on specialist health care use among elderly people.

Contributors

TSD and GB initiated and designed the study. TSD collected the data. TSD and GB carried out the data analyses. TSD drafted the paper, and all authors contributed to the writing of the manuscript and read and approved the final manuscript. GB is the guarantor of the study.

Acknowledgements

Thanks to researcher Erik R. Sund, Regional Health Authority of Northern Norway, and Professor Andy Jones, University of East Anglia, for valuable comments to the manuscript.

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Competing interests

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; and no other relationships or activities that could appear to have influenced the submitted work.

Funding

This work was supported by Regional Health Authority of Northern Norway, and the National Centre of Rural Medicine, Tromsø, Norway.

Ethical approval

The study was approved by the Privacy Ombudsman for Research in Norway in accordance with the Personal Data Act and Health Registry Act (project number 17869).

Data sharing

The raw dataset is available from the corresponding author. Appliciants must be prepared to conform by Norwegian privacy regulations. There are no additional data available.

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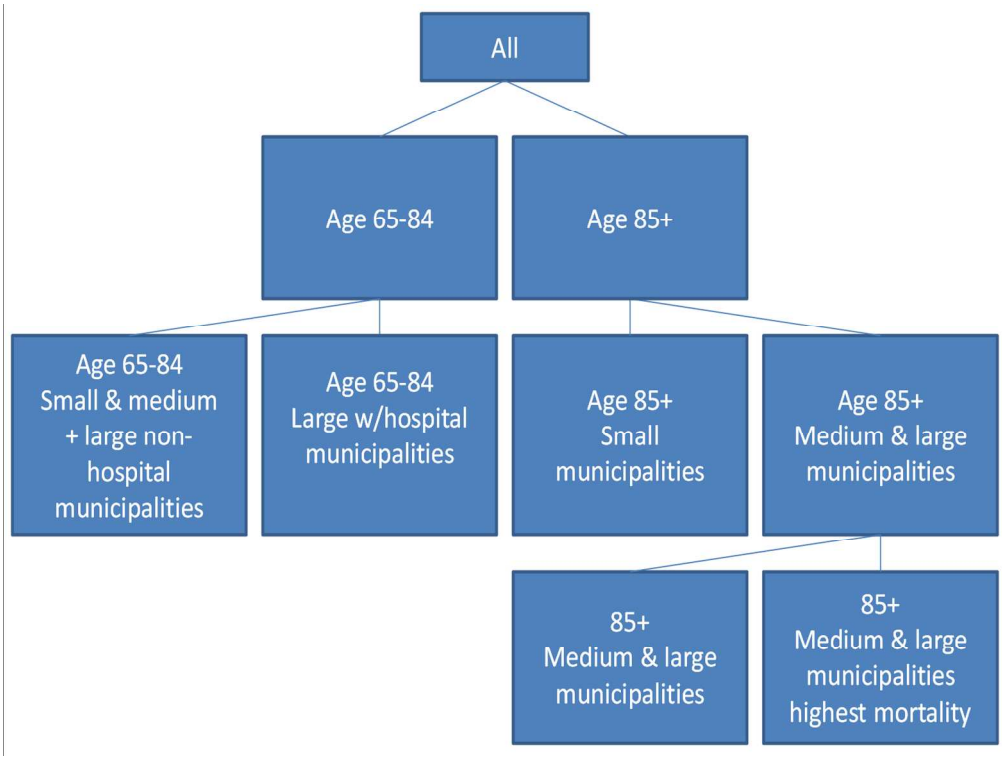

Figure 1 Diagram of stratification by age, the composite variable of municipal 'hospital status' and 'population size', and mortality.
279x209mm (150 x 150 DPI)

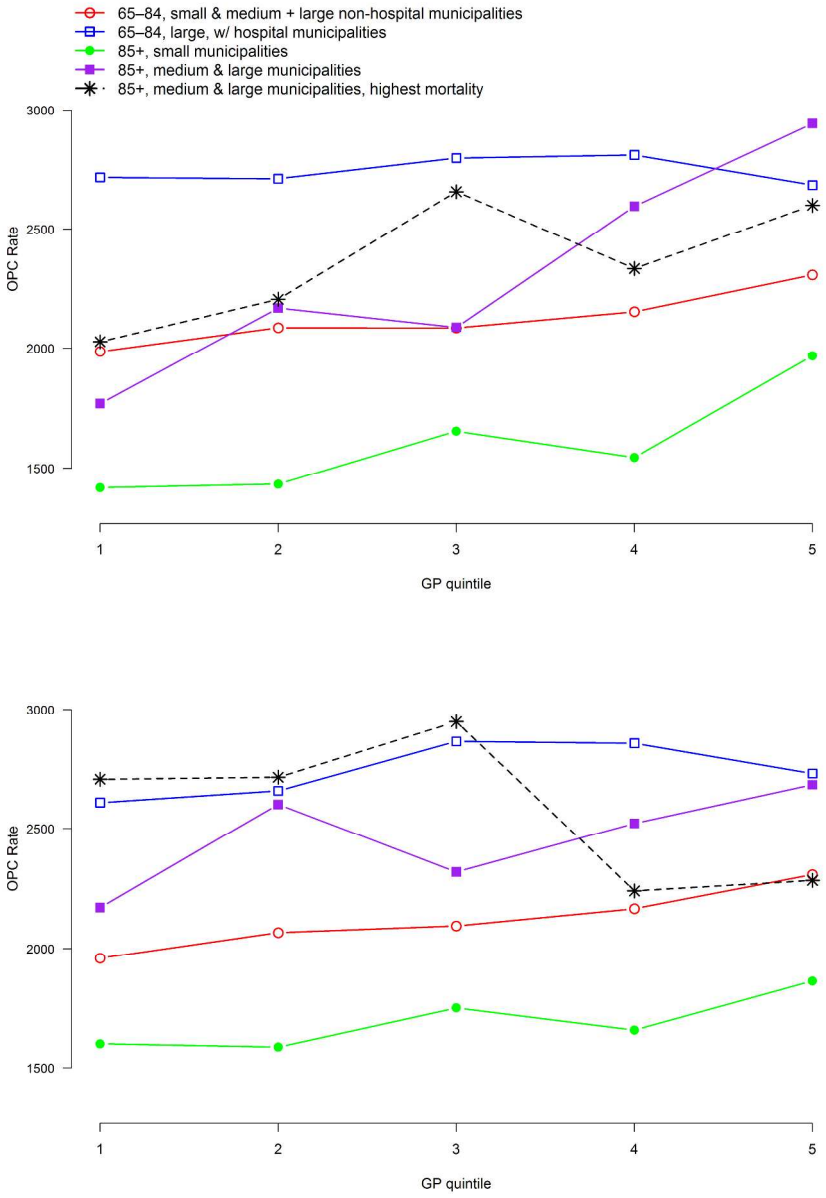

Figure 2 Crude (above) and adjusted (below) associations between general practitioner consultation and outpatient consultation rates. Stratified by age, the composite variable of municipal 'hospital status' and 'population size', and mortality. 1st quintile group represents the 20% lowest percentage in each 5-year age group. Accounted for repeated measures within municipality. Adjusted for sex, travel time to hospital and repeated measures within municipality. Norwegian population aged ≥65 years. 2009.

355x497mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***
Regarding manuscript "*The more primary health care, the less specialist care? A Norwegian national one-year cross-sectional study*"-Deraas,TS et al.

	Item No	Recommendation	On page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8
Bias	9	Describe any efforts to address potential sources of bias	6-10 + 14-15
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-9
		(*b*) Describe any methods used to examine subgroups and interactions	9+11
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Not applicable
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6-8
		(b) Indicate number of participants with missing data for each variable of interest	6
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9+11
		(*b*) Report category boundaries when continuous variables were categorized	6-7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not relevant
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7+9
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

Is a high level of GP consultations associated with low outpatients specialist clinic use? A cross-sectional study

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2012-002041.R1
Article Type:	Research
Date Submitted by the Author:	27-Nov-2012
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Primary Subject Heading:	Health services research
Secondary Subject Heading:	General practice / Family practice, Health policy
Keywords:	PRIMARY CARE, HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Rationing < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

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Is a high level of GP consultations associated with low outpatients specialist clinic use? A cross-sectional study

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Key words: General Practice, Primary Health Care, Small-Area Analysis, Health Services Research, Health Policy.

Word count: 3454

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ARTICLE SUMMARY:

Article focus:

- The majority of ecological studies suggest that proxies for higher primary health care accessibility such as primary care physician (PCP) density and PCP/ Specialist ratio are associated with lower hospital use.
- Studies on the association between PHC utilization and secondary health care utilization are lacking.
- The present cross-sectional study examines the association between general practice utilization and secondary care outpatient clinics utilization among elderly.

Key messages:

- Higher general practice consultation rate is associated with more outpatient secondary care use in a public financed health care system with low out-of pocket expenses.
- Legal and practical access to existing individual-level and system-level health care unit data is needed to examine the role of PHC for secondary care utilization.

Strengths and limitations:

- Complete national age and sex stratified data of all GP consultations and secondary care out-patient clinic consultations among elderly over 65, is a strength of the study.
- Aggregated data allowing for analysis and conclusions to be drawn at the municipal level where primary health care is administered is a study strength.
- Analyses were adjusted for several municipal level confounders, but lack of individual-level data made it impossible to adjust for individual-level confounders, such as morbidity, which is a limitation.

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ABSTRACT:

Objective: To examine if increased general practice activity is associated with lower outpatient specialist clinic use.

Design: Cross-sectional population based study.

Setting: All 430 Norwegian municipalities in 2009.

Participants: All Norwegians aged ≥65 years (n = 721 915; 56% women – 15% of the total population)

Main outcome measure: Specialised care outpatient clinic consultations per 1000 inhabitants (OPC rate). Main explanatory: GP consultations per 1000 inhabitants (GP rate).

Results: In total, there were 3339 031 GP consultations (57% women) and 1757 864 OPC consultations (53% women). The national mean GP rate was 4625.2 GP consultations per 1000 inhabitants (standard deviation [SD] 1234.3) and the national mean OPC rate was 2434.3 per 1000 inhabitants (SD 695.3). Crude analysis showed a statistically significant positive association between GP rates and OPC rates. In regression analyses, we identified three effect modifiers; age, mortality, and the municipal composite variable of 'hospital status' (present/not present) and 'population size' (small, medium and large). We stratified manually by these effect modifiers into five strata. Crude stratified analyses showed a statistically significant positive association for three out of five strata. For the same three strata, those in the highest GP consultation rate quintile had higher mean OPC rates compared to those in the lowest quintile after adjustment for confounders ($p<0.001$). People aged ≥85 in small municipalities had approximately 30% lower specialist care use compared to their peers in larger municipalities, although the association between GP-rates and OPC-rates was still positive.

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Conclusions: In a universal health insurance system with high GP-accessibility, a health policy focusing solely on a higher activity in terms of GP consultations will not likely decrease out-patient clinic use among elderly.

Key words: Primary Health Care, Health Services Research, Health Policy, Small-Area Analysis, Care Utilization.

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INTRODUCTION

Future health care utilization might escalate as a consequence of biomedical innovations, more informed patients, and population ageing, which leads to a higher proportion of chronically ill individuals. Specialist health care (SHC) uses a major and increasing proportion of health care budgets, so rationing of these services is a priority in most countries. Governments,[1,2] the World Health Organization (WHO),[3] and US employers[4] argue for a strengthening of primary health care (PHC) to enhance chronic care and to better control health care expenditure.

Historically, Norway has a well-developed primary health care in a universal health insurance system.[5] Nevertheless, variations in hospital use,[6] general practitioner (GP) referral rates,[7] and consultation costs[8] are reported at physician, municipality, and regional levels. A patient list system was introduced in 2001, partly to strengthen access to GPs and in connection with the newly implemented coordination reform it has been suggested to increase the number of GP's to ease pressure on the hospitals. Early detection of disease, and improved monitoring, care, and treatment in general practice, may decrease or increase the patient need for outpatient clinic or private specialist appointments.[9] This depends on GPs' threshold for referrals, reflecting the diagnostic, organizational and therapeutic armamentarium in their local primary care setting.

The Norwegian coordination reform assumes that care for chronically ill, elderly people can be less fragmented and less costly through the substitution of hospital use by enhanced primary care.[10] The main measures are increase in GP capacity and reorganisation of the cooperation both within and between the levels of health care.

An outpatient clinic (OPC) is by far the most frequent form of contact between GPs and hospitals in Norway, because the OPC consultations outnumber the hospital admission rate by a factor close to five.[11] Findings, mostly from American ecological, macro-level studies,

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indicate that in large geographical areas (countries and states) proxies for PHC accessibility, is associated with better overall access to health care, lower health care expenses and hospital use, and improved health outcomes.[12,13] However, primary care seems to have more impact in societies with higher social inequalities and at higher levels of aggregation.[13-15] We have not identified any previous studies investigating the association of direct measures of GP activity on secondary care utilization. Thus the question of whether GP-consultation rates are associated with lower OPC-consultation rates, which is the most common entry into secondary care, is currently unknown.

In the current study we had access to a national database including all GP consultations and all OPC consultations in Norway in 2009, which was the first year with almost complete data from private specialists.

The aim of this cross-sectional study was to examine the hypothesis that more general practice visits are associated with reduced use of specialised care by 1) exploring the association between rates of GP and OPC consultations among people aged >65 in Norway and 2) studying the effect modification of case-mix factors (age, sex, and mortality) and barriers to secondary care (travel time to hospital and municipal hospital status).

METHODS

Materials

This one year, total population based, cross-sectional study included all Norwegians aged ≥65 years (n = 721 915; 56% women – 15% of the total population) in 2009. As we had no access to individual level data, we chose to use aggregated data which was grouped according to Norwegian municipality of residence (n=430), sex, and the following age groups: 65–69, 70–74, 75–79, 80–84, 85–89, and ≥90. This was the highest data granularity available from public registries. One of the principal aims of the research was to examine the effect of age on associations. Hence rather than calculate age-standardised rates, a dataset was generated of

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5145 units of observation, based on the 430 municipalities multiplied by 12 age/sex groupings. Analysis of the data using this structure allowed us to examine the effect modification of age- and sex, something which is not possible with age- and sex- standardized data which is common in this field. Information on GP consultation rates was missing for 46 rows (706 individuals). We linked data from the following:

1. The Norwegian Patient Registry: OPC rate defined as the total number of both public and private OPC consultations in 2009 per 1000 inhabitants for each unit of analysis

2. Statistics Norway: mortality, socioeconomic variables

3. The Norwegian Health Economics Administration (HELFO): GP rate defined as the total number of GP office and out-of- hours casualty clinic consultations per 1000 inhabitants in 2009, in each unit of analysis.

The data were checked by hospitals and the Norwegian Patient Registry and underwent an internal quality check mainly based on comparisons with the previous year's data and internal consistency. The different data from Statistics Norway are derived from national public registries of all the citizens living in Norway.

Statistical methods

The outcome variable (OPC rate) had a Poisson distribution that approximates a normal distribution when the probability for the outcome is high (>5%). Thus, we manually built a linear regression model in SPSS (Statistical Package for Social Sciences) v.16 and SAS (Statistical Analysis System) v.9.2. To obtain as many percentile groups as possible to visualise threshold effects, while avoiding unstable results due to small numbers in each group, we classified our main explanatory variable, GP rate into quintiles. GP quintile 1 represented the lowest 20% and GP quintile 5 the highest 20% of the GP rate within each age

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group, thereby making age adjustment in analyses unnecessary. Table 1 describes the exact operationalization and impact of several variables known to influence health care use.[16]

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Table 1: Description and role in analyses of explanatory variables

Explanatory variable	Variable description	Relationship to OPC rate?	Included in final model?
Sex		OPC rates in men > women	Adjustment variable
Age	Five-years age groups 65–69;70–74 up to 90+	OPC rates at 65–84years of age higher than in those aged 85+	Stratifying variable
Composite variable: municipal population size and hospital status	1. No hospital, small (municipal population <5000) 2. No hospital, medium (municipal population >5000 to <20 000) 3. No hospital, large (municipal population >20 000) 4. Hospital and small and medium (municipal population < 20 000) 5. Hospital and large (municipal population > 20 000)	OPC-rates (from high to low) large hospital municipalities; Large municipalities without hospital; Small or medium municipalities with hospital; Small or medium municipalities without hospital	Stratifying variable
Mortality	Five-year age group and sex specific all cause mortality at the municipality level	Linear positive at age 65–84. Non-linear positive at age 85+	Stratifying variable
Travel time to hospital	Travel time in minutes from municipality town hall to closest hospital (source 2). Four travel time groups: 0–19 min, 20–59 min, 60–119 min, ≥120 min	Four travel time groups; linear negative in both age groups	Adjustment variable
Municipality education	Age and sex specific average proportion of the municipal population with primary school as highest education for the years 2002–6[a]	Linear negative in both age groups	Not included
Municipality relative poverty level	Average proportion of the population for the years 2005–8 with a disposable household income <60% of the median value[a,]	Non-linear positive in both age groups	Not included
Municipality unemployment	Average proportion of the population aged 16–66 years that was unemployed for the years 2000–9	Non-linear positive in both age groups	Not included

[a]From Eurostat.[16]

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Where bivariate correlation between the adjustment variables had a Pearson correlation coefficient ≥0.7, the variables were included as a joint composite variable. In the final model trends in the outcome across GP quintiles were tested by comparing the difference in annual Least Square means between the first and last quintiles using independent samples t-test.

The number of individuals (n) falling within the 5145 units of analysis varied between 1 and 10414 (mean 140.5). To ensure that those units containing few individuals did not have an unduly large influence on the results, all analyses were weighted by n. We did the analysis using a formalised evaluation of effect modification based on both statistical significance and policy relevance, in line with previous work.[17] Policy relevance was a priori defined as a more than 15% change (365 OPC consultations per 1000 inhabitants) compared with the reference. Confounding was defined as a change in the predicted least square means of the relationship between the main explanatory and outcome variable of >10%.[18]

The estimates of both GP and OPC rates in the 12 sex and age groups were expected to correlate within each municipality. To account for this, we adjusted for municipality by adding it to the model as a random effect variable. Finally, we checked that the distribution of the standardised residuals for both the intermediate model (main variables, age and sex) and the final model were normally distributed.

RESULTS

In total, there were 3339 031 GP consultations (56% women) and 1757 864 OPC consultations (53% women) over the 12 month period. The mean GP rate was 4625.2 GP consultations per 1000 inhabitants (standard deviation [SD] 1234.3) and the mean OPC rate was 2434.3 per 1000 inhabitants (SD 695.3). The national distribution of population, GP rates, and OPC rates by five GP quintiles and strata is given in Table 2.

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Table 2: Descriptives of outcome, explanatory, and stratifying variables

Age and municipality type	GP quintile						
	1	2	3	4	5	All	p value
Rate of OPC consultations (visits/1000 inhabitants)							
Men							
65–84, small & medium + large non-hospital	2130	2306	2286	2353	2420	2276	<0.000[1]
65–84, large, w/ hospital	2839	3015	2924	3229	3138	3050	<0.000
85+, small	1607	1644	2019	1890	2071	1873	<0.000
85+, medium & large	2024	2153	3029	2772	2946	2761	<0.000
85+, medium & large, highest mortality	1929	3209	3230	2624	2693	2754	<0.000
All	2022	2237	2310	2390	2352	2230	<0.000
Women							
65–84, small & medium + large non-hospital	1938	1979	1997	2025	2113	2014	<0.000
65–84, large, w/ hospital	2562	2461	2788	2655	2696	2658	<0.000
85+, small	1175	1288	1424	1294	1456	1282	<0.000
85+, medium & large	1688	1872	1977	2147	2094	1935	<0.000
85+, medium & large, highest mortality	1941	1759	2097	1938	1931	1899	<0.000
All	1680	1814	1923	1894	1988	1836	<0.000
Rate of GP consultations (visits/1000 inhabitants)[#]							
Men							
65–84, small & medium + large non-hospital	3006	4216	4599	5089	6738	4675	<0.001
65–84, large, w/ hospital	3720	4303	4450	5330	5809	4798	<0.000
85+, small	2793	3966	4724	5110	7704	5525	<0.000
85+, medium & large	3167	4175	4664	5208	6703	5552	<0.000
85+, medium & large, highest mortality	3443	4221	4888	5427	6521	5700	<0.000
All	2977	4174	4626	5135	7052	4963	<0.000
Women							
65–84, small & medium + large non-hospital	3195	4386	4611	5101	6257	4655	<0.000
65–84, large, w/ hospital	3965	4442	4684	5113	5237	4755	<0.000
85+, small	2856	4034	4756	5096	6828	4307	<0.000
85+, medium & large	3534	4137	4599	5257	6268	4579	<0.000
85+, medium & large, highest mortality	3335	3998	4614	4580	5192	4040	<0.000
All	3107	4270	4653	5105	6343	4551	<0.000
Population (n)							
Men							
65–84, small & medium + large non-hospital	45 699	29 714	23 547	25 621	43 105	167 686	
65–84, large, w/ hospital	19 961	38 927	18 477	23 246	12 197	112 808	
85+, small	2 757	1 196	1 733	1 364	6 678	13 728	<0.000[2]
85+, medium & large	611	617	2 641	8 024	6 191	18 084	
85+, medium & large, highest mortality	308	215	355	431	733	2 042	
All	69 336	70 669	46 753	58 686	68 904	314 348	
Women							
65–84, small & medium + large non-hospital	42 513	30 253	32 049	35 683	49 572	190 070	
65–84, large, w/ hospital	12 931	24 016	51 299	34 447	17 959	140 652	
85+, small	9 821	4 357	4 769	4 606	5 887	29 440	<0.001[2]
85+, medium & large	6 816	15 261	9 439	7 557	2 342	41 415	
85+, medium & large, highest mortality	18 14	2 168	1 225	422	361	5 990	
All	73 895	76 055	98 781	82 715	76 121	407 567	
Travel time between municipality and hospital (minutes)							
All							
65–84, small & medium + large non-hospital	63	52	56	53	58	58	<0.000
65–84, large, w/ hospital	3	4	4	6	3	4	<0.000
85+, small	74	57	51	64	59	64	<0.000
85+, medium & large	5	7	7	9	10	8	<0.000
85+, medium & large, highest mortality	4	7	8	5	7	6	<0.000
All	63	47	47	48	54	55	<0.000
All cause mortality rates (total deaths/ 1000 inhabitants)							
All							
65–84, small & medium + large non-hospital	33	34	37	32	42	36	<0.000
65–84, large, w/ hospital	36	36	28	40	32	35	<0.000
85+, small	181	192	178	182	235	201	<0.000
85+, medium & large	137	153	150	164	165	156	<0.000
85+, medium & large, highest mortality	243	258	220	260	377	285	<0.000
All	81	81	80	81	110	90	<0.000

[#]Absolute rates of GP consultations in each defined strata. [1] Tested with one-way ANOVA. [2] Tested with chi-square test.

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In crude analysis, there was a statistically significant positive relationship between GP rates and OPC rates (data not shown).

The association between the GP rate and the OPC rate was modified by age, mortality, and the composite variable of municipal 'hospital status' (present/ not present) and 'population size' (small, medium, large). We stratified manually by these effect modifying variables, resulting in five strata (Figure 1). Crude stratified analyses showed (Figure 2), a statistically significant positive t for the 'Age group 65–84 Small to medium & large non-hospital municipalities'-stratum, the 'Age group 85+ small, no hospital-stratum, and for the 'Age-group 85+ medium-large'-stratum. For the remaining two strata, the association was also positive, but not statistically significant.

We then identified two significant confounders: (1) sex and (2) travel time to hospital. In the fully adjusted model (Figure 2 and Table 3), the three strata with statistically significant positive association in crude stratified analysis showed a statistically significant positive trend comparing top and bottom quintiles (p<.0001).

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Table 3: Outpatient consultation rate per 1000 inhabitants (OPC rate) by GP quintiles, stratified by age and municipality type[#]. Norway 2009. Least Square (LS) means with 95%-confidence intervals (95% CI). Adjusted model[##].

		Age 65-84		Age 85+		
Municipality type		Small & medium + large non-hospital	Large, w/ hospital	Small	Medium & large	Medium & large, highest mortality
GP quintile	1	1960	2609	1601	2171	2707
		(1904 - 2015)	(2354 - 2865)	(1526- 1676)	(1944 - 2398)	(2434 - 2980)
	2	2067	2658	1587	2601	2715
		(2008 - 2126)	(2467 - 2849)	(1483 - 1691)	(2406 - 2795)	(2450 - 2980)
	3	2094	2865	1751	2319	2948
		(2035 - 2153)	(2682 - 3049)	(1656 - 1846)	(2138 - 2500)	(2653 - 3243)
	4	2166	2858	1658	2522	2240
		(2108 - 2224)	(2677 - 3039)	(1562 - 1755)	(2363 - 2681)	(1860 - 2620)
	5	2308	2731	1864	2684	2284
		(2252 - 2364)	(2491 - 2971)	(1790 - 1938)	(2488 - 2879)	(1947 - 2621)
	Diff 1-5	-348***	-122	-263***	-512***	-423
		(-427- -269)	(-474 - -231)	(-368- -157)	(-811- -213)	(-29-875)

[#] See Figure 1. [##] adjusted for travel time and sex. *** p-values<0.0001; independent samples t-test,

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The 85+ stratum with medium and large municipalities and the highest mortality now became a negative but still non-significant association (p<.07). The 85+ stratum for small municipalities without a hospital had a considerably lower OPC rate than all the other groups. This was between 24% and 39 % lower than the OPC-rates of the stratum aged 85+ living in medium/ larger municipalities.

DISCUSSION

The principal finding was a moderate positive association between GP consultation rates and rates of OPC use among elderly people in Norway in 2009. The main explanatory variable showed effect modification with age, mortality, and the composite of hospital status and municipality population size. The positive association remained when the analysis was adjusted for the two confounding variables – sex and travel time to hospital – except in the oldest age group with the highest mortality in medium–large municipalities. Socioeconomic variables did not influence the association, and were not included in the final analysis.

Strengths and limitations

In Norway, the gate keeping principle requires that GPs send most referrals, in the first instance, to an OPC or private specialist for a specialist evaluation, where further decisions about diagnostic procedures, treatments, follow-up, and referrals to other specialised personnel are made. About 90% of referrals to public OPCs and most referrals to private specialists are non-urgent, and the large OPC volume shows geographical variation.[11] Consequently, the use of OPCs and specialists is a reliable indicator of the total health care use resulting from GP activities. Our comprehensive and high quality, one-year dataset offers a suitable base to study associations between explanatory factors and OPC use for older people in a universal health care system. By developing regression models using municipality, age, and sex specific strata, we were able to examine age and sex effect modification in the age group mostly focused, namely elderly people. Available geographical, socioeconomic,

and demographic variables known to influence health care use made it possible to adjust for municipality and population characteristics.

As the Norwegian health care system has given PHC a high priority over the last decade, the findings have relevance for other countries planning to strengthen their PHC. Norway's 430 municipalities (2009) are well defined administrative units, most frequently used in public statistics and responsible for the provision of PHC, including GPs. The municipalities are responsible for- and provide the financial and organizational framework for primary care in Norway. Thus the municipality level of aggregation allows us to draw conclusions at the health care unit level, but not at the individual level. GPs send their consultation data to the Norwegian Health Economics Administration (HELFO) for financial reimbursement. As 99.6% of the population are registered by a GP as list patients, data on GP consultations are considered complete and of acceptable quality. In addition, the dataset comprises the total number of consultations from almost all casualty clinics.

In Norway, specialist care is offered within a hospital setting that is both publicly funded and organised ('public'), and among private specialists that is privately organised but predominately publicly funded ('private'). The hospital OPC data include both 'public' and 'private' specialist consultations.

Due to data restrictions we undertook this analysis at an aggregate level, and therefore our results might by limited by the ecological fallacy if the area based associations we observed do not hold at the individual level. Nevertheless the hypothesis that we were testing is area-based in nature as we are interested in exploring associations at system level that equates to that at which policies are implemented, so we argue that such aggregate analysis is appropriate in this case. A further limitation is that we only had data for a single time point,

and hence interpretation of our findings should be made in light of the limitations of cross sectional analyses for the determination of causality.

As no information of morbidity was available, we utilized all-cause mortality as a proxy for morbidity. This has limitations, as have other studies in this field,[13] while some present only crude analyses.[19] Some authors who have adjusted for morbidity in their analyses found little or no effect of morbidity adjustment on the association between GP volume and utilization measures.[8,20,21] We therefore believe that further adjustment of morbidity in our analyses would not have materially changed our findings.

Except for the highest GP quintile, mortality did not increase with GP quintiles, which is perhaps surprising. Nevertheless, whilst mortality was an effect modifier, the fact that it did not confound the associations we observed suggests that its use in place of information on morbidity is unlikely to have introduced any significant bias into our analysis.

Over 90% of the 'private' specialists have delivered their consultation data for 2009. As 30% of all OPC consultations are 'private' in the dataset, the total OPC rates are slightly under-estimated. We have no reason to believe that non-reporting of private OPCs is in any way related to GP consultation rates. Thus, we believe that this data error is random, although it may cause an underestimate of the observed positive relationships.

Overall, we believe that the limitations listed above do not threaten the conclusions in this study.

Previous research

Two American studies found a non-significant negative association between OPC use and the primary care physician:specialist ratio (PCP-ratio) or primary care physician density respectively.[14,15] In the US several specialists (internists, family practitioners [GPs], paediatricians, obstetricians, and gynaecologists) work as primary care physicians. About

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44% of the consultations inside US PHC in 2007 were estimated to take place at specialists in family medicine/ general practice, who are shown to have different values and goals from other specialists inside PHC.[22,23] Hence, the US studies on the association between PHC and hospital use might be difficult to translate into European or Norwegian contexts, where GPs are the only primary care physicians. The PCP-ratio and "physician density", used mostly in the American studies as explanatory variables for hospital use, are indirect primary care measures. Whether they are reliable proxies for the primary care activity is unclear. As variations in geography and demography influence both the coverage of GPs and the PCP-ratio, we have instead used a direct measure of the primary care delivered, namely the GP consultation rate (GP rate). Other studies have rarely focused specifically on the use of OPCs, which is the measure that we believe is the 'gate' leading to most of the other non-urgent specialist care activities in the Norwegian setting.

A Danish study, including referrals from 141 GPs to specialists, showed that a higher consultation rate was associated with more overall hospital use.[24] Contrary to this, a Swedish cross-sectional study from 4 hospital districts including 52 health centres showed that high rates of GP visits were associated with reduced hospitalisation.[25] These studies were undertaken in health systems that have many similarities with the Norwegian system, but the sample sizes were small. Kronman et al showed, in an American study of end of life primary care visits, that six or more GP visits had a possibly preventive effect on hospital use, thus indicating a GP effect above a certain threshold.[26]

Interpretation of the results

The major finding is that higher GP activity is associated with higher OPC activity among people 65 years and older. This contradicts other studies demonstrating an overall more efficient health care system in countries where GPs are gatekeepers to specialised health care.[27] Whether the strengthened bond between GPs and patients due to the patient list system

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has led to an even stronger GP emphasis on the patient advocate role at the expense of the gate keeper role is currently under debate.[8, 28, 29] A study from Danish health care, highly comparable to the Norwegian health care system, reports an significant higher GP propensity to refer to secondary care in 2009 compared to 1993, mostly to out- patient clinics.[30]

Probably, both medical and technical development, increased co-morbidity with age[31], a stronger population risk awareness,[32,33] a growing tendency towards disease mongering[34] and defensive medicine,[35,36] indicating more intensive therapeutic examinations and/ or follow-up[37] are all factors that probably influence both the GP and the OPC activity and hence the studied association.

Strengthening the supply of and access to a GP may replace specialist care in societies with deficits and inequalities in health care. However, above a certain level, e.g. in Norway with relatively high rates for both GPs and OPCs, there might be no further substitution effect of increasing GP availability without more clearly defining the organization and content of the services. This must include a consideration on how GPs could be used more effectively, and how GPs can be included in chronic care management

The absolute level of OPC use is substantially lower in the smaller and more distant municipalities (mean travel time approximately 1 hour) for all age groups (Table 2). We hypothesize that distance may be a barrier to secondary care. Whether this reflects an adequate pattern of use is unknown, but it is likely that these municipalities organize and integrate the total PHC system for elderly people differently. Two Canadian studies support such an interpretation.[38,39] One Canadian qualitative study indicated that lower referral rates from distant municipalities can mostly be explained by access to local resources and corresponding practice styles that influence the local ecology of total health care use.[40]

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The OPC utilization differences between the highest and lowest GP percentiles are between 10% and 15%, highest for the oldest groups. The difference is close to what we a priori defined as relevant to policy, although we are not able to define the optimal level of the OPC-rate. Whether this reflects a quality improvement potential among some general practitioners, is outside the scope of the study. However, a recently published English report states that albeit a general good quality, wide variation in performance and quality of care indicate an opportunity for quality improvement in general practice.[41]

The negative association found for the 85+ group with the highest mortality might illustrate that a higher GP presence meets the patient needs in this group better when in cooperation with municipal long term care. Also, patients with a high morbidity might be referred directly to hospital inpatient care instead of an OPC. As the 85+ group with high mortality consists of 1.1% of the population of the dataset, we cannot exclude that the finding is a result of unstable data (Table 2).

Further research

Characteristics of the health care system, case-mix, and living conditions (geographical, cultural, and socioeconomic) have an impact on the small area variations in health care use.[42] In Norway, with moderate socioeconomic and mortality inequalities, we find that the variability in use of specialist care is explained by both differences in case-mix and variations at the municipal and health care level. There is a need for data that allow the analysis of individuals and higher level units simultaneously, preferably over time. This analysis necessitates adequate statistical frameworks, such as multilevel modelling. In addition we need legal and practical access to existing data sources at the individual and GP level, including information on multi-morbidity and referrals that facilitates research on patient trajectories.

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We conclude that more of the same GP service will hardly ease the pressure on secondary care in a setting with universal health care coverage and high GP-accessibility. A reduction in secondary care utilization may be a joint product of both high GP access and a re-organization of care, according to new principles of chronic care management. If so, health workers, including GPs and specialists, should consider to reorganize, redistribute and delegate some of their clinical work[43] and participate or take the lead in collaborative care networks in partnership with some of their patients. However, implementing models for integrated chronic care is hard work,[44] and might suffer from single disease-orientated rather than a person-focused models, as many patients are multimorbid.[45-46] Complex daily practices,[47] interprofessional attitudes,[48] and insufficient management skills,[49] are challenges which need to be focused both in development of such teams and in education and continued training for health personnel in the future.[50] As such models are not necessarily transferable, they have to be developed and evaluated multidimensionally in a Scandinavian setting. How this will influence the utilization and costs of primary and secondary care is a subject for research.

CONCLUSIONS

A high GP consultation rate in Norway is associated with increased use of specialised outpatient health care. This finding suggests that, in a universal health insurance system with high GP-accessibility, it is unlikely that a health policy focusing only on a higher volume of GP consultations will decrease pressure on specialist health care use among elderly people.

Contributors

TSD and GB initiated and designed the study. TSD collected the data. TSD and GB carried out the data analyses. TSD drafted the paper, and all authors contributed to the writing of the manuscript and read and approved the final manuscript. GB is the guarantor of the study.

Acknowledgements

Thanks to researcher Erik R. Sund, Regional Health Authority of Northern Norway, and Professor Andy Jones, University of East Anglia, for valuable comments to the manuscript.

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Competing interests

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; and no other relationships or activities that could appear to have influenced the submitted work.

Funding

This work was supported by Regional Health Authority of Northern Norway, and the National Centre of Rural Medicine, Tromsø, Norway.

Ethical approval

The study was approved by the Privacy Ombudsman for Research in Norway in accordance with the Personal Data Act and Health Registry Act (project number 17869).

Data sharing

The raw dataset is available from the corresponding author. Appliciants must be prepared to conform by Norwegian privacy regulations. There are no additional data available.

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Is a high level of GP consultations associated with low outpatients specialist clinic use? A cross-sectional study

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Key words: General Practice, Primary Health Care, Small-Area Analysis, Health Services Research, Health Policy.

Word count: 3454

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ARTICLE SUMMARY:

Article focus:

- The majority of ecological studies suggest that proxies for higher primary health care accessibility such as primary care physician (PCP) density and PCP/ Specialist ratio are associated with lower hospital use.
- Studies on the association between PHC utilization and secondary health care utilization are lacking.
- The present cross-sectional study examines the association between general practice utilization and secondary care outpatient clinics utilization among elderly.

Key messages:

- Higher general practice consultation rate is associated with more outpatient secondary care use in a public financed health care system with low out-of pocket expenses.
- Legal and practical access to existing individual-level and system-level health care unit data is needed to examine the role of PHC for secondary care utilization.

Strengths and limitations:

- Complete national age and sex stratified data of all GP consultations and secondary care out-patient clinic consultations among elderly over 65, is a strength of the study.
- Aggregated data allowing for analysis and conclusions to be drawn at the municipal level where primary health care is administered is a study strength.
- Analyses were adjusted for several municipal level confounders, but lack of individual-level data made it impossible to adjust for individual-level confounders, such as morbidity, which is a limitation.

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ABSTRACT:

Objective: To examine if increased general practice activity is associated with lower outpatient specialist clinic use.

Design: Cross-sectional population based study.

Setting: All 430 Norwegian municipalities in 2009.

Participants: All Norwegians aged ≥65 years (n = 721 915; 56% women – 15% of the total population)

Main outcome measure: Specialised care outpatient clinic consultations per 1000 inhabitants (OPC rate). Main explanatory: GP consultations per 1000 inhabitants (GP rate).

Results: In total, there were 3339 031 GP consultations (57% women) and 1757 864 OPC consultations (53% women). The national mean GP rate was 4625.2 GP consultations per 1000 inhabitants (standard deviation [SD] 1234.3) and the national mean OPC rate was 2434.3 per 1000 inhabitants (SD 695.3). Crude analysis showed a statistically significant positive association between GP rates and OPC rates. In regression analyses, we identified three effect modifiers; age, mortality, and the municipal composite variable of 'hospital status' (present/not present) and 'population size' (small, medium and large). We stratified manually by these effect modifiers into five strata. Crude stratified analyses showed a statistically significant positive association for three out of five strata. For the same three strata, those in the highest GP consultation rate quintile had higher mean OPC rates compared to those in the lowest quintile after adjustment for confounders ($p<0.001$). People aged ≥85 in small municipalities had approximately 30% lower specialist care use compared to their peers in larger municipalities, although the association between GP-rates and OPC-rates was still positive.

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Conclusions: In a universal health insurance system with high GP-accessibility, a health policy focusing solely on a higher activity in terms of GP consultations will not likely decrease out-patient clinic use among elderly.

Key words: Primary Health Care, Health Services Research, Health Policy, Small-Area Analysis, Care Utilization.

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INTRODUCTION

Future health care utilization might escalate as a consequence of biomedical innovations, more informed patients, and population ageing, which leads to a higher proportion of chronically ill individuals. Specialist health care (SHC) uses a major and increasing proportion of health care budgets, so rationing of these services is a priority in most countries. Governments,[1,2] the World Health Organization (WHO),[3] and US employers[4] argue for a strengthening of primary health care (PHC) to enhance chronic care and to better control health care expenditure.

Historically, Norway has a well-developed primary health care in a universal health insurance system.[5] Nevertheless, variations in hospital use,[6] general practitioner (GP) referral rates,[7] and consultation costs[8] are reported at physician, municipality, and regional levels. A patient list system was introduced in 2001, partly to strengthen access to GPs and in connection with the newly implemented coordination reform it has been suggested to increase the number of GP's to ease pressure on the hospitals. Early detection of disease, and improved monitoring, care, and treatment in general practice, may decrease or increase the patient need for outpatient clinic or private specialist appointments.[9] This depends on GPs' threshold for referrals, reflecting the diagnostic, organizational and therapeutic armamentarium in their local primary care setting.

The Norwegian coordination reform assumes that care for chronically ill, elderly people can be less fragmented and less costly through the substitution of hospital use by enhanced primary care.[10] The main measures are increase in GP capacity and reorganisation of the cooperation both within and between the levels of health care.

An outpatient clinic (OPC) is by far the most frequent form of contact between GPs and hospitals in Norway, because the OPC consultations outnumber the hospital admission rate by a factor close to five.[11] Findings, mostly from American ecological, macro-level studies,

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indicate that in large geographical areas (countries and states) proxies for PHC accessibility, is associated with better overall access to health care, lower health care expenses and hospital use, and improved health outcomes.[12,13] However, primary care seems to have more impact in societies with higher social inequalities and at higher levels of aggregation.[13-15] We have not identified any previous studies investigating the association of direct measures of GP activity on secondary care utilization. Thus the question of whether GP-consultation rates are associated with lower OPC-consultation rates, which is the most common entry into secondary care, is currently unknown.

In the current study we had access to a national database including all GP consultations and all OPC consultations in Norway in 2009, which was the first year with almost complete data from private specialists.

The aim of this cross-sectional study was to examine the hypothesis that more general practice visits are associated with reduced use of specialised care by 1) exploring the association between rates of GP and OPC consultations among people aged >65 in Norway and 2) studying the effect modification of case-mix factors (age, sex, and mortality) and barriers to secondary care (travel time to hospital and municipal hospital status).

METHODS

Materials

This one year, total population based, cross-sectional study included all Norwegians aged ≥65 years (n = 721 915; 56% women – 15% of the total population) in 2009. As we had no access to individual level data, we chose to use aggregated data which was grouped according to Norwegian municipality of residence (n=430), sex, and the following age groups: 65–69, 70–74, 75–79, 80–84, 85–89, and ≥90. This was the highest data granularity available from public registries. One of the principal aims of the research was to examine the effect of age on associations. Hence rather than calculate age-standardised rates, a dataset was generated of

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5145 units of observation, based on the 430 municipalities multiplied by 12 age/sex groupings. Analysis of the data using this structure allowed us to examine the effect modification of age- and sex, something which is not possible with age- and sex- standardized data which is common in this field. Information on GP consultation rates was missing for 46 rows (706 individuals). We linked data from the following:

1. The Norwegian Patient Registry: OPC rate defined as the total number of both public and private OPC consultations in 2009 per 1000 inhabitants for each unit of analysis

2. Statistics Norway: mortality, socioeconomic variables

3. The Norwegian Health Economics Administration (HELFO): GP rate defined as the total number of GP office and out-of- hours casualty clinic consultations per 1000 inhabitants in 2009, in each unit of analysis.

The data were checked by hospitals and the Norwegian Patient Registry and underwent an internal quality check mainly based on comparisons with the previous year's data and internal consistency. The different data from Statistics Norway are derived from national public registries of all the citizens living in Norway.

Statistical methods

The outcome variable (OPC rate) had a Poisson distribution that approximates a normal distribution when the probability for the outcome is high (>5%). Thus, we manually built a linear regression model in SPSS (Statistical Package for Social Sciences) v.16 and SAS (Statistical Analysis System) v.9.2. To obtain as many percentile groups as possible to visualise threshold effects, while avoiding unstable results due to small numbers in each group, we classified our main explanatory variable, GP rate into quintiles. GP quintile 1 represented the lowest 20% and GP quintile 5 the highest 20% of the GP rate within each age

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group, thereby making age adjustment in analyses unnecessary. Table 1 describes the exact operationalization and impact of several variables known to influence health care use.[16]

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Table 1: Description and role in analyses of explanatory variables

Explanatory variable	Variable description	Relationship to OPC rate?	Included in final model?
Sex		OPC rates in men > women	Adjustment variable
Age	Five-years age groups 65–69;70–74 up to 90+	OPC rates at 65–84years of age higher than in those aged 85+	Stratifying variable
Composite variable: municipal population size and hospital status	1. No hospital, small (municipal population <5000) 2. No hospital, medium (municipal population >5000 to <20 000) 3. No hospital, large (municipal population >20 000) 4. Hospital and small and medium (municipal population < 20 000) 5. Hospital and large (municipal population > 20 000)	OPC-rates (from high to low) large hospital municipalities; Large municipalities without hospital; Small or medium municipalities with hospital; Small or medium municipalities without hospital	Stratifying variable
Mortality	Five-year age group and sex specific all cause mortality at the municipality level	Linear positive at age 65–84. Non-linear positive at age 85+	Stratifying variable
Travel time to hospital	Travel time in minutes from municipality town hall to closest hospital (source 2). Four travel time groups: 0–19 min, 20–59 min, 60–119 min, ≥120 min	Four travel time groups; linear negative in both age groups	Adjustment variable
Municipality education	Age and sex specific average proportion of the municipal population with primary school as highest education for the years 2002–6[a]	Linear negative in both age groups	Not included
Municipality relative poverty level	Average proportion of the population for the years 2005–8 with a disposable household income <60% of the median value[a,]	Non-linear positive in both age groups	Not included
Municipality unemployment	Average proportion of the population aged 16–66 years that was unemployed for the years 2000–9	Non-linear positive in both age groups	Not included

[a]From Eurostat.[16]

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Where bivariate correlation between the adjustment variables had a Pearson correlation coefficient ≥0.7, the variables were included as a joint composite variable. In the final model trends in the outcome across GP quintiles were tested by comparing the difference in annual Least Square means between the first and last quintiles using independent samples t-test.

The number of individuals (n) falling within the 5145 units of analysis varied between 1 and 10414 (mean 140.5). To ensure that those units containing few individuals did not have an unduly large influence on the results, all analyses were weighted by n. We did the analysis using a formalised evaluation of effect modification based on both statistical significance and policy relevance, in line with previous work.[17] Policy relevance was a priori defined as a more than 15% change (365 OPC consultations per 1000 inhabitants) compared with the reference. Confounding was defined as a change in the predicted least square means of the relationship between the main explanatory and outcome variable of >10%.[18]

The estimates of both GP and OPC rates in the 12 sex and age groups were expected to correlate within each municipality. To account for this, we adjusted for municipality by adding it to the model as a random effect variable. Finally, we checked that the distribution of the standardised residuals for both the intermediate model (main variables, age and sex) and the final model were normally distributed.

RESULTS

In total, there were 3339 031 GP consultations (56% women) and 1757 864 OPC consultations (53% women) over the 12 month period. The mean GP rate was 4625.2 GP consultations per 1000 inhabitants (standard deviation [SD] 1234.3) and the mean OPC rate was 2434.3 per 1000 inhabitants (SD 695.3). The national distribution of population, GP rates, and OPC rates by five GP quintiles and strata is given in Table 2.

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Table 2: Descriptives of outcome, explanatory, and stratifying variables

Age and municipality type	GP quintile						
	1	2	3	4	5	All	p value
Rate of OPC consultations (visits/1000 inhabitants)							
Men							
65–84, small & medium + large non-hospital	2130	2306	2286	2353	2420	2276	<0.000[1]
65–84, large, w/ hospital	2839	3015	2924	3229	3138	3050	<0.000
85+, small	1607	1644	2019	1890	2071	1873	<0.000
85+, medium & large	2024	2153	3029	2772	2946	2761	<0.000
85+, medium & large, highest mortality	1929	3209	3230	2624	2693	2754	<0.000
All	2022	2237	2310	2390	2352	2230	<0.000
Women							
65–84, small & medium + large non-hospital	1938	1979	1997	2025	2113	2014	<0.000
65–84, large, w/ hospital	2562	2461	2788	2655	2696	2658	<0.000
85+, small	1175	1288	1424	1294	1456	1282	<0.000
85+, medium & large	1688	1872	1977	2147	2094	1935	<0.000
85+, medium & large, highest mortality	1941	1759	2097	1938	1931	1899	<0.000
All	1680	1814	1923	1894	1988	1836	<0.000
Rate of GP consultations (visits/1000 inhabitants)[#]							
Men							
65–84, small & medium + large non-hospital	3006	4216	4599	5089	6738	4675	<0.001
65–84, large, w/ hospital	3720	4303	4450	5330	5809	4798	<0.000
85+, small	2793	3966	4724	5110	7704	5525	<0.000
85+, medium & large	3167	4175	4664	5208	6703	5552	<0.000
85+, medium & large, highest mortality	3443	4221	4888	5427	6521	5700	<0.000
All	2977	4174	4626	5135	7052	4963	<0.000
Women							
65–84, small & medium + large non-hospital	3195	4386	4611	5101	6257	4655	<0.000
65–84, large, w/ hospital	3965	4442	4684	5113	5237	4755	<0.000
85+, small	2856	4034	4756	5096	6828	4307	<0.000
85+, medium & large	3534	4137	4599	5257	6268	4579	<0.000
85+, medium & large, highest mortality	3335	3998	4614	4580	5192	4040	<0.000
All	3107	4270	4653	5105	6343	4551	<0.000
Population (n)							
Men							
65–84, small & medium + large non-hospital	45 699	29 714	23 547	25 621	43 105	167 686	
65–84, large, w/ hospital	19 961	38 927	18 477	23 246	12 197	112 808	
85+, small	2 757	1 196	1 733	1 364	6 678	13 728	<0.000[2]
85+, medium & large	611	617	2 641	8 024	6 191	18 084	
85+, medium & large, highest mortality	308	215	355	431	733	2 042	
All	69 336	70 669	46 753	58 686	68 904	314 348	
Women							
65–84, small & medium + large non-hospital	42 513	30 253	32 049	35 683	49 572	190 070	
65–84, large, w/ hospital	12 931	24 016	51 299	34 447	17 959	140 652	
85+, small	9 821	4 357	4 769	4 606	5 887	29 440	<0.001[2]
85+, medium & large	6 816	15 261	9 439	7 557	2 342	41 415	
85+, medium & large, highest mortality	18 14	2 168	1 225	422	361	5 990	
All	73 895	76 055	98 781	82 715	76 121	407 567	
Travel time between municipality and hospital (minutes)							
All							
65–84, small & medium + large non-hospital	63	52	56	53	58	58	<0.000
65–84, large, w/ hospital	3	4	4	6	3	4	<0.000
85+, small	74	57	51	64	59	64	<0.000
85+, medium & large	5	7	7	9	10	8	<0.000
85+, medium & large, highest mortality	4	7	8	5	7	6	<0.000
All	63	47	47	48	54	55	<0.000
All cause mortality rates (total deaths/ 1000 inhabitants)							
All							
65–84, small & medium + large non-hospital	33	34	37	32	42	36	<0.000
65–84, large, w/ hospital	36	36	28	40	32	35	<0.000
85+, small	181	192	178	182	235	201	<0.000
85+, medium & large	137	153	150	164	165	156	<0.000
85+, medium & large, highest mortality	243	258	220	260	377	285	<0.000
All	81	81	80	81	110	90	<0.000

[#]Absolute rates of GP consultations in each defined strata. [1] Tested with one-way ANOVA. [2] Tested with chi-square test.

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In crude analysis, there was a statistically significant positive relationship between GP rates and OPC rates (data not shown).

The association between the GP rate and the OPC rate was modified by age, mortality, and the composite variable of municipal 'hospital status' (present/ not present) and 'population size' (small, medium, large). We stratified manually by these effect modifying variables, resulting in five strata (Figure 1). Crude stratified analyses showed (Figure 2), a statistically significant positive t for the 'Age group 65–84 Small to medium & large non-hospital municipalities'-stratum, the 'Age group 85+ small, no hospital-stratum, and for the 'Age-group 85+ medium-large'-stratum. For the remaining two strata, the association was also positive, but not statistically significant.

We then identified two significant confounders: (1) sex and (2) travel time to hospital. In the fully adjusted model (Figure 2 and Table 3), the three strata with statistically significant positive association in crude stratified analysis showed a statistically significant positive trend comparing top and bottom quintiles ($p<.0001$).

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Table 3: Outpatient consultation rate per 1000 inhabitants (OPC rate) by GP quintiles, stratified by age and municipality type[#]. Norway 2009. Least Square (LS) means with 95%-confidence intervals (95% CI). Adjusted model[##].

		Age 65-84		Age 85+		
Municipality type		Small & medium + large non-hospital	Large, w/ hospital	Small	Medium & large	Medium & large, highest mortality
GP quintile	1	1960	2609	1601	2171	2707
		(1904 - 2015)	(2354 - 2865)	(1526- 1676)	(1944 - 2398)	(2434 - 2980)
	2	2067	2658	1587	2601	2715
		(2008 - 2126)	(2467 - 2849)	(1483 - 1691)	(2406 - 2795)	(2450 - 2980)
	3	2094	2865	1751	2319	2948
		(2035 - 2153)	(2682 - 3049)	(1656 - 1846)	(2138 - 2500)	(2653 - 3243)
	4	2166	2858	1658	2522	2240
		(2108 - 2224)	(2677 - 3039)	(1562 - 1755)	(2363 - 2681)	(1860 - 2620)
	5	2308	2731	1864	2684	2284
		(2252 - 2364)	(2491 - 2971)	(1790 - 1938)	(2488 - 2879)	(1947 - 2621)
	Diff 1-5	-348***	-122	-263***	-512***	-423
		(-427- -269)	(-474 - -231)	(-368- -157)	(-811- -213)	(-29-875)

[#] See Figure 1. [##] adjusted for travel time and sex. *** p-values<0.0001; independent samples t-test,

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The 85+ stratum with medium and large municipalities and the highest mortality now became a negative but still non-significant association (p<.07). The 85+ stratum for small municipalities without a hospital had a considerably lower OPC rate than all the other groups. This was between 24% and 39 % lower than the OPC-rates of the stratum aged 85+ living in medium/ larger municipalities.

DISCUSSION

The principal finding was a moderate positive association between GP consultation rates and rates of OPC use among elderly people in Norway in 2009. The main explanatory variable showed effect modification with age, mortality, and the composite of hospital status and municipality population size. The positive association remained when the analysis was adjusted for the two confounding variables – sex and travel time to hospital – except in the oldest age group with the highest mortality in medium–large municipalities. Socioeconomic variables did not influence the association, and were not included in the final analysis.

Strengths and limitations

In Norway, the gate keeping principle requires that GPs send most referrals, in the first instance, to an OPC or private specialist for a specialist evaluation, where further decisions about diagnostic procedures, treatments, follow-up, and referrals to other specialised personnel are made. About 90% of referrals to public OPCs and most referrals to private specialists are non-urgent, and the large OPC volume shows geographical variation.[11] Consequently, the use of OPCs and specialists is a reliable indicator of the total health care use resulting from GP activities. Our comprehensive and high quality, one-year dataset offers a suitable base to study associations between explanatory factors and OPC use for older people in a universal health care system. By developing regression models using municipality, age, and sex specific strata, we were able to examine age and sex effect modification in the age group mostly focused, namely elderly people. Available geographical, socioeconomic,

and demographic variables known to influence health care use made it possible to adjust for municipality and population characteristics.

As the Norwegian health care system has given PHC a high priority over the last decade, the findings have relevance for other countries planning to strengthen their PHC. Norway's 430 municipalities (2009) are well defined administrative units, most frequently used in public statistics and responsible for the provision of PHC, including GPs. The municipalities are responsible for- and provide the financial and organizational framework for primary care in Norway. Thus the municipality level of aggregation allows us to draw conclusions at the health care unit level, but not at the individual level. GPs send their consultation data to the Norwegian Health Economics Administration (HELFO) for financial reimbursement. As 99.6% of the population are registered by a GP as list patients, data on GP consultations are considered complete and of acceptable quality. In addition, the dataset comprises the total number of consultations from almost all casualty clinics.

In Norway, specialist care is offered within a hospital setting that is both publicly funded and organised ('public'), and among private specialists that is privately organised but predominately publicly funded ('private'). The hospital OPC data include both 'public' and 'private' specialist consultations.

Due to data restrictions we undertook this analysis at an aggregate level, and therefore our results might by limited by the ecological fallacy if the area based associations we observed do not hold at the individual level. Nevertheless the hypothesis that we were testing is area-based in nature as we are interested in exploring associations at system level that equates to that at which policies are implemented, so we argue that such aggregate analysis is appropriate in this case. A further limitation is that we only had data for a single time point,

and hence interpretation of our findings should be made in light of the limitations of cross sectional analyses for the determination of causality.

As no information of morbidity was available, we utilized all-cause mortality as a proxy for morbidity. This has limitations, as have other studies in this field,[13] while some present only crude analyses.[19] Some authors who have adjusted for morbidity in their analyses found little or no effect of morbidity adjustment on the association between GP volume and utilization measures.[8,20,21] We therefore believe that further adjustment of morbidity in our analyses would not have materially changed our findings.

Except for the highest GP quintile, mortality did not increase with GP quintiles, which is perhaps surprising. Nevertheless, whilst mortality was an effect modifier, the fact that it did not confound the associations we observed suggests that its use in place of information on morbidity is unlikely to have introduced any significant bias into our analysis.

Over 90% of the 'private' specialists have delivered their consultation data for 2009. As 30% of all OPC consultations are 'private' in the dataset, the total OPC rates are slightly under-estimated. We have no reason to believe that non-reporting of private OPCs is in any way related to GP consultation rates. Thus, we believe that this data error is random, although it may cause an underestimate of the observed positive relationships.

Overall, we believe that the limitations listed above do not threaten the conclusions in this study.

Previous research

Two American studies found a non-significant negative association between OPC use and the primary care physician:specialist ratio (PCP-ratio) or primary care physician density respectively.[14,15] In the US several specialists (internists, family practitioners [GPs], paediatricians, obstetricians, and gynaecologists) work as primary care physicians. About

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44% of the consultations inside US PHC in 2007 were estimated to take place at specialists in family medicine/ general practice, who are shown to have different values and goals from other specialists inside PHC.[22,23] Hence, the US studies on the association between PHC and hospital use might be difficult to translate into European or Norwegian contexts, where GPs are the only primary care physicians. The PCP-ratio and "physician density", used mostly in the American studies as explanatory variables for hospital use, are indirect primary care measures. Whether they are reliable proxies for the primary care activity is unclear. As variations in geography and demography influence both the coverage of GPs and the PCP-ratio, we have instead used a direct measure of the primary care delivered, namely the GP consultation rate (GP rate). Other studies have rarely focused specifically on the use of OPCs, which is the measure that we believe is the 'gate' leading to most of the other non-urgent specialist care activities in the Norwegian setting.

A Danish study, including referrals from 141 GPs to specialists, showed that a higher consultation rate was associated with more overall hospital use.[24] Contrary to this, a Swedish cross-sectional study from 4 hospital districts including 52 health centres showed that high rates of GP visits were associated with reduced hospitalisation.[25] These studies were undertaken in health systems that have many similarities with the Norwegian system, but the sample sizes were small. Kronman et al showed, in an American study of end of life primary care visits, that six or more GP visits had a possibly preventive effect on hospital use, thus indicating a GP effect above a certain threshold.[26]

Interpretation of the results

The major finding is that higher GP activity is associated with higher OPC activity among people 65 years and older. This contradicts other studies demonstrating an overall more efficient health care system in countries where GPs are gatekeepers to specialised health care.[27] Whether the strengthened bond between GPs and patients due to the patient list system

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has led to an even stronger GP emphasis on the patient advocate role at the expense of the gate keeper role is currently under debate.[8, 28, 29] A study from Danish health care, highly comparable to the Norwegian health care system, reports an significant higher GP propensity to refer to secondary care in 2009 compared to 1993, mostly to out- patient clinics.[30]

Probably, both medical and technical development, increased co-morbidity with age[31], a stronger population risk awareness,[32,33] a growing tendency towards disease mongering[34] and defensive medicine,[35,36] indicating more intensive therapeutic examinations and/ or follow-up[37] are all factors that probably influence both the GP and the OPC activity and hence the studied association.

Strengthening the supply of and access to a GP may replace specialist care in societies with deficits and inequalities in health care. However, above a certain level, e.g. in Norway with relatively high rates for both GPs and OPCs, there might be no further substitution effect of increasing GP availability without more clearly defining the organization and content of the services. This must include a consideration on how GPs could be used more effectively, and how GPs can be included in chronic care management

The absolute level of OPC use is substantially lower in the smaller and more distant municipalities (mean travel time approximately 1 hour) for all age groups (Table 2). We hypothesize that distance may be a barrier to secondary care. Whether this reflects an adequate pattern of use is unknown, but it is likely that these municipalities organize and integrate the total PHC system for elderly people differently. Two Canadian studies support such an interpretation.[38,39] One Canadian qualitative study indicated that lower referral rates from distant municipalities can mostly be explained by access to local resources and corresponding practice styles that influence the local ecology of total health care use.[40]

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The OPC utilization differences between the highest and lowest GP percentiles are between 10% and 15%, highest for the oldest groups. The difference is close to what we a priori defined as relevant to policy, although we are not able to define the optimal level of the OPC-rate. Whether this reflects a quality improvement potential among some general practitioners, is outside the scope of the study. However, a recently published English report states that albeit a general good quality, wide variation in performance and quality of care indicate an opportunity for quality improvement in general practice.[41]

The negative association found for the 85+ group with the highest mortality might illustrate that a higher GP presence meets the patient needs in this group better when in cooperation with municipal long term care. Also, patients with a high morbidity might be referred directly to hospital inpatient care instead of an OPC. As the 85+ group with high mortality consists of 1.1% of the population of the dataset, we cannot exclude that the finding is a result of unstable data (Table 2).

Further research

Characteristics of the health care system, case-mix, and living conditions (geographical, cultural, and socioeconomic) have an impact on the small area variations in health care use.[42] In Norway, with moderate socioeconomic and mortality inequalities, we find that the variability in use of specialist care is explained by both differences in case-mix and variations at the municipal and health care level. There is a need for data that allow the analysis of individuals and higher level units simultaneously, preferably over time. This analysis necessitates adequate statistical frameworks, such as multilevel modelling. In addition we need legal and practical access to existing data sources at the individual and GP level, including information on multi-morbidity and referrals that facilitates research on patient trajectories.

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We conclude that more of the same GP service will hardly ease the pressure on secondary care in a setting with universal health care coverage and high GP-accessibility. A reduction in secondary care utilization may be a joint product of both high GP access and a re-organization of care, according to new principles of chronic care management. If so, health workers, including GPs and specialists, should consider to reorganize, redistribute and delegate some of their clinical work[43] and participate or take the lead in collaborative care networks in partnership with some of their patients. However, implementing models for integrated chronic care is hard work,[44] and might suffer from single disease-orientated rather than a person-focused models, as many patients are multimorbid.[45-46] Complex daily practices,[47] interprofessional attitudes,[48] and insufficient management skills,[49] are challenges which need to be focused both in development of such teams and in education and continued training for health personnel in the future.[50] As such models are not necessarily transferable, they have to be developed and evaluated multidimensionally in a Scandinavian setting. How this will influence the utilization and costs of primary and secondary care is a subject for research.

CONCLUSIONS

A high GP consultation rate in Norway is associated with increased use of specialised outpatient health care. This finding suggests that, in a universal health insurance system with high GP-accessibility, it is unlikely that a health policy focusing only on a higher volume of GP consultations will decrease pressure on specialist health care use among elderly people.

Contributors

TSD and GB initiated and designed the study. TSD collected the data. TSD and GB carried out the data analyses. TSD drafted the paper, and all authors contributed to the writing of the manuscript and read and approved the final manuscript. GB is the guarantor of the study.

Acknowledgements

Thanks to researcher Erik R. Sund, Regional Health Authority of Northern Norway, and Professor Andy Jones, University of East Anglia, for valuable comments to the manuscript.

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Competing interests

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; and no other relationships or activities that could appear to have influenced the submitted work.

Funding

This work was supported by Regional Health Authority of Northern Norway, and the National Centre of Rural Medicine, Tromsø, Norway.

Ethical approval

The study was approved by the Privacy Ombudsman for Research in Norway in accordance with the Personal Data Act and Health Registry Act (project number 17869).

Data sharing

The raw dataset is available from the corresponding author. Appliciants must be prepared to conform by Norwegian privacy regulations. There are no additional data available.

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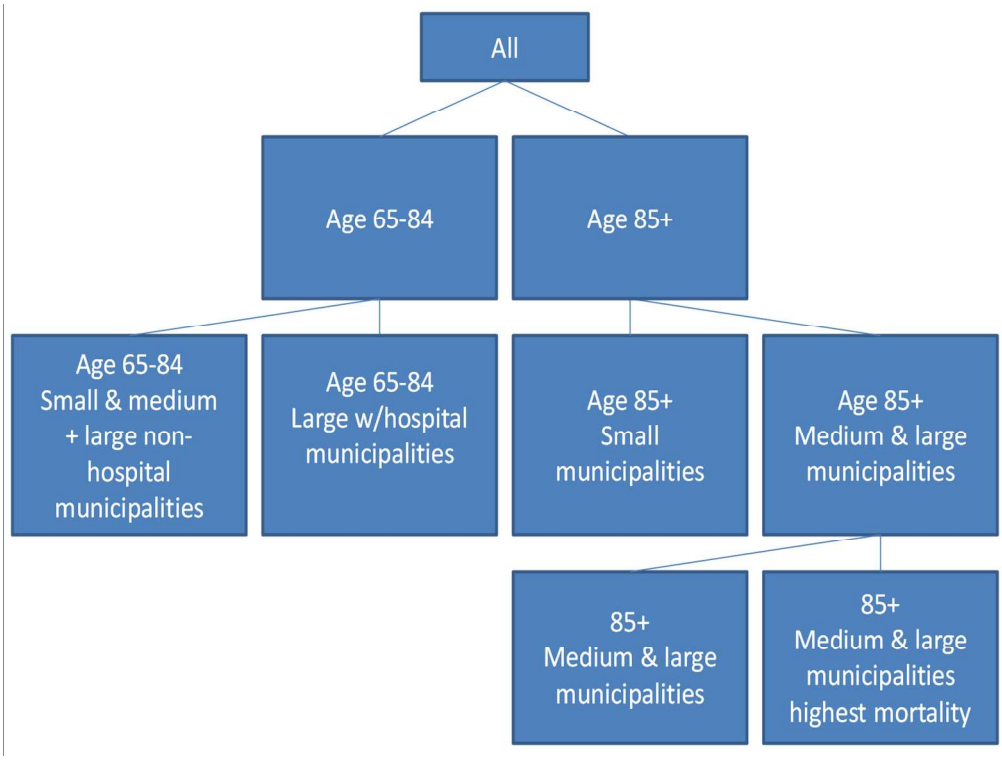

Figure 1 Diagram of stratification by age, the composite variable of municipal 'hospital status' and 'population size', and mortality.
279x209mm (150 x 150 DPI)

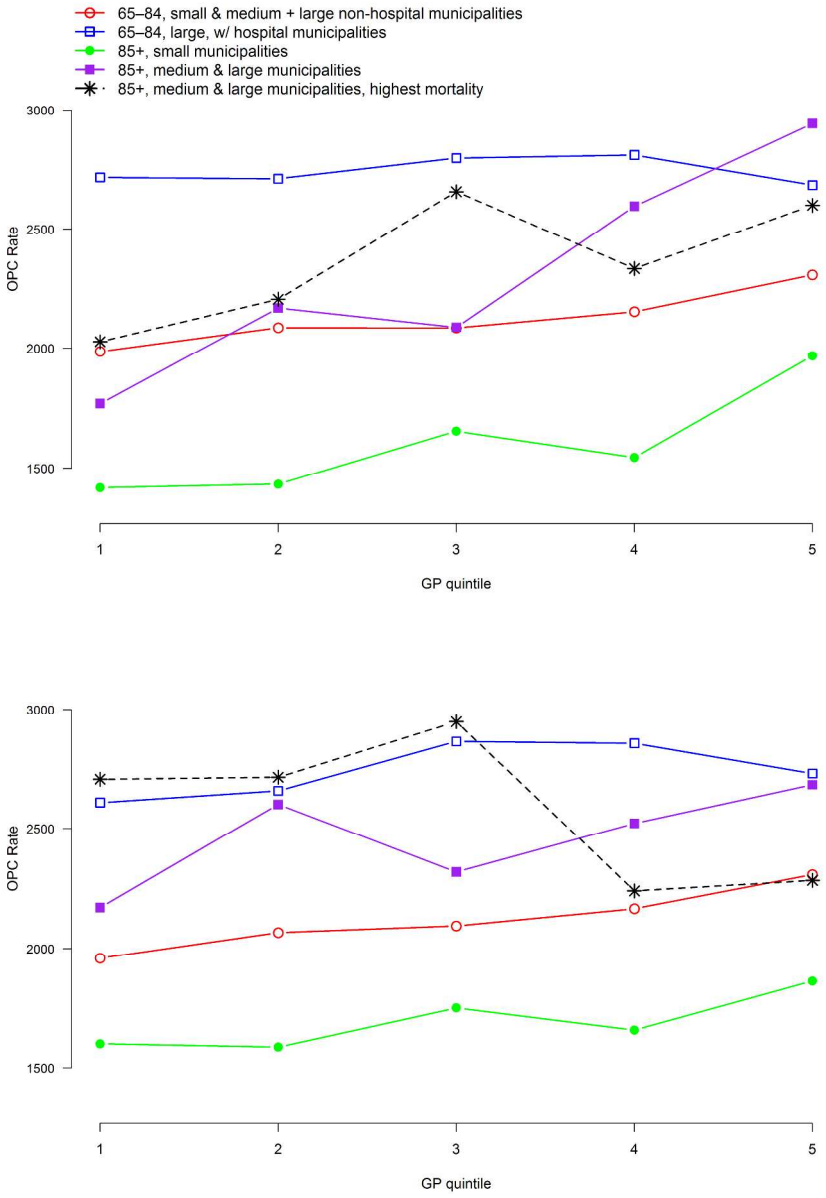

Figure 2 Crude (above) and adjusted (below) associations between general practitioner consultation and outpatient consultation rates. Stratified by age, the composite variable of municipal 'hospital status' and 'population size', and mortality. 1st quintile group represents the 20% lowest percentage in each 5-year age group. Accounted for repeated measures within municipality. Adjusted for sex, travel time to hospital and repeated measures within municipality. Norwegian population aged ≥65 years. 2009.

355x497mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***
Regarding manuscript "*The more primary health care, the less specialist care? A Norwegian national one-year cross-sectional study*"-Deraas,TS et al.

	Item No	Recommendation	On page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8
Bias	9	Describe any efforts to address potential sources of bias	6-10 + 14-15
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-9
		(*b*) Describe any methods used to examine subgroups and interactions	9+11
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Not applicable
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6-8
		(b) Indicate number of participants with missing data for each variable of interest	6
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9+11
		(*b*) Report category boundaries when continuous variables were categorized	6-7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not relevant
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	7+9
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

Correction

Deraas TS, Berntsen GR, Hasvold T, *et al*. Is a high level of general practitioner consultations associated with low outpatients specialist clinic use? A cross-sectional study. *BMJ Open* 2013;**3**: e002041. There are two typographical errors in this article:

The first error appears on page 5, at the end of the Results section. 'p=0.07' was incorrectly written as 'p<0.07' in the sentence 'The 85+ stratum with medium and large municipalities and the highest mortality now became a negative but still non-significant association (p<0.07)'.

The second error appears in table 3, in row 'Diff 1–5', column 'Medium and large, highest mortality'. '−423' should be '+423'.

BMJ Open 2013;**3**:e002041corr1. doi:10.1136/bmjopen-2012-002041corr1