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# DOES VARIATION IN GP PRACTICE MATTER FOR THE LENGTH OF SICK LEAVE? A MULTILEVEL ANALYSIS BASED ON NORWEGIAN GP-PATIENT DATA

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# Does variation in GP practice matter for the length of sick leave? A multilevel analysis based on Norwegian GP–patient data *


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# Abstract

In many countries, the social insurance system is under pressure from an ageing population. An increasing number of people are on sickness benefits and disability pensions in Norway. The general practitioner (GP) is responsible for assessing work capacity and issuing certificates for sick leave based on an evaluation of the patient. Although many studies have analysed certified sickness absence and predictive factors, very few studies focus on the length of sick leave and no studies assess its variation between patients, GPs or geographical areas within a multilevel framework. This study aims to analyse factors explaining the variation in the length of certified sick leave and to disentangle patients, GPs and municipality sources of variation in sickness durations for the whole population of Norwegian workers in 2003. This study uses a unique Norwegian administrative data set that merges data from different sources. The study uses a matched patient–GP data set, and employs a multilevel random intercept model to separate out patient, GP and municipality-level explained and unexplained parts of the variation in the certified sickness durations. We find that all observed patient and GP characteristics are significantly associated with the length of sick leaves (LSL). However, 98% of the variation in the LSL is attributed to patient factors rather than influenced by variations in GP practice or differences in municipality-level characteristics. Medical diagnosis is an important observed factor explaining certified sickness durations. Low variations across GPs may imply that the gatekeeping role of Norwegian GPs is weak compared with their advocate role.



*Keywords:* general practitioners (GPs), length of sick leave, multilevel regression models, matched GP–patient data,

*JEL classification:* I11, I12, I18,

# 1 Introduction

In many countries, the social insurance system is under pressure from an ageing population and an increasing number of people on sickness benefits and disability pensions. From 1990 through 2007, the number of persons on sickness benefits in Norway increased by 180%. Around 25% (700,000 persons) of the population below the pension age of 67 years receive income support on the grounds of sickness, health problems or disability Nav (2007). The number of persons on sickness benefits is high in Norway compared with other countries ((Bonato and Lusinyan, 2004)).

Three institutional factors may partly explain the high number of persons on sickness benefits. First, Norway has generous sickness benefits, paying 100% of the current wage for up to a year. Second, the cost to employers of having workers on sick leave is low. Third, the general practitioners' (GPs) medical assessments are seldom scrutinized or evaluated by social insurance institutions.

The main predictive factors for length of sick leave (LSL) are health (diagnosis), age, gender, family circumstances, economic incentives and restrictions in insurance legislation, type of work, social norms and the functioning of the labour market; see for instance Alexanderson (1998), Shiels and Gabbay (2006), Tellens (1989). In addition, there is a large degree of variation in different geographical regions such as municipalities ((Mabeck and Kragstrup, 1993), (Arrelöv et al., 2005)). GP responsibilities include assessing ability to work and issuing certificates for sick leave based on an evaluation of the patient. To date, very little attention has been given to understanding the gatekeeping role of GPs and how much of the variation in sickness absence they can explain.[1]

GPs act as gatekeepers in the sickness benefit system in most western European countries, see for instance Swartling et al. (2007), Stone (1979), Meershoek et al. (2007). This means that they assess the existence of disease, decide whether the disease affects the ability to work, and weigh the pros and cons of sick leave. If sick leave is recommended, the GP must decide its duration and grade (full or part time), and measures to be taken during the absence (treatment, rehabilitation, medication, contact with the employer, referrals and examinations ((Söderberg and Alexanderson, 2003)). The GP must then do paperwork, such as issuing a certificate

[1] Swartling et al. (2007) explore using interviews to discover how GPs view their gatekeeping role and sick-listing practice in Sweden.

stating the medical diagnosis and the duration, and recommending activities or rehabilitation measures. Sometimes more information is required, which makes the evaluation of the patient and her situation complex and time consuming.

In a review of the literature, Söderberg and Alexanderson (2003) found that, given the same patient characteristics, there are large differences between GPs regarding the LSL they certified. GPs face many dilemmas in deciding the LSL ((Hussey et al., 2004), (Timpka et al., 1995) and (Englund and Svärdsudd, 2000)), and there are sometimes conflicting interests between the patient and the GP. Englund and Svärdsudd (2000) found that even in cases where the GP would not recommend sick leave, a certificate was issued in 87% of cases, and concluded that patients appear to have a strong influence on sick leave practice. Tellens et al. (1990) report a large variation between doctors. The gatekeeping role of GPs seems to be weak compared with the role of being a patient advocate ((Ford, 1998), (Berg et al., 2000), (Hussey et al., 2004). Many GPs want to relinquish their gatekeeping role ((Hussey et al., 2004)).

Although many studies have analysed certified sick leave and predictive factors, very few studies focus on the LSL within a multilevel statistical model where different components (patient/GP/municipality) of the explained and unexplained parts of the variation in certified sickness spells are analysed (Söderberg and Alexanderson, 2003). In this study we use a matched patient–GP data set to analyse factors explaining the variation in the length of certified sick leave for the whole population of Norwegian workers in 2003. We use both individual patient data (such as the length of individual sickness absence, medical diagnosis, socioeconomic and work-related factors) and GP data (such as GP age, gender and patient list length). We were able to merge administrative data on patients and GPs because in Norway, general practice is a list-based system in which every inhabitant has the right to be in the care of a regular GP. We also include municipality-specific variables, such as unemployment rates, mortality measures and rural/urban dimensions.

We used a multilevel linear random intercept model that allowed us to separate out patient, GP and municipality sources of variation in sick leave durations. We found that all observed GP characteristics (age, gender, list length, wage scheme) contributed significantly to the variation in length of sick leave. However, individual factors contribute to a much larger extent than GP or municipality factors. Medical diagnosis is an important observed factor explaining certified sick leave durations. We found that 98% of the variation in the length of sick leaves was attributed to individual factors rather than influenced by variation in GP practice or differences in municipality-level characteristics. Low variations across GPs may imply that the gatekeeping role of Norwegian GPs is weak compared with their advocate role.

The paper is structured as follows. Section 2 describes the data and variables used in the empirical analysis. Section 3 discusses the empirical approach and presents the multilevel regression model. Section 4 presents the empirical results, while Section 5 discusses the main finding. Section 6 concludes the paper.

## 2 Institutional settings

The Norwegian sickness system provides both cash benefits and medical benefits within the social insurance system. Employers pay cash benefits for the first 16 calendar days of sick leave, while the insurance system covers the wage loss from the 17th day up to a maximum of 52 weeks.

The sickness benefit in Norway pays 100% of covered earnings, payable from the first full day of incapacity for up to 52 weeks; thereafter the patient is covered by a rehabilitation allowance or disability pension. The maximum earnings for benefit purposes are six times the base amount (G, around NOK 60,000). Self-employed persons receive 65% of assessed covered earnings after a 14-day waiting period (they may voluntarily insure for 100% of earnings, a shorter waiting period or both).

Self-certification can only be used within the first three days, and the employee must obtain a medical sickness certificate from a physician from the fourth day of the sickness spell. If a person works in an IA firm (firms with a special agreement with the government, in which one aim is to reduce sick leave), the self-certification is eight calendar days. For longer sick leaves, the employee and the employer must work out a rehabilitation plan within six weeks.

Norwegian general practice is a list-based system in which every inhabitant has the right to be in the care of a regular GP. GPs are allowed to have up to 2500 patients on their lists but may limit their lists below this level. The payment system (salary model) is a mix of a capitation fee and fee-for-service. The regular GP has a duty to prioritize inhabitants on his/her own patient list, and the GP scheme formalizes the relationship between the patient and doctor. GPs have the responsibility for planning and coordinating individualized preventive work, examination and treatment. They are also responsible for the patient's medical records, for updating medical histories and recording medicine use.

GPs with fixed salaries are municipal employees. The municipalities cover all expenses of the positions, but the National Insurance Scheme (NAV) provides fixed grants to the municipalities per position. The duties of these fixed-salary GPs are set by municipal instructions. GPs with municipal contracts are private practising physicians who sign an agreement with the municipality. For more on the difference between employed and contracted GPs, see Aakvik and Holmås (2006).

# 3 Data and variables

This study used unique Norwegian administrative data in an analysis of how individual LSLs are affected by GPs and GP characteristics. In the study, we merged data from the following data sources. First, information on individual sick leave, together with extensive individual background information, was taken from the FD-Trygd database in Statistics Norway (SSB). This database contains social insurance information on the entire Norwegian population. Second, data on physicians were collected from the Norwegian labour and welfare organization's (NAV's) regular GP database. This database contains information (including age, gender, and patient list length) about all Norwegian GPs collected from SSB and the Norwegian Social Science Data Services (NSD). By merging the two data sets we can explore extensive information on both GPs and their patients.

The sample consists of employees who experienced a sick leave episode in 2003 because of psychological problems or musculoskeletal pain[2]. This group of patients is particularly interesting for several reasons. First, psychological problems and musculoskeletal pain are the major causes for sick leave in Norway (around 60% of the total sick leave episodes in 2003). Second, by focusing on these causes of sickness, we probably reduce the potential problem that some employees obtain sick leave from others than their GP, for example at an emergency ward.

[2]Hensing et al. (2006), Hensing et al. (2000) have analysed the relationship between psychological problems and sickness absence and duration, and Brage et al. (1998) has analysed how sickness duration has related to musculoskeletal diagnoses.

The FD-Trygd database contains individual information on sick leaves, with exact dates for the beginning and end of leave. However, there is no information about absence during the employer period (the 16 days paid by the employer). Thus, in our analysis, each leave period referred to days covered by the National Insurance Administration (NIA), excluding periods shorter than 16 days. For each patient we only consider the first sickness spell and we further restrict our sample to the ten largest diagnoses.

Table 1 gives an overview of diagnoses and the number of sickness episodes per diagnosis. The total number of sickness episodes was 127,397 in 2003, but because of missing observations on explanatory variables, our sample includes 110,802 cases. We first notice that the sample consists of considerably more females (65,790) than males (45,062). A comparatively large proportion of females obtain sick leave for psychological problems (diagnoses P02, P03 and P76), 39.5% compared with 31.1% for males, while a higher proportion of males suffer from back syndrome with and without radiating pain (29.6% vs. 19.3% of the females). Neck syndrome is more prevalent among females than males (12.1% vs. 7.9%), while there are only minor gender differences in other diagnoses.

We also report sample characteristics in Table 1 of the variables that have been used in the statistical models.[3] We see that the average LSL is quite long for this group of patients at just over 71 days. There are only small gender differences; females have about one day longer sick leave than men.

## 4 Methods

Our statistical analysis anticipates that the patients' LSL is partly dependent on patients' personal attributes, physician (GP) characteristics and the administrative municipalities to which they belong. This hierarchical or nested structure in patients' LSL is modelled by separating the patient, GP and municipality sources of variation. By assuming that the coefficients for all three level are fixed (i.e. assuming a linear random-intercept model), we may write the following multilevel/nested linear model:

$$y_{igm} = \beta X_{igm} + \gamma Y_{gm} + \delta Z_m + w_m + u_{ig} + e_{igm}, \qquad (1)$$

[3]See Table A1 in the Appendix for a description of each variable used in the analysis.

where $y_{igm}$ represents the LSL (the dependent variable), which is related to a vector of patient-level explanatory variables $X$, the GP characteristics $Y$ and the municipality characteristics $Z$.

In this specification the overall error term $\nu_{igm}$ is decomposed into $w_m+u_{ig}+e_{igm}$, where $w_m$ is the random error term for the $m$th municipality, $u_{ig}$ denotes the nested effect of the $i$th individual within the $g$th GP and $e_{igm}$ is the remaining disturbance term (the error term for the $i$th individual treated by the $g$th GP within the $m$th municipality). The error terms are assumed to be independently and identically distributed (iid) with mean zero and their respective variances. These disturbance terms are assumed to be independent of each other.

The ability to partition variance at different levels (e.g. municipality, GP and patient) is a unique feature of multilevel regression analysis, and its consideration is relevant for better estimation and quantification of the relative importance of individual compositional and higher-level effects (e.g. in our case patients nested within GPs) for understanding patient/GP/municipality variations in the length of sick leave. In our three-level multilevel regression analysis, level 1 contains 101,802 patients nested within 3,690 GPs at level 2, and GPs are nested within 414 municipalities at level 3. Because the dependent variable is continuous, a multilevel linear model is used.

To examine the variations explained by different levels, ideally four sequential models would be estimated. The first model would be a null (empty) model of patients (level 1) nested within GP (level 2) and GPs nested within municipalities (level 3) with no predictor in the fixed part and only the intercepts in the random part of the model (Model I). This model presents a baseline for comparing the size of higher levels' variations (e.g. GP variations) in the patients' LSL in subsequent models. In the second model we would add all the patients' characteristics in the fixed part of the model that may examine the effect of patient-level predictors on LSL (Model II). Model III is the same as Model II, but adds all the GPs' personal characteristics in the fixed part of the model. Controlling for patient characteristics, this model potentially examines the effect of GP-level predictors on the patients' LSL (fixed part). In the random part of the model, the practice variation of the GPs' certification on the LSL is estimated before and after taking into account the effect of the GP-level observable characteristics. By following this approach, one can examine by how much the unexplained variation is reduced. Finally, the fourth model not only includes all patient and GP-level predictors but also adds municipality-level observable characteristics to the fixed effects. In the random part of the results, this model allows us to examine the extent to which observable municipal characteristics explain municipality-level differences in the patients' LSL (Model IV).

To illustrate the relevance of the GP or municipality differences (variances) for understanding the patients' differences in the LSL, we calculate the intraclass correlation (ICC). The intraclass (cluster) correlation can be expressed as the proportion of the patient differences in the LSL (i.e. patient-level variance) that is at the GP or municipality level.[4] If the ICC is close to 0%, the proportion of the total variance at the GP or the municipality level is small, implying that the GP or the municipality are less relevant for understanding patient disparities in LSL. By this strategy, in particular, we can quantify how much of the GP differences in the length of absenteeism are explained by differences in the patient composition of the GP or municipality, and how much of these GP or municipality differences are explained by the GP characteristics or the municipal level of attributes.

# 5 Results

In this section, we first present the fixed-part results followed by the random-part results of the random intercept model. Note that, because of minor changes in the fixed part and random part results based on models II and III, we do not present the results for these models in the tables. Instead, we compare the results for the null model (Model I) and the model with all three level predictors (Model IV) in the fixed part of the model. In addition to presenting the full model, we also report results for male and female patients separately.

[4] For example, the proportion of the patient-level variance ($\sigma_M^2+\sigma_G^2+\sigma_i^2$) that is at the GP-level ($\sigma_G^2$ ) can be calculated by the general formula as ICC = $(\sigma_G^2)/(\sigma_M^2+\sigma_G^2+\sigma_i^2)$.

## 5.1 Fixed-part results

### 5.1.1 Patient-level characteristics

The independent differential effects of the patient-level covariates are presented in Table 2, which shows that most of the patient-level predictors are significantly associated with the LSL. In particular, the results show that age is positively and significantly associated with the LSL for both genders. It seems that the age effect is rather higher for males than for females. As expected, different socioeconomic variables, such as education and income, are negatively and significantly associated with the LSL. For example, on average, a one-year increase in schooling is associated with a decrease in the LSL of more than a day for males and around 0.6 days for females. Working hours per week seems to be a significant predictor for the patients' LSL. As the working hours decrease, patients' LSL also decreases and the magnitudes of the associations are found to be higher for the male patients' LSL than their female counterparts.

In respect to the diagnosis, the LSLs are significantly higher for patients with 'neck syndrome', 'back syndrome with radiating pain', 'feeling depressed' or 'depressive disorder', compared with patients with 'back symptom'. Except for the 'back syndrome with radiating pain', male patients' LSLs are higher than females'. Compared with a patient working in manufacturing industry, LSLs are significantly higher for patients working in agriculture, construction, wholesale and retail or financial sectors, and in all cases male patients' LSLs are higher than female patients'.

### 5.1.2 Physician-level attributes

Physician-level attributes include physician age, sex, specialization status, list length and whether they are paid a fixed wage or through a capitation scheme. As seen in Table 2, most of the physician-level attributes are significantly associated with the patients' LSL. An older male and fixed-salary GP with a longer list length issues shorter LSL certificates than a younger, female and non-fixed-salary (capitation) physician. It is interesting to note that a male physician certifies significantly shorter LSLs for male patients, on average more than two days shorter than for their female counterparts. No significant difference in the LSL is observed for the female patients when the sick leave certificate is issued by a male physician. Specialist physicians seem to issue significantly longer LSL (by more than 2 days) than non-specialist physicians for male patients; however, this association was not found to be significant for female patients.

#### 5.1.3 Municipal-level characteristics

Most of the municipal-level attributes are not significantly associated with patients' LSL. A female patient's LSL is significantly more than three days shorter if she lives in a rural area; however, this area characteristic is not significantly associated with the male patients' LSL. Municipal-level 'index mortality' seems positively and significantly related with male patients' LSL, whereas 'index unemployment' seems negatively and significantly associated with female patients' LSL.

### 5.2 Random-part results

To what extent is GP practice variation or municipality variation important for the patients' LSL? Table 3 describes the random part of the results, which give us indications for this question. The null model with no predictors (Model I) shows a significant variation in the length of sick leave between GPs ($\sigma_G^2 = 54.1$) and municipalities ($\sigma_M^2 = 70.5$) for all patients. After controlling for patients' observable attributes (Model II), an insignificant increase in the variation between GPs ($\sigma_G^2 = 58.9$) is observed, but the variation decreases at the municipal and patient levels. After accounting for the patients' and GPs' characteristics (Model III), the variation between GPs and municipalities further decreases slightly ($\sigma_G^2 = 54.6$). Finally, after controlling for patients', physicians' and municipality observable attributes (Table 2, Model IV), between-physicians variation reduced negligibly ($\sigma_G^2 = 54.2$) and between-municipality variation was also reduced ($\sigma_G^2 = 63.0$), although the variability is still significant. Similar findings regarding changes in the variations from model to model are also observed for males and females. This result implies for explaining differences in patients' LSLs that the variations in the differences in physicians' characteristics and the municipality differences are statistically significant but very small and only to a minor extent explained by the GP or municipality-level observable characteristics.

Nevertheless, to quantify the extent of the role that GP practice variations play in determining the patients' LSL, intraclass (cluster) correlation (ICC) statistics can be used. In the random part of our results (in the null model), the ICC was 0.80% (Model I) for the GP level and 1.07% at the municipal level. After including patients' and GPs' socio-demographic predictors and municipality-level observable characteristics (Model IV) the ICC is found to be almost constant for the GP level (0.84%) and it is slightly decreased at the municipality level (0.98%). This result suggests that variation in the patients' LSL is mainly affected by patient individual attributes (around 98%) rather than influenced by the GP-level variation or differences in the municipality-level characteristics where they live.

# 6 Discussion

In many countries, the social insurance system is under pressure from increasing numbers of people on sickness benefit and disability pensions. As with many other western countries, the Norwegian health care system is increasingly dependent on the GP's gatekeeper role for cost containment and fair and effective resource allocation. Although many studies have analysed certified sick leave and predictive factors, there is still little known about the factors explaining the variation in the length of certified sick leave and the relative contributions to the variation from patient, GP or geographical area where they live. To our best knowledge, the contributions of this paper are among the first that use merged administrative data on patients and GPs to analyse how observed and unobserved factors influence the duration of LSL. Our multilevel linear random intercept model allows us to separate out patient, GP and municipality sources of variation in LSL for the Norwegian population of workers in 2003.

We find that all observed GP characteristics (age, gender, list length, wage scheme) contribute significantly to the variation in length of LSL. However, patient factors contribute to a much larger extent than GP or municipality factors. The result indicates that 98% of the variation in the length of sickness absenteeism is attributed to patient factors rather than influences of random variation in GP practice or differences in municipality-level characteristics. Our results indicate that differences across patients certified in different practices are not as important as characteristics shared by the total group of patients itself, both in terms of observed and unobserved differences.

Existing studies on GP practice variation use simple statistical analyses and there is no study that separates patient, GP and municipality sources of variation in LSL in a multilevel framework. Hence, it is not possible to compare our random-part results with other studies. Nevertheless, using a much simpler model, Shiels and Gabbay (2006) find that GP effects were much smaller than anticipated, which is in line with our results.

We can, however, compare our fixed-part results with other studies. In particular, we find that older GPs issue shorter LSL certificates; however, in a previous comparative study, Tellens et al. (1990) found that older physicians issued certificates for longer sick leaves. Two alternative explanations can be given for these dissimilar findings. On the one hand, older GPs are more experienced and may be rather conservative, therefore, as the gatekeepers they are more reluctant to issue longer sick leave certificates. On the other hand, older GPs may have known their patients for a longer time, which may allow them to certify patients' longer sickness leaves. The influence of the gender of the GP on the issuing of sickness certificates has also been discussed in earlier literature (Söderberg and Alexanderson, 2003). The studies report different findings and no indicative conclusion had been found on the differential practice of male and female GPs. We find that a male GP certifies a significantly lower LSL for the male patients: on average more than two days shorter than their female counterparts. However, no significant difference in LSLs is found for female patients, whether the sick leave certificate is issued by a male or female physician. For more on patient–GP gender interaction, see Shiels and Gabbay (2006), who reported that GP and patient gender appear to have most impact on sickness certification in the intermediate period (6–28 weeks), but that no effect was found for longer sick leaves.

It is also hypothesized that GP practice variation in sick leaves may be influenced by area or structural-level factors (Söderberg and Alexanderson, 2003). Using a simple statistical analysis, Arrelöv et al. (2005) found a large variation of the length of the sick-leave certificates and sick-leave episodes between counties and between communities in Sweden. However, using a multilevel framework, we find a negligible (around 1%) unexplained practice variation in the length of sickness absenteeism at the municipality level. Our finding is also supported by other studies that use Scandinavian data to asses the importance of area variations for other health measures. In particular, using a multilevel method, Islam et al. (2006) concluded that the variation in health status is mainly affected by individual factors (more than 98%) rather than municipality characteristics in Sweden.

While we believe our analysis offers many advantages compared with many other studies, our study is not without limitations. Using a large cross-national survey with national representative samples, we investigated a wide range of patient and GP attributes potentially associated with LSL. However, this study is based on cross-sectional information and hence is limited in terms of the potential to establish causal relationships. Residential mobility and the length of time that the patient is treated by the same GP or that a GP practices in the same municipality could be a concern, (Islam et al., 2006); however, because of a lack of information, we are not able to adjust our models and do not raise this issue in our analyses. Nevertheless, we learn that only a very small proportion of patients change their GP or GPs change municipality. Another concern could be that the low variance between GPs found in our models underestimates the true variance of the association between patients' characteristics, so the LSL is not constant across GPs. To allow the effect of patient-level covariates to vary across GPs, potentially we could permit the slope of the patient-level variables to vary at the GP level. By acknowledging this possibility, we would try to estimate random-coefficient models for different patient-level covariates (e.g. age, education and income); however, in any case the model does not converge and we leave further exploration of this issue for future work.

Bearing in mind these limitations, do our findings imply that GPs' practice variations really matter for the patient LSL? The answer could be 'yes', because the results indicate that patients' LSL is influenced by the GP characteristics. Even though it is very low, we find an unexplained significant variance in LSL between GPs. While one should be cautious about interpreting fixed-part results, a rather closer look should be given to the random-part results, particularly on the magnitude of the unexplained sources of variation at different levels. To assess the extent to which GP or area characteristics play a role in determining patient LSL, intracluster correlation (ICC) statistics are an appropriate way to identify and quantify, particularly, GP-level influences on the patients' LSL. In our study, GP- and municipality-level ICC appears to be extremely low, altogether less than 2%. This should be interpreted to mean that less than 2% of the total residual variation in the LSL is accounted for by differences between GP and municipality characteristics, meaning that the huge majority of variation exists across patients. Low variation between GPs implies that GPs play insignificant role in the certification process of the patients' LSL, which may also raise the concern regarding the gatekeeping role of Norwegian GPs.

# 7 Conclusions

Medical diagnosis is an important observed factor explaining certified LSLs, and this feature is an intrinsic part of the GPs' role as gatekeepers. The GP is expected to act as a rationing agent on behalf of society and to adhere to national guidelines for prescriptions and referrals. At the same time the powers and rights of patients and the public have been strengthened through several organizational and legal reforms that encourage doctors to share decisions with patients. We find that 98% of the variation in the length of sickness absenteeism is attributed to individual factors rather than influenced by variation in GP practice or differences in municipality-level characteristics. Overall, we conclude that low variations across GPs may imply that the gatekeeping role of Norwegian GPs is weak compared with their advocate role and their gatekeeping role should be evaluated further by social insurance institutions.

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Table 1: Descriptive statistics of the variables used in the regression analyses

| Variable | All patients | Males | Females |
|---|---|---|---|
| *Patient characteristics* | | | |
| Sick days | 71.291 (82.157) | 70.587 (81.994) | 71.773 (82.266) |
| Male | 0.407 (0.491) | - | - |
| Age | 42.043 (11.138) | 42.088 (11.173) | 42.012 (11.113) |
| Years of education | 19.571 (9.928) | 11.906 (3.164) | 12.378 (3.188) |
| Income/1000 | 2171.28 (2129.16) | 2503.33 (2969.67) | 1943.68 (1211.66) |
| Number of individuals in the household | 2.766 (1.414) | 2.731 (1.485) | 2.790 (1.362) |
| Number of children < 6 | 0.248 (0.551) | 0.260 (0.576) | 0.240 (0.533) |
| Years of experience | 18.642 (9.908) | 21.639 (10.691) | 18.153 (9.101) |
| Sick days in 2002 | 20.139 (41.451) | 18.485 (39.735) | 21.272 (42.550) |
| *Working hours per week* | | | |
| Working hours 4-19 | 0.121 (0.326) | 0.047 (0.210) | 0.172 (0.377) |
| Working hours 20-29 | 0.110 (0.312) | 0.022 (0.147) | 0.170 (0.376) |
| Working hours 30 + | 0.769 (0.421) | 0.931 (0.254) | 0.658 (0.474) |
| *Diagnosis* | | | |
| Back symptom/complaint | 0.059 (0.206) | 0.064 (0.241) | 0.056 (0.227) |
| Low back symptom | 0.045 (0.208) | 0.048 (0.213) | 0.044 (0.205) |
| Neck syndrome | 0.104 (0.305) | 0.079 (0.270) | 0.121 (0.326) |
| Back syndrome without radiating pain | 0.133 (0.340) | 0.163 (0.369) | 0.113 (0.316) |
| Back syndrome with radiating pain | 0.101 (0.302) | 0.133 (0.340) | 0.080 (0.271) |
| Shoulder syndrome | 0.103 (0.304) | 0.106 (0.307) | 0.101 (0.301) |
| Tennis elbow | 0.094 (0.292) | 0.098 (0.297) | 0.091 (0.288) |
| Acute stress reaction | 0.097 (0.296) | 0.082 (0.274) | 0.107 (0.309) |
| Feeling depressed | 0.072 (0.258) | 0.058 (0.234) | 0.081 (0.273) |
| Depressive disorder | 0.192 (0.394) | 0.171 (0.376) | 0.207 (0.405) |
| *Industry* | | | |
| Agriculture | 0.008 (0.089) | 0.014 (0.116) | 0.004 (0.065) |
| Mining | 0.015 (0.123) | 0.029 (0.167) | 0.006 (0.080) |
| Manufacturing | 0.133 (0.339) | 0.222 (0.415) | 0.072 (0.259) |
| Construction | 0.065 (0.246) | 0.145 (0.352) | 0.001 (0.099) |
| Wholesale and retail | 0.161 (0.367) | 0.158 (0.365) | 0.163 (0.369) |
| Transport | 0.088 (0.283) | 0.142 (0.349) | 0.051 (0.220) |
| Financial | 0.092 (0.290) | 0.096 (0.294) | 0.090 (0.287) |
| Public administration | 0.062 (0.242) | 0.052 (0.221) | 0.070 (0.255) |
| Education | 0.078 (0.268) | 0.042 (0.200) | 0.103 (0.304) |
| Health | 0.297 (0.457) | 0.102 (0.303) | 0.430 (0.495) |
| *Physician characteristics* | | | |
| Age | 47.621 (8.777) | 47.723 (8.992) | 47.552 (8.626) |
| Male | 0.730 (0.444) | 0.815 (0.388) | 0.671 (0.470) |
| Specialist | 0.612 (0.487) | 0.596 (0.491) | 0.623 (0.485) |
| List length | 1337.41 (390.732) | 1335.70 (393.32) | 1338.59 (388.95) |
| Fixed wage | 0.058 (0.236) | 0.062 (0.241) | 0.057 (0.232) |
| *Municipality characteristics* | | | |
| Large cities | 0.587 (0.492) | 0.577 (0.494) | 0.593 (0.491) |
| Other urban areas | 0.290 (0.454) | 0.298 (0.458) | 0.285 (0.451) |
| Rural areas | 0.123 (0.328) | 0.125 (0.331) | 0.122 (0.327) |
| Index mortality | 5.584 (2.121) | 5.592 (2.135) | 5.579 (2.111) |
| Index unemployment | 6.116 (2.258) | 6.115 (2.262) | 6.116 (2.256) |
| Number patients | 110,802 | 45,062 | 65,740 |
| Number physicians | 3,690 | 3,584 | 3,639 |
| Number municipalities | 414 | 411 | 413 |

Table 2: Fixed part results of the random intercept model

| | Total sample | Male patients | Female patients |
|---|---|---|---|
| *Patient characteristics* | | | |
| Male | -1.206$^{**}$ (0.605) | - | - |
| Age | 1.068$^{***}$ (0.045) | 1.487$^{***}$ (0.090) | 1.001$^{***}$ (0.053) |
| Years of education | -0.730$^{***}$ (0.082) | -1.068$^{***}$ (0.127) | -0.564$^{***}$ (0.108) |
| Income/1000 | -0.005$^{***}$ (0.001) | -0.058$^{***}$ (0.013) | -0.023 (0.028) |
| Number of individuals in the household | -0.955$^{***}$ (0.191) | -1.566$^{***}$ (0.288) | -0.268 (0.256) |
| Number of children < 6 | 3.405$^{***}$ (0.503) | 0.261 (0.758) | 5.899$^{***}$ (0.677) |
| Years of experience | -0.480$^{***}$ (0.051) | -0.822$^{***}$ (0.094) | -0.458$^{***}$ (0.063) |
| Sick days in 2002 | 0.136$^{***}$ (0.006) | 0.138$^{***}$ (0.009) | 0.135$^{***}$ (0.007) |
| *Working hours per week: Base category: Working hours 4-19* | | | |
| Working hours 20-29 | -6.739$^{***}$ (1.003) | -13.084$^{***}$ (3.053) | -5.764$^{***}$ (1.073) |
| Working hours 30 + | -5.924$^{***}$ (0.785) | -12.022$^{***}$ (1.792) | -4.536$^{***}$ (0.895) |
| *Diagnosis: Base category: Back symptom/complaint* | | | |
| Low back symptom | -0.671 (1.513) | -2.536 (2.284) | 0.515 (2.007) |
| Neck syndrome | 9.999$^{***}$ (1.257) | 13.500$^{***}$ (2.014) | 8.004$^{***}$ (1.620) |
| Back syndrome without radiating pain | -2.327$^{*}$ (1.205) | -3.164$^{*}$ (1.769) | -1.423 (1.635) |
| Back syndrome with radiating pain | 18.330$^{***}$ (1.263) | 16.775$^{***}$ (1.828) | 20.630$^{***}$ (1.745) |
| Shoulder syndrome | 11.858$^{***}$ (1.259) | 12.367$^{***}$ (1.903) | 11.269$^{***}$ (1.672) |
| Tennis elbow | -0.027 (1.276) | -0.224 (1.926) | -0.185 (1.697) |
| Acute stress reaction | -11.791$^{***}$ (1.276) | -9.376$^{***}$ (2.006) | -13.190$^{***}$ (1.655) |
| Feeling depressed | 4.445$^{***}$ (1.352) | 8.944$^{***}$ (2.170) | 1.935 (1.737) |
| Depressive disorder | 28.276$^{***}$ (1.152) | 31.456$^{***}$ (1.768) | 25.937$^{***}$ (1.514) |
| *Industry: Base category: Manufacturing* | | | |
| Agriculture | 10.624$^{***}$ (2.771) | 11.202$^{***}$ (3.337) | 7.676 (4.950) |
| Mining | -11.453$^{***}$ (2.062) | -12.996$^{***}$ (2.385) | -4.408 (4.090) |
| Construction | 9.943$^{***}$ (1.166) | 12.120$^{***}$ (1.279) | 3.424 (3.364) |
| Wholesale and retail | 9.012$^{***}$ (0.926) | 10.878$^{***}$ (1.267) | 6.719$^{***}$ (1.426) |
| Transport | -2.779$^{***}$ (1.057) | -3.537$^{***}$ (1.295) | -2.222 (1.827) |
| Financial | 4.654$^{***}$ (1.063) | 6.002$^{***}$ (1.496) | 2.372 (1.586) |
| Public administration | -7.216$^{***}$ (1.205) | -10.681$^{***}$ (1.871) | -6.742$^{***}$ (1.688) |
| Education | -3.032$^{***}$ (1.171) | -0.823 (2.114) | -5.468$^{***}$ (1.584) |
| Health | -5.006$^{***}$ (0.881) | -3.666$^{***}$ (1.472) | -6.708$^{***}$ (1.297) |
| *Physician characteristics* | | | |
| Age | -0.151$^{***}$ (0.036) | -0.069 (0.049) | -0.202$^{***}$ (0.046) |
| Male | -1.648$^{***}$ (0.671) | -2.370$^{**}$ (1.060) | -0.949 (0.804) |
| Specialist | 0.767 (0.646) | 1.475$^{*}$ (0.894) | 0.305 (0.817) |
| List length/100 | -0.371$^{***}$ (0.084) | -0.394$^{***}$ (0.115) | -0.391$^{***}$ (0.107) |
| Fixed wage | -3.218$^{***}$ (1.360) | -4.042$^{**}$ (1.835) | -3.002$^{*}$ (1.721) |
| *Municipality characteristics* | | | |
| Other urban areas | 1.450 (1.459) | 2.370 (1.562) | -0.934 (1.680) |
| Rural areas | -1.998 (1.506) | 0.645 (1.747) | -3.413$^{**}$ (1.775) |
| Index mortality | 0.340 (0.235) | 0.583$^{**}$ (0.268) | 0.168 (0.277) |
| Index unemployment | -0.511$^{**}$ (0.235) | -0.084 (0.270) | -0.691$^{**}$ (0.278) |
| Constant | 52.834$^{***}$ (3.582) | 43.479$^{***}$ (5.158) | 57.870$^{***}$ (4.559) |
| Number patients | 110,802 | 45,062 | 65,740 |
| Number physicians | 3,690 | 3,584 | 3,639 |
| Number municipalities | 414 | 411 | 413 |

Note: Standard errors are in the parentheses.

'***', '**' and '*' are represent significance level at the 1%, 5% and 10% level respectively.

Table 3: Random effects parameters for the random intercept models

| *Model I: Null model* | All | Males | Females |
|---|---|---|---|
| $\sqrt{\text{Municipalities}}$ ($\sigma_m$) | 8.393 (0.552) | 8.099 (0.718) | 7.944 (0.636) |
| $\sqrt{\text{Physicians}}$ ($\sigma_G$) | 7.358 (0.444) | 5.916 (1.024) | 8.808 (0.666) |
| $\sqrt{\text{Residual}}$ ($\sigma_i$) | 81.477 (0.176) | 81.454 (0.279) | 81.497 (0.230) |
| *Model II: includes patient-level covariates only* | | | |
| $\sqrt{\text{Municipalities}}$ ($\sigma_m$) | 7.993 (0.542) | 7.313 (0.694) | 8.527 (0.664) |
| $\sqrt{\text{Physicians}}$ ($\sigma_G$) | 7.673 (0.423) | 5.242 (1.000) | 8.513 (0.594) |
| $\sqrt{\text{Residual}}$ ($\sigma_i$) | 79.596 (0.172) | 79.217 (0.272) | 79.739 (0.225) |
| *Model III: includes patient-level and GP-level covariates* | | | |
| $\sqrt{\text{Municipalities}}$ ($\sigma_m$) | 7.935 (0.544) | 7.214 (0.692) | 8.497 (0.667) |
| $\sqrt{\text{Physicians}}$ ($\sigma_G$) | 7.391 (0.430) | 5.453 (1.049) | 8.216 (0.606) |
| $\sqrt{\text{Residual}}$ ($\sigma_i$) | 79.597 (0.172) | 79.221 (0.272) | 79.741 (0.225) |
| *Model IV: includes all three-level covariates* | | | |
| $\sqrt{\text{Municipalities}}$ ($\sigma_m$) | 7.934 (0.543) | 7.067 (0.700) | 8.156 (0.607) |
| $\sqrt{\text{Physicians}}$ ($\sigma_G$) | 7.363 (0.430) | 5.467 (1.047) | 8.516 (0.663) |
| $\sqrt{\text{Residual}}$ ($\sigma_i$) | 79.597 (0.180) | 79.221 (0.272) | 79.740 (0.225) |
| Number patients | 110,802 | 45,062 | 65,740 |
| Number physicians | 3,690 | 3,584 | 3,639 |
| Number municipalities | 414 | 411 | 413 |

Note: Standard errors are in the parentheses.

Table A1. Variable definitions

| | |
|---|---|
| *Patient characteristics* | |
| Sick days | Number of sick days covered by the National Insurance Administration (excluding spells shorter than 16 days) |
| Male | 1 if patient is male, 0 otherwise. |
| Age | Age of the patient |
| Years of education | Years of completed education |
| Income/1000 | Labour income in 2002 (in 1000 NoK) |
| Individuals in the household | Number of individuals in the household |
| Number of children < 6 | Number of children younger than 6 |
| Years of experience | Years with income above basic counting unit in pension system in 2002 (NoK 56861) |
| Sick days in 2002 | Number of sick days in 2002 |
| *Working hours per week* | |
| Working hours 4-19 | 1 if patient is working 4 – 19 hours per week, 0 otherwise |
| Working hours 20-29 | 1 if patient is working 20 – 29 hours per week, 0 otherwise |
| Working hours 30 + | 1 if patient is working 30 or more hours per week, 0 otherwise |
| *Diagnosis:* | |
| Back symptom/complaint | 1 for diagnosis "back symptom/complaint (L02)", 0 otherwise |
| Low back symptom | 1 for patient with low back symptom (L03), 0 otherwise |
| Neck syndrome | 1 for patient with neck syndrome (L83), 0 otherwise |
| Back syndrome without radiating pain | 1 for patient with back syndrome without radiating pain (L84), 0 otherwise |
| Back syndrome with radiating pain | 1 for patient with back syndrome with radiating pain (L86), 0 otherwise |
| Shoulder syndrome | 1 for patient with shoulder syndrome (L92), 0 otherwise |
| Tennis elbow | 1 for patient with tennis elbow (L93), 0 otherwise |
| Acute stress reaction | 1 for patient with acute stress reaction (P02), 0 otherwise |
| Feeling depressed | 1 for patient with feeling depressed (P03), 0 otherwise |
| Depressive disorder | 1 for patient with depressive disorder (P76), 0 otherwise |
| *Industry:* | |
| Agriculture | 1 if patient is working in agriculture, forestry or fishing, 0 otherwise |
| Mining | 1 if patient is working in mining or electricity, gas and water supply, 0 otherwise |
| Manufacturing | 1 if patient is working in manufacturing, 0 otherwise |
| Construction | 1 if patient is working in construction, 0 otherwise |
| Wholesale and retail | 1 if patient is working in wholesale, retail trade, hotel or restaurant, 0 otherwise |
| Transport | 1 if patient is working in transport, 0 otherwise |
| Financial | 1 if patient is working in financial intermediation, real estate, renting and business activities, 0 otherwise |
| Public administration | 1 if patient is working in public administration, 0 otherwise |
| Education | 1 if patient is working in education, 0 otherwise |
| Health | 1 if patient is working in health or social work, 0 otherwise |
| *Physician characteristics* | |
| Age | Age of physician |
| Male | 1 if the physician is male, 0 otherwise |
| Specialist | 1 if the physician is a specialist, 0 otherwise |
| List length | Number of patients on the list |
| Fixed wage | 1 for physicians with fixed salary, 0 otherwise |
| *Municipality characteristics* | |
| Large cities | 1 if patient resident in large city, 0 otherwise |
| Other urban areas | 1 if patient is resident in other urban area, 0 otherwise |
| Rural areas | 1 if patient is resident in rural area, 0 otherwise |
| Index mortality | Index mortality (1 – 10, 1 for municipalities with the highest mortality) |
| Index unemployment | Index unemployment (1 – 10, 1 for municipalities with the highest unemployment) |

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