10. COMPARING UNMET NEED FOR MEDICAL CARE ACROSS EU COUNTRIES: DOES RISK-ADJUSTMENT MATTER?

Valerie Moran Andrea Riganti   Luigi Siciliani   Andrew M. Jones[1]

10.1   Introduction

Under various international agreements, EU governments have an obligation to ensure equitable access to core health services, which implies a commitment to address levels of unmet need for medical care (European Commission, 2016). In 2017, the European Commission put forward the European Pillar of Social Rights to deliver a social and fair Europe and to serve as a compass for change. The Pillar includes three main dimensions in the field of employment and social policies. The third dimension covers social protection and inclusion, including access to healthcare. The Pillar is accompanied by a "social scoreboard", which monitors its implementation by tracking trends and performances across EU countries and feeds into the European Semester of economic policy coordination. The European Semester supports EU member states to coordinate their economic policies and deal with their economic challenges (European Commission, 2017).

A common issue facing European countries is the unequal distribution in access to healthcare and subsequent inequalities in health outcomes (European Commission, 2017a). An indicator currently used in the social scoreboard to measure access to healthcare is "self-reported unmet need for medical care" which draws on data from EU-SILC. Countries with higher levels of unmet need will face more challenges in improving access to healthcare.

When undertaking comparisons of health outcomes across providers or the health systems it is common to adjust measures for influential risk factors outside the direct control of health care providers or health systems to attempt to facilitate comparisons (Iezzoni, 2009; Moger and Peltola, 2014). Risk-adjustment variables can encompass demographic and socio-economic factors (Iezzoni, 2009; Juhnke et al, 2016; OECD, 2019). Access to health care is also affected by public policy outside the health sector, such as education, employment and social protection (European Commission, 2016).

Measuring unadjusted unmet need for medical care allows countries to assess the extent to which access to medical care is an important societal problem that national governments should address, and to monitor how unmet need evolves over time. The comparison of unmet need as an indicator of access across countries should recognise that countries differ in factors that influence unmet need and are outside the control of the health system. Ideally, cross-country comparisons should control for these risk factors. Adjusting for demographic and socio-economic factors makes differences in unmet need more comparable across countries and contributes to more consistent health system performance assessment, which in turn can guide policy design and intervention to address unmet need. Currently, comparisons of unmet medical need across EU countries using EU-SILC data are not adjusted for individual-level risk factors.

It is important to acknowledge the subjective nature of self-reported unmet need, which may be influenced by factors that are unobserved and cannot be easily controlled. Such factors include cultural norms and attitudes towards health and illness, health knowledge or literacy and expectations of health services (Chaupain-Guillot

and Guillot, 2015; Israel, 2016; Eurostat, 2010; Baeten et al, 2018). For example, respondents with low health knowledge or literacy may underreport unmet need (Chaupain-Guillot and Guillot). These factors are likely to vary across countries and this should be borne in mind when comparing the indicator across countries.

Previous studies have used EU-SILC data to investigate individual- and country-level determinants of self-reported unmet medical need across countries (Chaupain-Guillot and Guillot, 2015; Elstad, 2016; Detollenaere et al, 2017; Reeves et al, 2017; Israel, 2016; Fiorillo, 2019; Madureira-Lima et al, 2018). However, these studies do not compare differences in unmet need for medical care across countries before and after adjusting for individual-level variables, which is our focus. By undertaking such an exercise, we provide insights into how unadjusted differences in unmet need across countries are sensitive to the inclusion of risk factors, and the reliability of current performance comparison in unmet need across the EU.

In this chapter, we investigate how much unmet need differs across EU countries before and after adjusting for demographics (age and gender), possible determinants of need (chronic conditions) and socioeconomic status (education, unemployment, at-risk-of-poverty and household disposable income). We provide confidence intervals for unmet need in each country to show the extent to which differences across countries are statistically significant.

This chapter proceeds as follows: Section 10.2 describes the EU-SILC data used in our analysis; Section 10.3 explains our risk-adjustment method; Section 10.4 presents the results; Section 10.5 discusses our findings, gives policy recommendations and concludes.

10.2   Data

EU-SILC measures unmet need during the previous 12 months for 1) medical examination or treatment and 2) dental examination or treatment. We focus only on unmet need for medical examination or treatment as public coverage for dental care is more limited across EU countries (OECD/EU, 2018) and accounting for these differences is beyond the scope of this study.

The dependent variable, *unmet need*, measures if the individual (aged 16 and over), experienced unmet need for medical examination or treatment during the last 12 months. More precisely, unmet need is a dichotomous variable with two possible outcomes: (1) yes, there was at least one occasion when the person really needed an examination or treatment but did not [receive it]; and (2) no, there was no occasion when the person really needed an examination or treatment but did not [receive it]. In Appendix 10.1 we provide further detail on the unmet need question in the EU-SILC survey.

In some countries, adult variables are obtained by means of interview from a sample of persons according to the 'selected respondent model (i.e. collecting the personal interview for a representative sample composed of one adult aged 16 years or over per household, see Chapter 2 of this volume).

The UDB includes 608 180 observations, of which 513,204 are considered adults (aged 16 years or over) in 2018 with household-level income variables observed for 2017 apart from the UK (total annual household income calculated on the basis of current income) and Ireland (calculation on the basis of a moving income reference period). For Slovakia, Ireland and the UK, 2018 data were unavailable at the time of analysis, therefore we used data for 2017.

Covariates include gender, age, chronic illness or condition, education, unemployment status, at-risk-of-poverty and income. We include quadratic and cubic functions of age to capture non-linearity in the relationship between unmet need and age. We include a variable to reflect whether a respondent suffers from any chronic (long-standing) illness or condition as countries may differ in terms of population health status and prevention policies. The inclusion of this variable also attempts to capture need for health care. In a sensitivity analysis, we consider two additional health variables in the EU-SILC survey: self-reported general health and limitation in activities because of health problems. Self-reported general health is related to how a person perceives her/his health in general and all current household members aged 16 and over (or selected

respondents) are asked this question. There are five possible answers for this question, which range from *Very bad* to *Very good*. Limitation in activities because of health problems refer to any *limitation in activities people usually do because of health problems for at least the past six months*. This variable has three categories: strongly limited, limited and not limited and we entered the variable into the models using these three categories (as dummy variables) without transformation. As for the other health variables, all household members (or selected respondents) aged 16 or over are asked this question.

Educated people may better articulate their needs or demand more care in the form of self-reported need. *Education* variables are based on the ISCED 2011 classification (UNESCO and UNESCO Institute for Statistics, 2012). Following previous studies (Börsch-Supan. et al, 2005; Siciliani and Verzulli, 2009), we construct three categorical variables to capture different educational levels. *Low* education includes categories "0" (no education), "1" (primary education) and "2" (lower secondary education). *Intermediate* education includes categories "3" (upper secondary education) and "4" (post-secondary, non-tertiary education). *High* education includes tertiary education categories, from "5" (Short-cycle tertiary education) to "8" (Doctoral or equivalent level).

The risk of poverty follows the EU definition. We also control for unemployment using the EU-SILC variable used to assess the number of months spent in unemployment in an income reference period. We divide this variable into four levels to capture different durations of unemployment: 1) zero months in unemployment, 2) between one and six months in unemployment, 3) between six and eleven months in unemployment and 4) twelve months in unemployment.

Individuals with high incomes have access to a higher level of resources to purchase healthcare (e.g. from the private sector) or to afford higher levels of co-payments. Total *annual disposable household income* is computed as gross household income net of regular taxes on wealth, regular inter-household cash transfer paid and taxes on income and social insurance contributions in the previous income reference period received, as the best proxy for current income.

Total annual disposable income is a continuous variable and it is measured in Euros. For countries that do not belong to the Euro area (namely Bulgaria, Croatia, Czechia, Denmark, Hungary, Poland, Romania, Sweden and the UK) the conversion factor is provided by Eurostat as a variable in the EU-SILC dataset. To adjust for household size, we normalise income measure using the modified OECD scale included in the EU-SILC dataset. The modified OECD scale gives a value of 1 to the first adult (above 14 years old), followed by 0.5 for each additional household member above 14 years and 0.3 for each household member under 14 years. Moreover, we use the Eurostat deflator (Eurostat, 2020) to adjust income for Purchasing Power Standard (PPS) in order to make comparisons across countries.

In order to analyse the relationship between unmet need and income, we categorise annual equivalised disposable income (expressed in PPS,) into deciles based on the distribution across the whole EU sample. As a sensitivity analysis, we consider annual equivalised disposable income in PPS measured as a continuous variable.

Among the initial sample of individuals aged 16 or over (513 204 observations), 27 572 individuals (5.4%) were excluded as they had missing values on unmet need or were not the selected respondent (in Denmark, Finland, Netherlands, Slovenia and Sweden), i.e. 43 185 observations, 8.4%. The UK had the largest percentage (17%) of missing data on unmet need. Moreover, we excluded from the sample 2 155 observations (0.4%) due to missing data on covariates (education: n=1 253, chronic conditions: n=817, unemployment status: n=34) and extreme or negative annual equivalised disposable income (under -€20 000PPS: n=42, over €600 000PPS: n=9). The final sample has 440 292 observations.

10.3 Methods

We estimate the following logit model:

$$P\left(y_{ij}|x_{ij}\right) = F\left(\boldsymbol{\alpha_j} + \sum_k \beta^k x_{ij}^k\right)$$

Where y_{ij} is a dummy variable for reporting unmet for individual i in country j ($j = 1,\ldots,28$). $\boldsymbol{\alpha_j}$ is a vector of country fixed effects. x_{ij}^k is a vector of k control variables for individual i in country j and $F(z) = e^z/(1 + e^z)$ is the cumulative logistic distribution.

To compare across models with different sets of covariates, for each country we evaluate the predicted probability $\hat{P}_j = F\left(\hat{\alpha}_j + \sum_k \hat{\beta}^k \bar{x}^k\right)$ of reporting unmet need at the EU sample mean of covariates $\bar{\boldsymbol{x}}^{\boldsymbol{k}}$.

We use personal cross-sectional weights (UDB variable RB050) to ensure the results are representative of population composition. The model is estimated with robust standard errors using Stata Version 16 (StataCorp., 2019). We report fixed effects coefficients, which have a log-odds ratio interpretation.

10.4 Results

10.4.1 Descriptive statistics

Table 10.1 shows the descriptive statistics of individuals in our sample. 3.2% of individuals report unmet need across the whole EU. 52.2% are women. The mean age is 49.1 years. 29.1% have low education, 43.4% have intermediate education, and 27.4% have high education. 33.7% of individuals have a chronic condition. The average annual equivalised disposable income is €19 400PPS. 17% is at risk of poverty. 91.8% of individuals are employed or economically inactive while 4.4% are unemployed for 12 months. Compared to individuals in the whole sample, those who report unmet need are more likely to be female, have low education, suffer from a chronic condition, be at risk of poverty, be unemployed for 12 months and have a lower average annual equivalised disposable income (€13,300). The mean age of those who report unmet need is a little higher than the population and equal to 52 years.

Table 10.1: Descriptive statistics for population and respondents reporting unmet need, EU-27 and UK, 2018

Variable	Mean, population	SD, population	Mean, among those reporting unmet need	SD, among those reporting unmet need
Unmet need (%)	3.2			
Gender: Female (%)	52.2		56.1	
Education: High (%)	27.4		20.8	
Education: Intermediate (%)	43.4		42.7	
Education: Low (%)	29.1		36.5	
Chronic conditions: Yes (%)	33.7		55.2	
At risk of poverty: Yes (%)	17.0		28.0	
Unemployment: 0 months (%)	91.8		88.2	
Unemployment: 1-6 months (%)	2.4		3.2	
Unemployment: 7-11 months (%)	1.3		1.7	
Unemployment: 12 months (%)	4.4		6.9	
Age (years)	49.1	18.1	52.0	17.4
Income (disposable), 1000 PPS	19.4	14.7	13.3	10.5

Reading note: mean values refer to individuals in our sample.

10.4.2 Regression results

Table 10.2 provides the results of the logit models, with the probability of reporting unmet need evaluated at the average EU value of covariates. Column I shows the unadjusted country fixed effects, which represent the (unadjusted) proportion of unmet need for the population. Differences in unmet need across countries are statistically significant at the 0.1% level (p-value <0.001). 95% confidence intervals for the country fixed effects are 2 percentage points (pp).

Table 10.2: Unmet need, unadjusted and adjusted for age, gender, chronic condition, education, unemployment, at-risk-of-poverty and income, EU-27 and UK, 2018

Model	I	II	III	IV	V	VI
Age and gender		Yes	Yes	Yes	Yes	Yes
Chronic condition			Yes	Yes	Yes	Yes
Education				Yes	Yes	Yes
Unemployment and poverty					Yes	Yes
Income						Yes
Austria	.0041	.0040	.0034	.0034	.0033	.0039
Spain	.0043	.0041	.0037	.0033	.0031	.0030
Germany	.0052	.0051	.0039	.0042	.0040	.0045
Malta	.0053	.0054	.0047	.0041	.0042	.0044
Netherlands	.0095	.0092	.0081	.0082	.0081	.0087
Luxembourg	.0096	.0095	.0089	.0085	.0083	.0117
Republic of Cyprus	.0170	.0173	.0139	.0136	.0128	.0131
Belgium	.0214	.0209	.0206	.0203	.0198	.0220
Czechia	.0242	.0225	.0200	.0211	.0212	.0178
Italy	.0258	.0247	.0286	.0261	.0252	.0255
Lithuania	.0306	.0297	.0261	.0274	.0248	.0193
Bulgaria	.0320	.0310	.0318	.0315	.0286	.0195
Ireland	.0328	.0331	.0305	.0302	.0290	.0318
France	.0336	.0329	.0277	.0275	.0275	.0308
Portugal	.0358	.0346	.0286	.0251	.0250	.0205
Slovenia	.0413	.0389	.0325	.0333	.0316	.0291
Croatia	.0425	.0415	.0365	.0362	.0334	.0259
Sweden	.0432	.0420	.0366	.0372	.0367	.0377
Slovakia	.0511	.0508	.0460	.0476	.0479	.0353
Hungary	.0566	.0553	.0469	.0474	.0474	.0329
United Kingdom	.0582	.0559	.0444	.0448	.0441	.0456
Finland	.0597	.0572	.0438	.0449	.0436	.0456
Romania	.0694	.0683	.0731	.0703	.0687	.0461
Denmark	.0701	.0680	.0630	.0650	.0659	.0733
Poland	.0848	.0825	.0713	.0737	.0728	.0575
Greece	.1023	.0991	.1040	.1000	.0952	.0729
Latvia	.1108	.1072	.0927	.0967	.0886	.0693
Estonia	.1889	.1825	.1504	.1578	.1493	.1291

Note: Dependent variable is whether the individual reports unmet need, or not. Countries are listed in ascending order according to unadjusted unmet need in population in column I. Age is also included with quadratic and cubic functions, and these are interacted with gender. Income: annual equivalised disposable income adjusted for purchasing power standard categorised in deciles according to EU distribution.

Reading note: In Estonia, 18.9% of the population report unmet need. This reduces after adjusting for the average EU value of 1) age and sex to 18.3%, 2) age, sex and chronic condition to 15.0%, 3) age, sex, chronic condition and education to 15.8%, 4) age, sex, chronic condition, education, at-risk-of-poverty and unemployment to 14.9%, and 5) age, sex, chronic condition, education, poverty, unemployment and income to 12.9%.

Figure 10.1 plots the confidence intervals for each country and shows the extent to which unadjusted unmet need differs across countries. While Luxembourg and Netherlands do not differ in unmet need from each other, they have lower unmet need than Belgium or Italy. In Figure 10.1 we also compare unmet need between the unadjusted model and the most comprehensive model of Column VI in Table 10.2. We can see that adjusting for several factors (age, gender, chronic condition, education, at-risk-of-poverty, unemployment and income), generally reduces differences of unmet need across countries with income playing a key role (see below). Statistically significant differences in adjusted unmet need remain for the majority of countries. The difference between unadjusted and adjusted unmet need is less than 2pp in the majority of countries. The reduction in unmet need is highest in Estonia (6pp) and Latvia (4pp) and smaller (2-3pp) in Romania, Hungary, Poland and Greece.

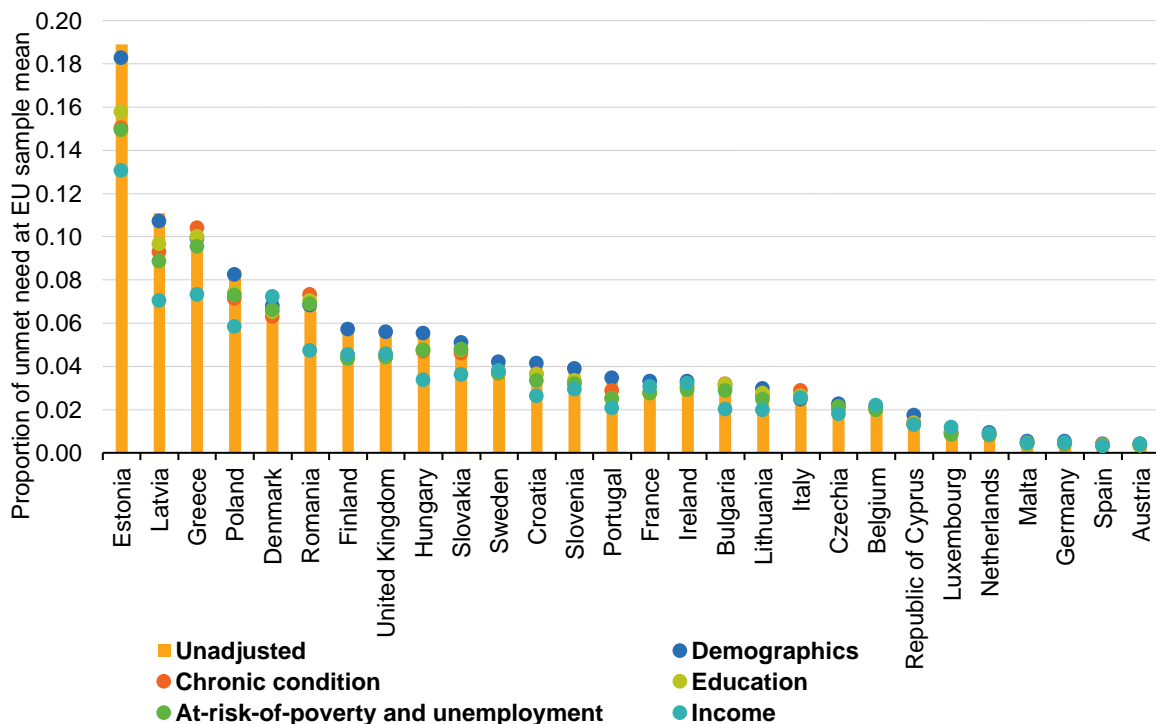**Figure 10.1:** Unadjusted and adjusted unmet need across EU-27 and UK, 2018
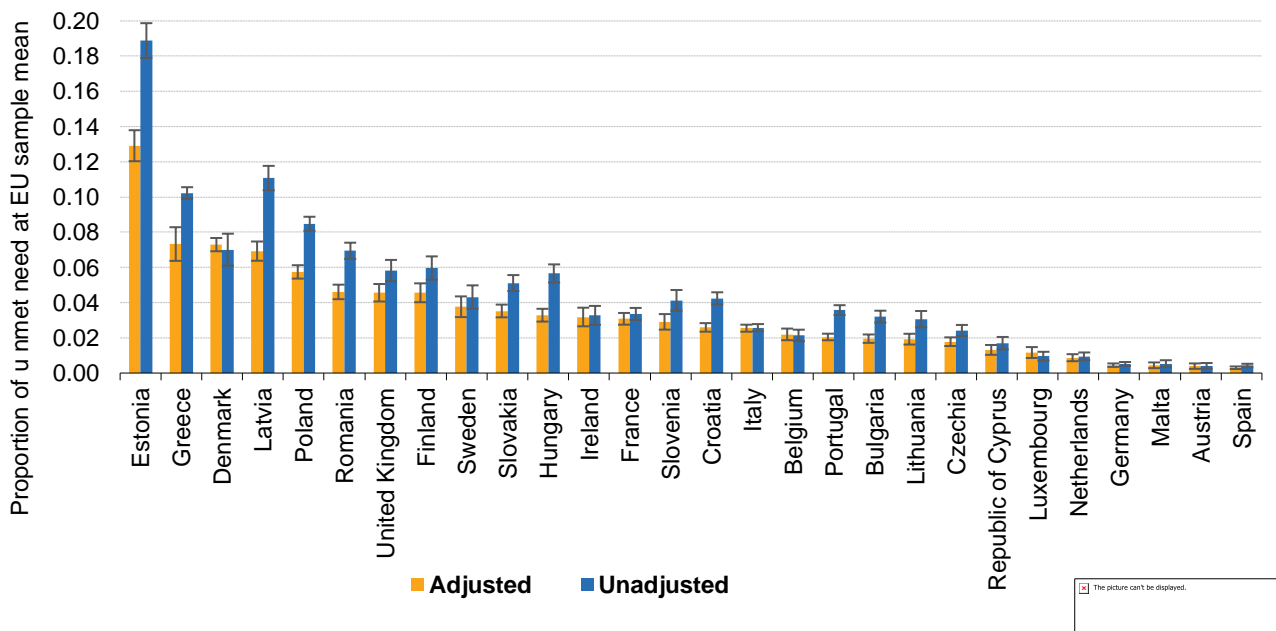
Note: Unadjusted unmet need in EU-27 countries and the UK (blue bars) and unmet need after adjusting for age, gender, chronic condition, highest educational attainment, at-risk-of-poverty, unemployment and annual equivalised disposable income adjusted for purchasing power standard categorised in deciles (orange bars) with 95% confidence intervals. Age is also included as quadratic and cubic functions; the quadratic and cubic functions of age are also interacted with gender. Countries are listed in descending order according to adjusted unmet need.

Reading note: In Estonia, 18.9% of the population report (unadjusted) unmet need (blue bar). After adjusting for the average EU value of age, sex, chronic condition, education, poverty, unemployment and income, unmet need reduces to 12.9% (orange bar). In contrast, in Spain, only 0.4% of the population report (unadjusted) unmet need (blue bar), which reduces to 0.3% after adjusting for all of the control variables (orange bar).In Estonia, the difference between the unadjusted and adjusted unmet need is statistically significant, but this is not the case for all countries (e.g. Denmark and Ireland).

Next, we describe the contribution of each group of control variables in more detail. Column II in Table 10.2 controls for age and gender and shows that differences in unmet need change by a very small amount after controlling for these variables. This is also illustrated in Figure 10.2, where unadjusted unmet need is compared with unmet need adjusted for demographics illustrated by the blue dots.

Figure 10.2: Differences in unmet need across EU-27 and UK countries, unadjusted and adjusted for different groups of controls, 2018

Column III in Table 10.2 controls for chronic conditions and is also illustrated by the red dots in Figure 10.2. The results show that unmet need is reduced with the addition of this variable. The reduction is the largest in Estonia (3.3pp reduction, from 18.3% to 15.0%) and in Latvia, Poland, Finland and the UK (1.1-1.5pp reduction). There are however exceptions: unmet need increases in Greece, Italy and Romania as the lower national prevalence of chronic conditions is substituted with the higher European average prevalence.

Column IV in Table 10.2 controls for education and is also illustrated by the light green dots in Figure 10.2. There is a negligible change in unmet need in all countries (variation is 0.3pp or less) relative to Column III, except for Latvia, Estonia, Portugal and Greece, where it is more pronounced. Unmet need increases in Latvia and Estonia (by 0.4pp and 0.7pp respectively), where the educational level is far higher than the EU average. Unmet need reduces in Portugal and Greece (by 0.4pp), which have lower national levels of educational attainment compared to the EU average.

Column V in Table 10.2 further controls for variables measuring individual risk of poverty and unemployment, and is also illustrated by the green dots in Figure 10.2. These additional factors lead to small changes in unmet need, relative to Column IV, in almost all countries (maximum 0.3pp changes) except in Greece (-0.5pp), Estonia and Latvia (-0.9pp and -0.8pp respectively).

Column VI in Table 10.2 includes deciles of household disposable income (in PPS values), in addition to age, gender, chronic condition, education, at-risk-of-poverty and unemployment. This is also illustrated by the light blue dots in Figure 10.2 (as well as in Figure 10.1, as discussed above). Risk-adjusted unmet need is altered

by the further inclusion of household disposable income as a control variable, especially for countries which have lower than average income in PPS terms relative to the EU average. In particular for Greece and Eastern European countries (Estonia, Latvia, Romania, Poland, Hungary, and Slovakia), risk adjusted unmet need significantly reduces, relative to Column V, after controlling for disposable income by at least 1pp (ranging from 1.3pp in Slovakia to 2.3pp in Romania). It reduces by 0.6-0.9pp in Croatia, Bulgaria and Lithuania, and by 0.3-0.5pp in Czechia, Portugal and Slovenia. Risk-adjusted unmet need increases by 0.3pp in France, Ireland, Luxembourg, and 0.7pp in Denmark. Risk-adjusted and unadjusted unmet need estimates are similar for other countries, after controlling for disposable income (less than 0.2pp variation).

10.4.3 Sensitivity analysis: additional health variables

We included self-reported general health and limitations in activities because of health problems to our final specification (column VI in Table 10.2). For the majority of countries the results were unaffected by the inclusion of these variables (Figure 10.3). However, the inclusion of self-reported general health reduced unmet need in Estonia, Denmark and Latvia and increased unmet need in Greece. We provide this specification as a sensitivity analysis because we are concerned about possible reverse causality with higher unmet need leading to poorer self-reported health and possibly greater limitations in activities. Moreover, health is affected directly by health systems through the provision of healthcare services, while the other variables (demographic, education, income) are not under direct control of the health system. In addition, we lose about one third of the observations for Lithuania due to missing values for self-reported general health.

Figure 10.3: Differences in unmet need across EU-27 and UK countries, with inclusion of additional health variables, 2018
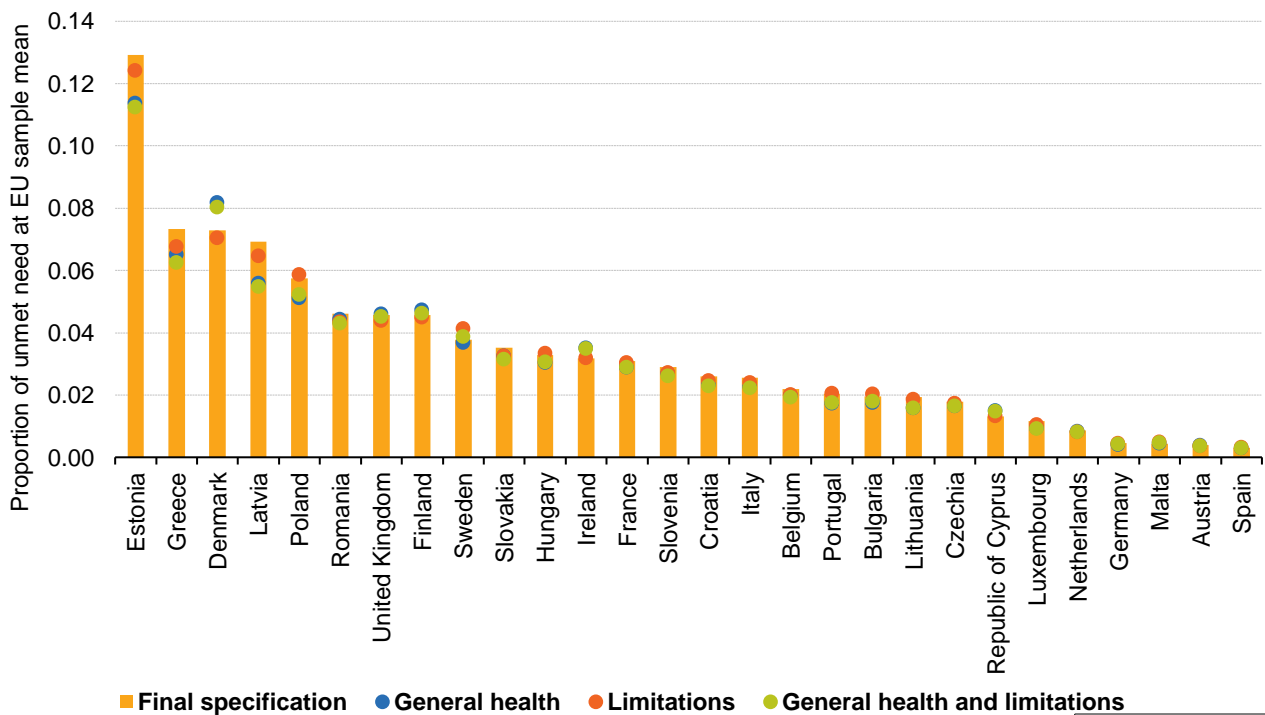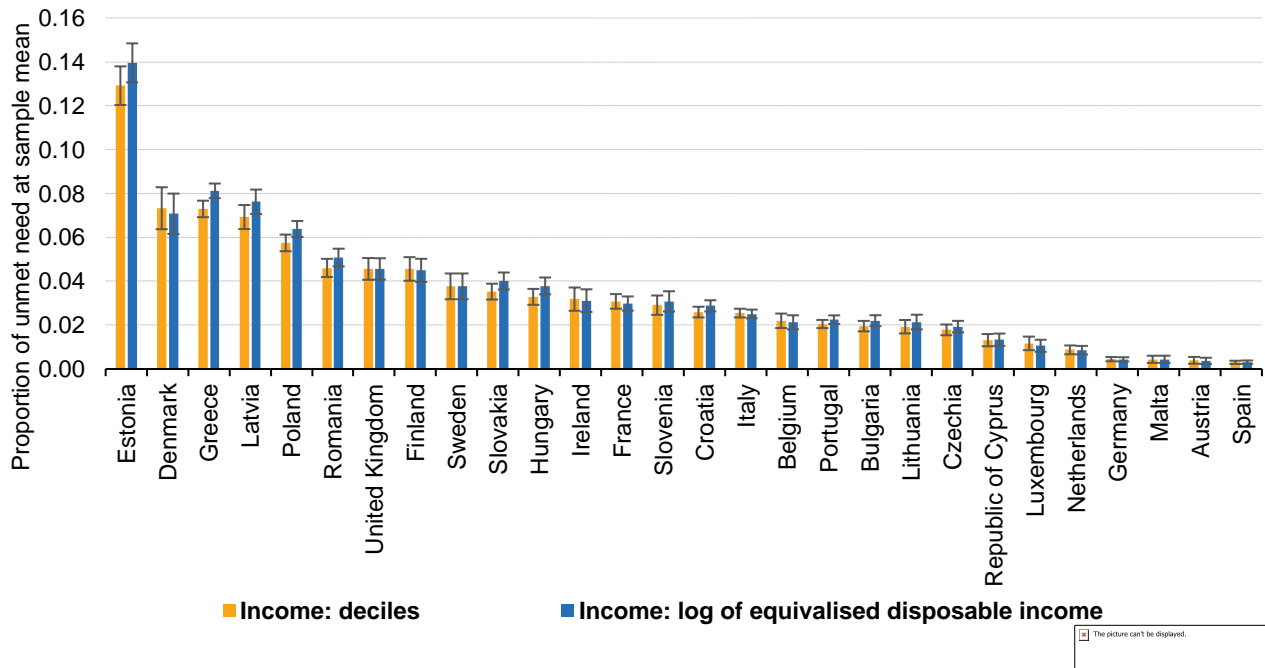

Note: Unmet need at EU average, logit specification. A variable measuring the interaction of age and gender is included while age is also included as quadratic and cubic functions and the quadratic and cubic functions of age are also interacted with gender. Income is measured as the annual equivalised disposable income adjusted for purchasing power standard categorised in deciles according to the whole EU distribution. Countries are listed in descending order according to adjusted unmet need.
Reading note: In Estonia, unmet need adjusted for age and gender, chronic condition, highest educational attainment, at-risk-of-poverty, unemployment and income is 12.9% (orange bar). When self-reported general health status is added, unmet need reduces to 11.4% (blue dot) while the addition of limitation in activities because of health problems reduces unmet need to 12.4% (red dot). The addition of both variables reduces unmet need to 11.2% (light green dot). In contrast, in Austria and Spain, the addition of these variables does not change unmet need, which remains at 0.4% and 0.3% respectively.

10.4.4 Sensitivity analysis: equivalised disposable income

As an additional sensitivity analysis, in our preferred specification (Column V in Table 10.2) we include equivalised disposable income in PPS measured as a continuous variable with a logarithmic transformation instead of deciles. Results are robust to this change in specification, as can be seen in Figure 10.4. The ranking according to unmet need is similar for the two models and figures are not statistically different within countries except for Greece.

Figure 10.4: Differences in unmet need across EU-27 and UK countries with income measured in deciles and as the log of equivalised disposable income, 2018

Note: Unmet need after controlling for age, gender, chronic condition, highest educational attainment, at-risk-of-poverty, unemployment and disposable income adjusted for purchasing power standard with 95% confidence intervals, logit specification. Control variables: (orange bar) age, gender and age and gender interaction; age is also included as quadratic and cubic functions and the quadratic and cubic functions of age are also interacted with gender; chronic condition, highest educational attainment, at-risk-of-poverty, unemployment and annual equivalised disposable income adjusted for purchasing power standard and it is categorised in deciles according to the whole EU distribution. In (blue bar) age, gender and age and gender interaction; age is also included as quadratic and cubic functions and the quadratic and cubic functions of age are also interacted with gender; chronic condition, highest educational attainment and (log of) annual equivalised disposable income measured as a continuous variable and adjusted for purchasing power standard. Countries are listed in descending order according to adjusted unmet need with income measured as deciles. Reading note: In Estonia, unmet need is 12.9% when it is adjusted for income measured in deciles, which reflects the income distribution (in addition to the other control variables) (orange bar). Unmet need increases to 14% when income is measured as a continuous variable with a logarithmic transformation (blue bar). However, the differences are not statistically significant.

10.5   Discussion and conclusion

Self-reported unmet need for medical care is a practical and simple way of measuring access to care that is commonly used in European countries (Allin and Masseria, 2009; OECD, 2019a). In this chapter, we investigate if unmet need differs across countries using EU-SILC data for 2018. We compare countries before and after adjusting for factors that are outside the control of the health system, such as demographic, education, at-risk-of-poverty, unemployment and income variables.

While many of these countries have low levels of unmet need, others including Denmark and Sweden have relatively high levels of unmet need. Most of the control variables have a relatively modest impact on unmet need. While risk-adjustment resulted in reductions in unmet need in countries such as Estonia, Greece and Latvia, relatively high levels of unmet need remain after adjustment. These are likely to be due to structural issues across health systems that relate to barriers to access due to affordability, waiting lists or times, or physical accessibility. In order to investigate if this is the case, we analysed the reasons for unmet need. We found that 82% of respondents in Greece felt that the main reason for unmet need was related to affordability

(medical care was too expensive) while in Estonia 80% of respondents stated that waiting lists were the main reason for unmet need (Table 10.A2). Unmet need may also arise due to personal circumstances, knowledge, preferences and perceptions of health care and this highlights the subjective nature of unmet need highlighted in the Introduction. Again, there may be a role for policy intervention, for example by improving health literacy, especially among people with low socio-economic, education and health status (European Commission, 2016). Due to a lack of evidence on the factors that may influence self-reported unmet need, it is necessary to investigate how different individuals in different countries understand and interpret the questions on unmet need (European Commission, 2016).

The relationship between income and unmet need is well established in previous studies using EU-SILC (Chaupain-Guillot and Guillot, 2015; Elstad, 2016; Israel, 2016; Eurostat, 2010) but less so in relation to how income affects country comparisons on unmet need. Israel (2016) found that social allowance (means-tested benefits for households who fall into particular categories, for example single parents, or who are eligible due to low household income) was associated with a reduction in unmet need for medical care for financial reasons. The author surmised that this was because social allowance provided a basic income to the lowest income group (first quintile) and increased income for the lower-middle income group (second quintile). However, this may depend on the design of the social allowance and if it was targeted to the second income quintile, which is not the case in many countries. Similarly, Madureira-Lima et al (2018) found that financial hardship had a mediating role on the relationship between unmet need and unemployment implying that the reduction in income resulting from loss of employment was leading to an increase in unmet need. Our analysis shows that differences in annual equivalised disposable income within the EU play an important role in the comparison of unmet need across countries, relative to the differences in demographics or educational attainment. Consequently, differences in unmet need between countries are smaller after controlling for income, which allows for a more meaningful comparison of unmet need as a measure of health system performance.

Missing data on unmet need is an issue for the UK only, where we find 17% of missing data. Respondents are equal in terms of income distribution and at-risk-of-poverty, but those who do not report unmet need are in general males, younger, with high or intermediate education and without chronic conditions (Table 10.A.3). Therefore, for the UK we are likely to be estimating a "lower bound" of unmet need, as unmet need increases for women and increases with age, lower levels of education and presence of chronic conditions.

Our analysis compares adjusted with unadjusted unmet need across EU countries. Adjusting unmet need for differences in demographics and socio-economic factors that are outside the control of health systems improves the comparability of unmet need access as a measure of health system performance in international comparisons. We find that, in general, most of these variables have a relatively modest impact on differences in unmet need across EU countries, except for household income. Although controlling for income reduces differences in unmet need across countries, marked and significant differences remain in several EU countries (Baltic States, Poland, Hungary, Romania and Greece). While measuring unadjusted unmet need can be useful for individual countries to assess the size of their access problem, there is also scope for measuring risk-adjusted unmet need to improve cross-country comparisons for the purposes of health system performance assessment on access.

References

Allin, S. and Masseria, C. (2009) Unmet need as an indicator of health care access. *Eurohealth, 15*(3), pp. 7-10.

Baeten, R., Spasova, S., Vanhercke, B. and Coster, S. (2018) *Inequalities in access to healthcare. A study of national policies*. Brussels: European Commission.

Börsch-Supan A., Brugiavini A., Jürges H., Mackenbach J., Siegrist J. and G., W. (2005) *Health, ageing and retirement in Europe—first results from the Survey of Health, Ageing and Retirement in Europe,* Mannheim: Mannheim Research Institute for the Economics of Ageing.

Chaupain-Guillot, S. and Guillot, O. (2015) Health system characteristics and unmet care needs in Europe: an analysis based on EU-SILC data. *European Journal of Health Economics, 16*(7), pp. 781-96.

Detollenaere, J., Hanssens, L., Vyncke, V., De Maeseneer, J. and Willems, S. (2017) Do we reap what we sow? Exploring the association between the strength of European primary healthcare systems and inequity in unmet need. *PloS one, 12*(1), pp. e0169274-e0169274.

Elstad, J. I. (2016) Income inequality and foregone medical care in Europe during The Great Recession: multilevel analyses of EU-SILC surveys 2008-2013. *International journal for equity in health, 15*(1), pp. 101-101.

European Commission (2017) *European Semester Thematic Factsheet Health Systems* Available: https://ec.europa.eu/info/sites/info/files/file_import/european-semester_thematic-factsheet_health-systems_en_0.pdf.

European Commission. (2017a) EXPH (EXpert Panel on effective ways of investing in Health). Opinion on Benchmarking Access to Healthcare in the EU. Brussels: European Union.

European Commission. (2016) Expert Panel on effective ways of investing in Health (EXPH), Report on Access to Health Services in the European Union. Brussels: European Commission.

Eurostat (2020) *Eurostat metadata purchasing power parities (prc_ppp)*. Available at: https://ec.europa.eu/eurostat/cache/metadata/en/prc_ppp_esms.htm.

Eurostat (2010) *Methodological issues in the analysis of the socioeconomic determinants of health using EU-SILC data*. Eurostat Methodologies and Working Papers. Luxembourg: Publications Office of the European Union.

Fiorillo D. (2019) Reasons for unmet needs for health care: the role of social capital and social support in some western EU countries. International Journal of Health Economics and Management, 20(1), pp.79-98

Iezzoni, I. (2009) Risk adjustment for performance measurement. in Smith, P. C., Mossialos, E., Papanicolas, I. and Leatherman, S., (eds.) *Performance Measurement for Health System Improvement*, Cambridge: Cambridge University Press.

Israel, S. (2016) How social policies can improve financial accessibility of healthcare: a multi-level analysis of unmet medical need in European countries. *International journal for equity in health, 15*, pp. 41.

Juhnke, C., Bethge, S. and Muhlbacher, A. C. (2016) A review on methods of risk adjustment and their use in integrated healthcare systems. *International Journal of Integrated Care, 16*(4), pp. 4.

Madureira-Lima, J., Reeves, A., Clair, A. and Stuckler, D. (2018) The Great Recession and inequalities in access to health care: a study of unemployment and unmet medical need in Europe in the economic crisis. *International Journal of Epidemiology, 47*(1), pp. 58-68.

Moger, T. A. and Peltola, M. (2014) Risk adjustment of health-care performance measures in a multinational register-based study: A pragmatic approach to a complicated topic. *SAGE Open Medicine, 2*, pp. 2050312114526589.

OECD (2019) *Health Care Quality Indicators*, Available: https://stats.oecd.org/Index.aspx?QueryId=51879.

OECD (2019a) *Health for Everyone?: Social Inequalities in Health and Health Systems*. OECD Health Policy Studies. Paris: OECD Publishing.

OECD/EU (2018) *Health at a Glance: Europe 2018: State of Health in the EU Cycle*. Paris: OECD Publishing.

Reeves, A., McKee, M., Mackenbach, J., Whitehead, M. and Stuckler, D. (2017) Public pensions and unmet medical need among older people: cross-national analysis of 16 European countries, 2004-2010. *Journal of Epidemiology and Community Health, 71*(2), pp. 174-180.

Siciliani, L. and Verzulli, R. (2009) Waiting times and socioeconomic status among elderly Europeans: evidence from SHARE. *Health Economics, 18*(11), pp. 1295-306.

StataCorp. (2019) Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC.

UNESCO and UNESCO Institute for Statistics (2012) *International Standard Classification of Education ISCED 2011*. Montreal: UNESCO Institute for Statistics.

Appendix 10.1: Unmet need question on SILC questionnaire

Eurostat define a respondent as having unmet need if "there was at least one occasion when the person really needed examination or treatment but did not receive it" and the aim of the variable is to capture restricted access to medical care. (Operational file 2018). Eurostat recommends that the question should be implemented using a two-way approach with a filter before the unmet need question as follows:

PH040_Q1: Was there any time during the past 12 months when you really needed medical examination or treatment (excluding dental) for yourself?

Yes (I really needed at least at one occasion medical examination or treatment) [1];

No (I did not need any medical examination or treatment) [2].

FILTER: If PH040_Q1 = 1 then GO TO PH040_Q2.

PH040_Q2: Did you have a medical examination or treatment each time you really needed?

Yes (I had a medical examination or treatment each time I needed) [1];

No (there was at least one occasion when I did not have a medical examination or treatment) [2].

This two-step procedure is summarised using the following flags in PH040_Q2:

1 Filled (PH040_Q1 = 1)

-1 Missing

-2 Not applicable: the person did not really need any medical examination or treatment (PH040_Q1=2)

-3 Non-selected respondent

However, it seems that some countries do not follow Eurostat's recommendation. Table 10.A.1 shows for each country, (i) the probability of being in unmet need for the total population i.e. those who answered "Yes" to PH040_Q2 are included in the numerator and general survey respondents are included in the denominator and (ii) the probability of being in unmet need conditional on having experienced need for medical care – i.e. those who answered "Yes" to PH040_Q2 are included in the numerator and those who answered "Yes" to PH040_Q1 are included in the denominator, thereby excluding those who did not really need any medical examination or treatment (PH040_Q1=2, which are the ones with flag =-2).

For some countries (Austria, Denmark, Estonia, Ireland, Portugal, Slovakia and the UK) the two proportions are equal, meaning (a) that all respondents experienced need for medical care or (b) respondents were not asked the question on medical need before unmet need, with (b) appearing to be the more realistic option.

Table 10.A.1: Conditional and unconditional probabilities of experiencing unmet need, EU-27 and UK, 2018

Country	Unmet need, "unconditional" on reporting need (%)	Unmet need, conditional on reporting need (%)
Austria	0.4	0.4
Belgium	2.1	2.7
Bulgaria	3.2	5.9
Croatia	4.2	6.2
Cyprus	1.7	2.1
Czech	2.4	2.9
Denmark	7.0	7.0
Estonia	18.9	18.9
Finland	6.0	8.3
France	3.4	3.9
Germany	0.5	0.8
Greece	10.2	23.3
Hungary	5.7	8.4
Ireland	3.3	3.3
Italy	2.6	5.5
Latvia	11.1	15.0
Lithuania	3.1	4.4
Luxembourg	1.0	1.2
Malta	0.5	1.1
Netherlands	1.0	2.9
Poland	8.5	14.6
Portugal	3.6	3.6
Romania	6.9	8.2
Slovakia	5.1	5.1
Slovenia	4.1	5.5
Spain	0.4	0.6
Sweden	4.3	8.1
UK	5.8	5.8

Reading note: In Sweden, 4.3% of all respondents reported unmet need for medical care. However, unmet need increases to 8.1% among respondents who reported a need for medical care. In the UK, 5.8% of all respondents reported unmet need for medical care, the same percentage as among those who reported a need for medical care, implying either that all respondents needed medical care or were not asked if they needed medical care.

Table 10.A.2: Reasons for unmet need, EU-27 and UK, 2018

Country	Adjusted unmet need	Affordability	Waiting lists	Physical accessibility	Other reasons
Spain	0.0030	13.7	24.2	-	62.1
Austria	0.0039	22.4	3.9	1.9	71.8
Malta	0.0044	10.9	19.2	-	69.9
Germany	0.0045	16.2	15.0	4.9	63.9
Netherlands	0.0087	10.0	13.2	1.3	75.6
Luxembourg	0.0117	27.0	5.1	-	67.8
Republic of Cyprus	0.0131	80.9	1.9	0.8	16.4
Czechia	0.0178	1.9	5.6	5.2	87.3
Lithuania	0.0193	13.4	54.3	3.7	28.6
Bulgaria	0.0195	46.3	2.5	9.5	41.7
Portugal	0.0205	44.7	10.2	2.5	42.6
Belgium	0.0220	80.4	0.9	0.6	18.1
Italy	0.0255	77.1	14.3	0.7	7.8
Croatia	0.0259	11.5	6.5	16.2	65.9
Slovenia	0.0291	2.7	80.7	0.6	15.9
France	0.0308	21.1	12.7	0.6	65.6
Ireland	0.0318	40.0	45.3	0.7	14.0
Hungary	0.0329	5.4	5.5	3.3	85.9
Slovakia	0.0353	13.5	28.5	6.7	51.3
Sweden	0.0377	2.1	37.3	-	60.6
Finland	0.0456	0.3	84.0	0.4	15.3
United Kingdom	0.0456	2.1	52.1	2.3	43.4
Romania	0.0461	49.2	13.9	6.9	29.9
Poland	0.0575	13.4	33.0	3.0	50.6
Latvia	0.0693	38.3	12.7	4.8	44.2
Greece	0.0729	81.6	3.2	1.5	13.7
Denmark	0.0733	3.6	13.7	1.0	81.6
Estonia	0.1291	3.0	79.7	4.1	13.1

Reading note: In Estonia, 3.0% of respondents reported that the main reason for unmet need was due to affordability of care (too expensive), 79.7% due to waiting lists, 4.1% due to physical accessibility (too far to travel or no means of transport) and 13.1% due to other reasons (no time because of work or caring for children or others, fear of healthcare, waited to see if problem would resolve, did not know good doctor or specialist, or other reasons).

Table 10.A.3. Characteristics of respondents with non-missing and missing data on unmet need, UK 2018

Variable	Mean, non-missing subsample	Mean, missing subsample
Unemployment: 0 months (%)	96.9	94.6
Unemployment: 1-6 months (%)	1.2	1.8
Unemployment: 7-11 months (%)	0.5	0.3
Unemployment: 12 months (%)	1.4	3.4
Age	49.7	36.4
At-risk-of-poverty: No (%)	82.6	84.0
At-risk-of-poverty: Yes (%)	17.4	16.0
Chronic condition: No (%)	54.7	72.2
Chronic condition: Yes (%)	45.3	27.8
Education: High (%)	43.1	35.2
Education: Intermediate (%)	31.2	42.0
Education: Low (%)	25.7	22.8
Gender: Female (%)	53.7	39.4
Gender: Male (%)	46.3	60.6
Income (disposable), 1000 PPS	22.8	24.0

Reading note: Considering the UK data, compared to respondents who responded to the question on unmet need, those who did not respond to this question were more likely to be unemployed for 12 months (3.4% versus 1.4%), to be younger (36 years versus 50 years), at comparable risk of poverty (16% versus 17%), less likely to have a chronic condition (28% versus 45%), more likely to have an intermediate level of education (42% versus 31%), more likely to be male (61% versus 46%) and have a comparable level of income (£24,000 versus £22,800).