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The distribution of GPs in Ireland in relation to deprivation

Abstract

The aim of this study was to describe the distribution GP services in Ireland with respect to deprivation. Seven percent of rural inhabitants live within walking distance of the nearest GP compared to 89% of city dwellers. The longest average travel times occur in the most deprived rural areas. The variation in travel times across deprivation scores was modest, particularly in city, town and village areas. The highest workloads were observed in the most deprived urban areas. The current distribution of GPs in Ireland is relatively equitable although the most deprived practices have high workloads or appear to be overstretched. Incentives may be required to increase service provision in these highly deprived areas.

Keywords

Deprivation, accessibility, travel time, General Practitioner

Introduction

The negative relationship between socio-economic deprivation and health is well documented and is often mirrored by inequalities in access to health care (Tudor Hart, 1971). A number of studies have assessed geographic access to GPs in relation to socioeconomic status with varied results. A reasonably equitable distribution of GPs by socioeconomic status was found in Perth, Australia (Hyndman and Holman, 2001). A study in the North East of England found better access to GPs in more deprived areas (Adams and White, 2005). More recent findings showed no significant difference in access to GP surgeries by deprivation level in Glasgow (Macintyre et al., 2008). A number of studies on service provision in deprived areas point towards older GPs, poorer standards in premises and an increased number of practices without training status (Williams et al., 2004). Practices in deprived areas achieve lower Quality and Outcomes Framework scores in the UK (Ashworth et al., 2007), supporting the view that poorer standards apply in more deprived areas although the gap between affluent and deprived areas appears to be reducing (Doran et al., 2008). Shorter average distances to GP surgeries in more deprived areas may be allied to longer waiting times and possibly poorer quality care.

Internationally, unequal distributions of primary care services have been addressed by way of financial inducements to attract GPs to locate in disadvantaged neighbourhoods (Jarman, 1983). These payments are generally calculated based on the socioeconomic characteristics of the practice catchment area. However, not all deprived people live in deprived areas and not all people in a deprived area are necessarily deprived. Due to this heterogeneity of deprivation in small areas, targeting on the basis of areas may result in a failure to reach many deprived individuals (Salmond and Crampton, 2002). As a consequence the effectiveness of these area level payments may not adequately address the problem of providing equal access for equal need (Senior, 1991).

Thirty per cent of the Irish population is covered under the General Medical Services (GMS) scheme, which provides care free at the point of use for the most economically deprived section of the population and the elderly. Eligibility for the GMS scheme is determined on a means tested basis for under 70s and was available to all those over 70 from 2001 to 2008. Conversely the majority of the population pay full fees to access GPs and full costs for prescriptions. Such pricing factors reduce utilisation of services and give rise to unmet need (Thomas et al., 2006, Madden et al., 2005, O'Reilly et al., 2007). Although covering only 30% of the population, the GMS scheme

accounts for 57% of GP income and is much valued by GPs as it is superannuated and attracts subsidies for staffing. It has resulted in nearly all general practices in Ireland combining GMS and private practice. Funding for the GMS scheme appears to be secure despite the adverse economic conditions in Ireland. The capitation rates for GMS patients have been reduced thereby enabling increased coverage without increased cost.

By EU standards Ireland has a low number of GPs per population and this scarcity is expected to worsen over the next decade because of an ageing GP workforce (Thomas et al., 2008, Teljeur and O'Dowd, 2009). There are also concerns that GPs are not distributed evenly across the population with some counties being underserved, particularly the commuter-belt counties of the larger cities. Government strategy has been to provide a better distribution of GPs through placing well-designed primary care centres in deprived areas. The aims of this study were to assess for the first time the geographic distribution of GP services in Ireland with respect to materially deprived populations and to determine if further incentives are required to create a more equitable distribution of GPs.

Methods

Setting

In the 2002 census Ireland recorded a population of 3,917,203 across 3422 Electoral Divisions (EDs). The average ED population was 1145 (ranging from 55 to 24404). Since 1989, under the General Medical Services (GMS) scheme the state has contracted GPs to provide care free at the point of use for the poorest 30% of the population on a capitation basis. From 1999 to 2008 the coverage of the GMS scheme has varied between 28.1% and 32.5% of the population. Coverage has been increasing since 2005. At the time of the study, all over 70s were automatically entitled to free care under the GMS scheme. Consequently the majority of the population pay full fees to access GPs and full costs for prescriptions. An estimated 96% of practices provide care under the GMS scheme.

GP locations

GP addresses were obtained from two data sources for 2003: the GMS scheme and the Maternity-Infant Care Scheme. The latter scheme aims to provide a fixed number of free GP consultations to expectant mothers and most GPs participate in the scheme. The Maternity-Infant Care Scheme list should therefore provide information on most if not all GPs not involved in the GMS scheme. Where a GP was based at multiple practices, their time was distributed uniformly across those practices. For example, if a GP was based

at three locations, it was assumed that they spent a third of their consulting time at each practice. No information on the number of weekly sessions was available. GP addresses were geocoded to a point location.

Access to GPs

A number of methods have been used to estimate access to GPs. One approach is to calculate the ratio of GPs to population by area and compare areas with the assumption that patients do not utilise services outside of the area in which they reside. For highly aggregated areas (e.g. counties or regions) such a simple ratio might be a reasonable proxy but at a small area level it can give rise to distorted results. It is not reasonable to assume utilisation is restricted to the immediate area of residence and that patients frequently do not use their nearest available practice but travel further for various reasons (e.g. a location close to where they work or the family home). To account for the choices available to patients a gravity model approach was used in this study (Wing and Reynolds, 1988, Haynes et al., 2003).

Travel times from each ED to the nearest 20 practice locations were calculated in the form of private car travel along the road network. The population weighted centre was determined for each ED. Attainable travel speeds were obtained from the National Roads Authority with corrections made for congestion and junctions. A doubly-constrained spatial interaction model was used to allocate the population of each ED to its nearest 20 practices (Wilson, 1971). Details of the model and its derivation are given in the technical appendix.

The percentage population within walking distance of a GP was also computed for each ED. Walking distance was defined as 800m straight-line distance from a house-point to the nearest practice. Walking at just under 5 km/h a person can cover 800m in 10 minutes and this is assumed to be feasible for most members of the population travelling to their GP (Lovett et al., 2002).

General practice utilisation

Primary care utilisation is higher amongst more deprived and older patients, as their needs are greater and they face no price barriers (Carlisle et al., 2002). The 2001 Living In Ireland Survey conducted by the Economic and Social Research Institute gathered individual level data including socio-economic indicators and frequency of attendance at a GP surgery in the previous 12 months (Nolan, 2007). Mean rates of attendance were computed by age, sex and social class and applied to ED populations to estimate the annual attendances for over 15 year olds. Total attendances were computed for practice catchments to estimate workload at a practice level.

Deprivation

The 2002 National Deprivation Index was used to assign a deprivation index value to each ED (Kelly and Teljeur, 2004). The deprivation index combines four indicators of material deprivation into a score: unemployment, low social class, car ownership, and local authority housing. The deprivation score can also be expressed in deciles to label the most deprived 10% of EDs. For this study the deprivation score is used in preference to the deciles to capture the variability that can occur within a single deprivation decile. As the deprivation score is positively skewed, the most deprived decile spans a wide range of scores. As deciles are a more common choice for displaying deprivation data, the plots in the results section utilise deprivation score on the x-axis but also mark the deprivation deciles to facilitate identifying percentages of areas.

In order to explore the non-linear relationship between the outcome measures (access and utilization) and deprivation score at ED-level, a generalized additive model (GAM) was employed to visualize these dependencies. The GAM package (v 1.0) within the R statistical program (v2.8) was used with the default choice of smoothing spline (R Development Core Team, 2008).

Area type

EDs were classified into four groups: city, town, village or rural (Teljeur and Kelly, 2008). The classification scheme is based on the settlement type that the majority of an ED population live in. The city EDs relate to the five cities in Ireland. Towns range in size from 1014 to 32505 inhabitants. Village EDs are those in which the majority of the population live in settlements but are not already classed as city or town EDs. All EDs where the majority of inhabitants are not in any settlement are classified as rural.

Results

The combination of the GMS and Mother-Infant Care Scheme lists produced a single list with 2,456 GPs. The Irish College of General Practitioners has a membership of 2,362 GPs which it estimates to be 95% of all GPs. If this is the case then there should be in the region of 2,486 GPs nationally, suggesting that 99% of GPs were identified by the combined two lists. Of the 2456 GPs, 317 were based at more than one location. A total of 1,843 unique practice locations were identified from the address list. Relative to population share, GPs are over-represented in city, town and village EDs (see Table 1).

<Insert Table 1 here>

Just over half of the population live within walking distance of their nearest GP. The difference between area types is quite marked, with a clear gradient of increased walking access in more urban areas. Only 7.1% of rural inhabitants could walk to their GP. The majority of inhabitants in village EDs are still outside walking. In city EDs there is little variation in percentage with walking access by deprivation score (Figure 1). For both town and village EDs there appears to be improved walking access with increasing deprivation. In rural areas there is little variation in walking access by deprivation.

<Insert Figure 1 about here>

On the basis of the spatial interaction model, 40% of patients travel to their nearest GP practice. Fifty nine percent travel to the nearest two and 71% to the nearest three practices. The median travel time by car nationally is 7.9 minutes to the GP. The median travel time in city areas was 3.0 minutes compared to 2.6 minutes in town EDs. Median travel times is comparable in city, town and village EDs. In contrast, the average travel time in rural areas is three times that of the other areas. The association between travel time and deprivation as modelled using a GAM is shown in Figure 2 below. Deprived city EDs have a slighter higher median travel time than less deprived EDs but the differences are very small. The median travel time decreases with increasing deprivation in town and village EDs. The gradient is particularly marked in town EDs. Rural EDs show a general trend of increased median travel time with increasing deprivation.

<Insert Figure 2 about here>

The Living in Ireland Survey data produced rates of attendance that increased with age and decreasing social class. The estimated total annual number of GP visits for over 15's was 9,516,139 attendances. There is a strong correlation between the increasing age and the annual number of visits to a GP. In rural EDs there are higher proportions of over 70's in the most deprived EDs leading to high rates of attendance but populations are small and dispersed. In urban areas, the most deprived EDs have lower proportions of over 70's but large populations producing high absolute numbers of visits. Rates of GP attendance by age and sex were compared between urban and rural areas. A Poisson regression was used to predict GP visits by age, sex and urban-rural status of individuals. While age and sex were predictive of GP visits, urban-rural status was not a significant predictor.

Figure 3 plots the mean annual visits per GP by estimated deprivation score for each practice population. In both city and rural EDs the mean number of visits per GP increases with deprivation. In city EDs there is a dramatic

increase in workload in practices in extremely deprived areas. The picture for town EDs is more complicated with the most deprived decile containing the highest and lowest workloads. The least deprived town EDs also have very high workloads. Village EDs, on the other hand suggest increased workloads with increased deprivation. GPs in both town and village EDs have higher workloads than their counterparts in city and rural EDs of equivalent deprivation score.

<Insert Figure 3 about here>

Discussion

The results for urban areas show that for many deprived patients access is good which is appropriate given the higher disease burden of this part of the population. Travel times are short and most city and town inhabitants live within walking distance of the nearest practice. Paradoxically, access is not as good for the *least* deprived groups as it is for some of the more deprived groups, particularly in towns and villages, although the differences are small. Setting up and running a practice in affluent areas is expensive due to property costs and better off patients can avail of direct access to specialist providers which further interferes with general practice income. However, in city areas there is a marked relationship between deprivation and workload such that practices in more deprived areas have much higher workloads. A high workload suggests longer waiting times, may affect consultation length, and will negatively impact on GP stress and morale.

In rural areas, there is a broad pattern of worsening access with increasing deprivation implying the presence of other cost barriers to seeking care such as transport. Very few rural inhabitants live within walking distance of their nearest GP. Given the lack of public transport provision in rural areas, the need for a car to visit the GP may be a major barrier to accessing treatment for more deprived rural inhabitants.

Rural populations in Ireland tend to be dispersed rather than concentrating in villages. For a GP to achieve a large enough population catchment to run a viable practice, the catchment will have to encompass a large geographic area. A large catchment area inevitably leads to longer average travel times. To reduce travel times would entail increasing the number of rural GPs. It is possible that average travel times to GPs in rural areas cannot be further reduced without impacting on the financial viability of some of the rural practices.

The State has implemented two related incentives that resource general practice services in deprived areas. As already outlined, GPs are contracted through the GMS scheme to provide treatment to the elderly and the most deprived members of the population on a capitation basis. The GMS also provides for differential payments on the basis of age and how far the patient lives from the practice. In rural areas where patients typically live further from their practice, a GP can earn a higher fee per capita than in an urban practice. Thus the GMS scheme acts as an incentive to maintain rural practices. As an adjunct to the GMS scheme, an incentive scheme was established in 1993 whereby GPs who moved to generic or less expensive drug prescribing were given practice development funding by the State (Comptroller and Auditor General, 2007). The savings achieved by GPs were apportioned between the GPs concerned and the State, the latter using it to create a GP development fund. Only GPs who were part of the GMS could apply for grants from the development fund and the grants could only be used to increase or enhance the services available to patients. The value of the grant available to a GP was in proportion to the number of GMS patients enlisted with that GP. As only GMS GPs could avail of this funding the fund was primarily directed at practices with large GMS lists that were inevitably located closer to more deprived areas. The drugs savings that financed the development fund diminished over time and the schemes were suspended in 2005. The GMS and associated practice development fund provide income and resources to GPs with a predominantly deprived practice population.

It is expected that the pricing of, and subsidies for, GP services in Ireland have created incentives for patient behaviour which will have a knock-on effect for GP location. More specifically, GPs operating as contractors with the State or with private patients will want, in general, to locate in areas where their returns are higher. In the Irish context this would imply that GPs would locate where the local population is either: affluent (as they will be less responsive to price barriers to care); the very economically deprived or the elderly (as they are both high users and face no price barriers to care due to care being funded by the GMS). In the absence of the GMS, there would be little incentive for GPs to locate in deprived areas. The evidence from this study suggests that in cities those who are deprived experience good access, although access is poorest in the most deprived areas. Deprived city populations attend practices with higher workloads than in less deprived areas. In towns and villages, the most deprived have the best access. However, the differences across deprivation scores are less marked than the distinction between urban (city, town and village areas) and rural areas. Rural inhabitants have little prospect of walking to their GP and have further to travel to get to a GP giving rise to the need for access to a car.

Although the distribution of GPs is relatively equitable there are still pockets of poor access in the most highly deprived areas suggesting that extra incentives are required to encourage GPs to locate to such areas. Potential interventions to improve access to GPs for the most deprived areas must differ depending on whether an urban or rural context is being considered. Urban areas with high deprivation tend to have significant social problems and considerable work-related stress for GPs which may counter the incentive of GMS income. Provision of suitable premises and options for part-time work might remove some of the barriers to working in such areas. Nearly all of the poor access in highly deprived urban areas is concentrated in suburbs of Dublin city. These areas generally have large stable populations but may lack appropriate premises. Although the GP development fund financed practice improvements, the sums of money available would not have been sufficient to build new premises without significant additional investment. The majority of the deprived rural areas with poor access have, at best, stable populations but many are in decline. The low workloads restrict potential income and the isolated setting are not attractive to GPs. Finding a service delivery solution for rural areas is quite different and perhaps no less challenging than for urban areas.

This study has used a spatial interaction model to allocate patients to GP practice and hence, to calculate access and workload measures. The extent to which that spatial interaction model accurately predicts travel patterns could only be determined using a sample dataset of travel patterns. A distance decay function was developed that adjusted for local conditions accounting for different travel behaviour in urban and rural areas. The model correlation between the observed and estimated flows of patients was good, although there was a tendency for the model to overestimate where the mean trip was short and underestimate where the mean trip was longer. The numbers of patients attending a practice were also well predicted although again there was a tendency to underestimate larger values. However, for both there was no systematic difference in the residuals by either area type or deprivation level. The lack of bias suggests that the results are an accurate depiction of travel behaviour. The sample dataset of travel patterns did not allow for a distinction between different age groups. It is possible that older patients may be more inclined than younger patients to use a GP closer to home and hence would require a slightly different distance decay function. However, with the data available an age-specific model could not be developed. Frequency of GP visits by age and sex were compared for urban and rural areas and no significant difference was found, indicating that there was no differential utilisation by area type. To model workload, it has been assumed that all GP visits are equivalent. Certain patient groups, such as the elderly or those with chronic conditions, may require longer consultations and add

disproportionately to GP workload. However, we assume on balance that this averages out over a large number of individual visits.

The focus of this study has been on the GP distribution relative to deprivation using a travel time as a proxy for access. It is clear that deprived patients are less likely to have access to a car to travel to the GP and will rely on public transport or other means. It was not feasible to incorporate information on public transport into the spatial interaction model due to the national nature of this study. Particularly in rural Ireland, there is little formal provision of public transport and it is likely that patients without their own transport will rely on a taxi or friends. At present there is no centralised data collection of GP data so no data were available to measure waiting times at practices or services provided at practices.

The variation in median travel time by deprivation is relatively small, particularly for urban areas suggesting that on the whole, GP practices are well located. The much higher workloads observed in deprived city areas on the other hand, point towards understaffed facilities. It also appears that town and village practices have higher workloads than their city and rural equivalents. The infrastructure may be relatively well distributed but the GP workforce is not. The GMS scheme is unusual in European terms in that it targets economically deprived individuals rather than areas. Still, a relatively equitable distribution of GPs has been achieved although some living in deprived areas still experience poor access. Alternative incentives may be required to improve access for that minority of highly deprived areas with poor access. Alternative incentive packages need to be devised in the few remaining un-serviced deprived areas to achieve good universal access to general practitioners.

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Ethics committee

Ethical approval was not required for this study.

Competing interests

None

Author's contributions

CT and AK conceived the study. CT and AK were responsible for the data analysis. All of the authors contributed to the interpretation of the results and drafting of the manuscript. All authors read and approved the final manuscript.

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Technical appendix

The number of interactions between an area and the available facilities decreases with increasing distance – the so-called spatial interaction model. As the number of patients per ED was fixed and the capacity of each GP surgery was capped, a doubly-constrained, production-attraction constrained model was used.

The rate at which interactions decrease with distance in the spatial interaction model is described by a distance decay function. For this study, the distance decay function was derived from an analysis of GMS patient data for one health board region. The twelve months of GMS prescribing data contained the origin Electoral Divisions (EDs) of patients and the destination EDs of prescribing GPs. The data covered the former Eastern Regional Health Authority, an area of mixed urban and rural settings which contained 37% of the national population. In unconstrained model, there is potentially no cap on how many patients a single GP might treat. For the spatial interaction model, the capacity of a GP surgery was constrained according to the upper and lower limits observed in the data. A GP could not treat less than 200 or more than 3500 patients.

Travel times for each ED to the nearest 20 practices were computed using a GIS. After calculation of travel times, 1 minute was nominally added to all times to account for time spent getting on the road. The observed mean distances were compared to estimated mean distances using a spatial interaction model allowing travel to the nearest 20 GPs only.

A variety of decay functions were tested including inverse power, negative exponential and Gamma. However, it was found that on calibration, these functions tended to bias towards urban or rural conditions. An alternative function was formulated that incorporated local information in the form of the median distance to the nearest 20 practices. The measure of median distance explicitly accounts for the local density of services, which tends to be lower in rural areas. The distance decay function was estimated to be the following:

$$f(d_{ij}) = \frac{d_{0.5}^{2.074}}{d_{0.5}^{2.074} + d_{ij}^{3.691}}$$

Where: d_{ij} = the distance from area i to practice j
$d_{0.5}$ = the median distance from area i to nearest 20 practices

In areas with a high median distance, the rate of distance decay is lower. The penalty for bypassing the nearest practice is high in distance terms but this does not appear to be as significant a deterrent to travel as it is in urban areas. Hence the decay function is adaptive to local conditions.

The correlation between the observed and estimated mean distances had a relatively good level of fit ($R^2 = 0.84$). However, there is a tendency for overestimation at shorter distances and underestimation at longer distances as the linear fit shows:

$$\hat{d} = 0.72 + 0.80d$$

Where: $\hat{d}$ = estimated distance
d = real distance

The residuals between the observed and estimated distances were tested for systematic bias by area type and area deprivation using Wilcoxon signed ranks test. Area type was defined using a four category classification: city, town, village and rural (Teljeur and Kelly, 2008). Deprivation was expressed as deciles. There was no statistically significant difference between residuals by area type (p=0.998) or deprivation level (p=0.237). Although residuals showed more variability in rural areas, the mean residual for rural EDs was comparable to the other area types.

The spatial interaction model was also tested with regard to prediction of GP workload. The correlation between the observed and estimated patient counts had a relatively good level of fit ($R^2 = 0.83$) but there was an underestimation for practices with greater numbers of patients. The linear fit between observed and estimated patient numbers was as follows:

$$\hat{s} = 258.4 + 0.74s$$

Where: $\hat{s}$ = estimated patient count
s = real patient count

As for distance, the residuals between the observed and estimated numbers of patients travelling to each practice were tested for systematic bias by area type and area deprivation. There was no statistically significant difference between residuals by area type (p=0.3910) or deprivation level (p=0.1049).

Figure captions:

Table 1. Population, GPs, access and workload by area type

Figure 1. Proportion population within walking distance of the nearest GP practice by deprivation score

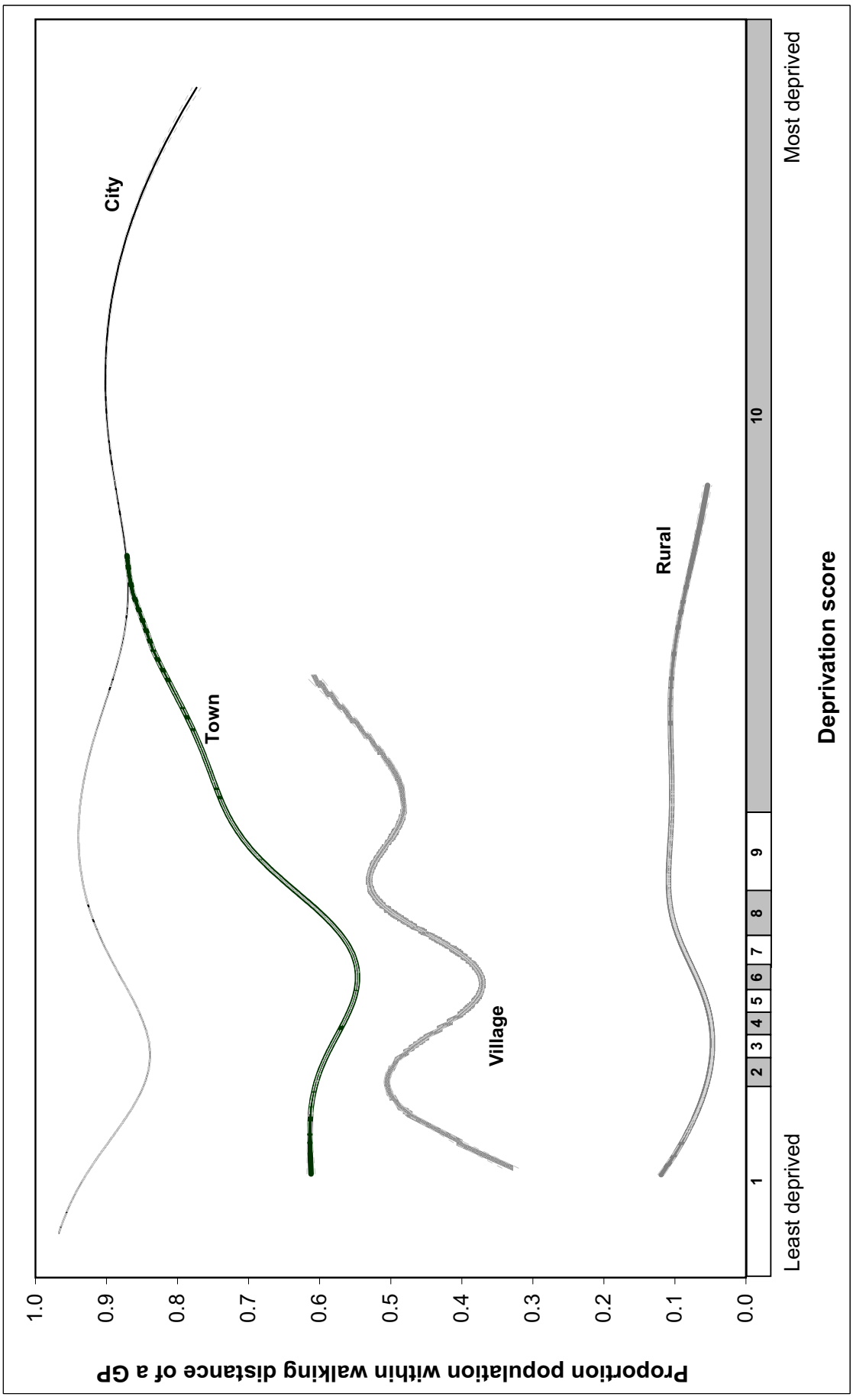
Figure 2. Median travel time to GPs by deprivation score in Ireland

Figure 3. Annual patient visits per GP by deprivation score in Ireland

Table 1. Population, GPs, access and workload by area type

Area type	Population		GPs		Walking distance to nearest GP (%)	Average travel time to GP (mins)	Average visits per GP per annum
	N	(%)	N	(%)			
City	1394248	(35.6)	996	(54.0)	88.8	3.0	5512
Town	997950	(25.5)	875	(47.5)	63.7	2.6	7087
Village	302807	(7.7)	316	(17.1)	46.3	3.3	6623
Rural	1222198	(31.2)	265	(14.4)	7.1	10.5	5577

Figure(s)



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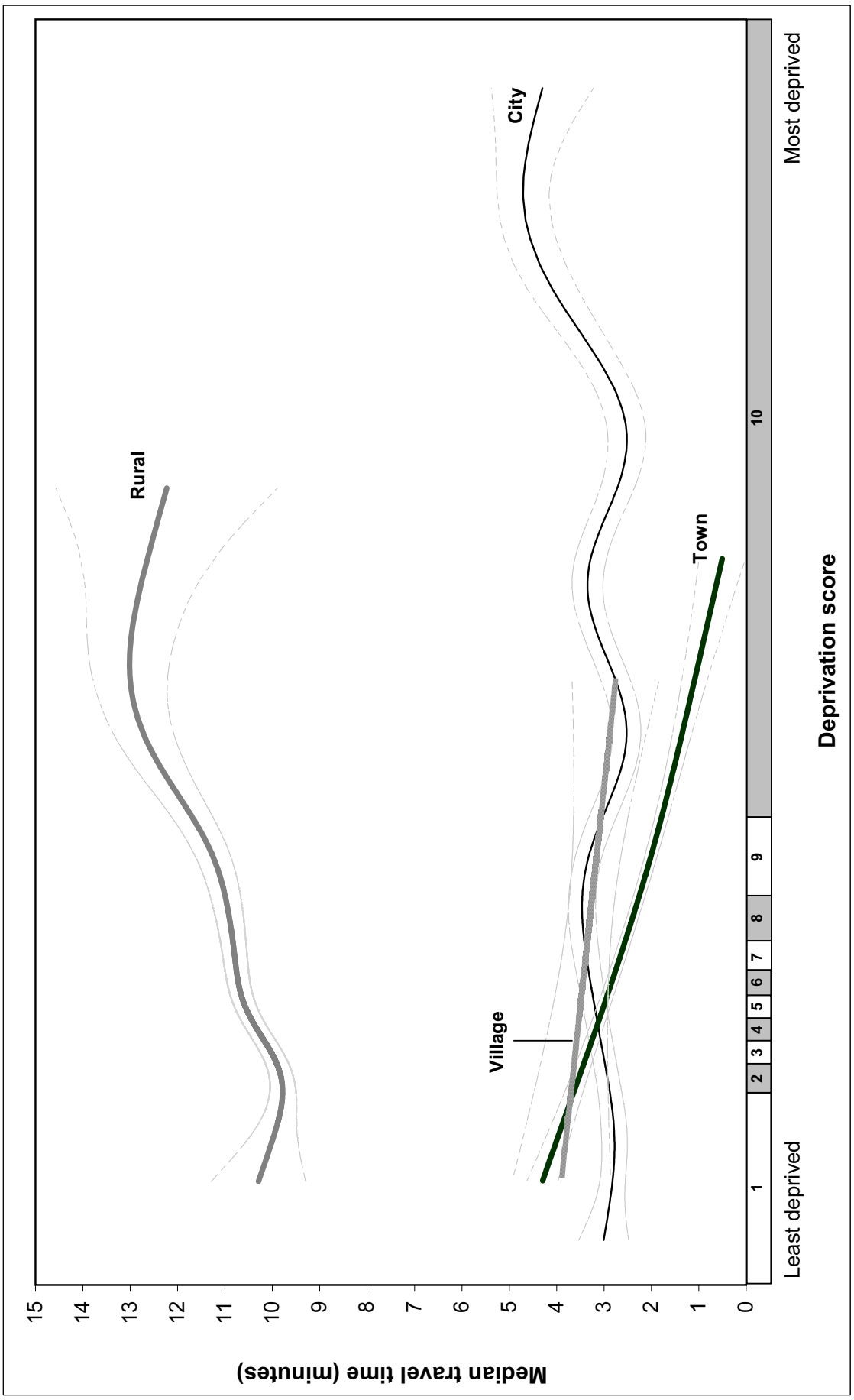

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