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Urban–rural health differences: primary care data and self reported data render different results

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ABSTRACT

Aim: Assessing the usefulness of GP electronic medical records for assessing the health of rural populations by comparing these data with data from health interview surveys.

Data: Data from electronic medical records routinely recorded in general practices in 2000–2002. Data on self-reported health problems were obtained through questionnaires in a subset of the same patient population.

Results: According to GP-records, acute somatic and chronic diseases were more frequently presented in rural areas. At the same time self reported health problems point to a better health in rural areas.

Conclusion: GP electronic medical records may be used to monitor the health of rural populations. These data can be obtained relatively quickly and easily and against acceptable cost. However, they do not give the same outcomes as health interview surveys. Reasons for this discrepancy may be; differences in the accessibility of specialist services and help seeking behaviour between urban and rural populations.

1. INTRODUCTION

In the developed (post-) industrialized world urbanicity is often found to be related to health status of the population. It is generally found that in modern industrialized societies (self reported) health status, and especially mental health status is worse in urban areas than in rural areas ([Caldwell et al., 2004], [Larson and Correa-de-Araujo, 2006], [Maas et al., 2006], [Verheij et al., 2008] and [Weich et al., 2006]). Utilisation of all sorts of health services is usually found to be higher in urban areas too, though this may not only be a result of health differences but also of differences in access to health services in urban areas or help seeking behaviour. In line with the classic studies by Milgram (1970) and Wirth (1938) urbanicity is often found to be associated with deprivation, violence, concentrations of ethnic minorities and environmental health hazards, whereas the rural element is associated with salutogenic factors like ‘space’, fresh air and a green and healthy environment (Maas et al., 2006).

Studies on the health of farmers in the Netherlands and Finland showed that farmers had fewer health problems than the rest of the working population ([Nielen et al., 2008], [Stiernstrom et al., 2001] and [Thelin et al., 2009]). The studies in Finland showed that the rural non-farming population was healthier compared to the urban population, except for musculoskeletal disorders (Thelin et al., 2009). This raised the

question whether only farmers experienced fewer health problems than urban residents or whether this observation is valid for the rural areas population as a whole.

On the other hand, the health of rural populations is at risk. Increasing antibiotic resistance, outbreaks of foot-and-mouth disease, avian flu, Q-fever and swine flu impose serious physical as well as mental health threats to especially rural populations. Dutch rural areas are relatively densely populated compared to rural areas in other parts of the world. In combination with high concentrations of animals as a result of intensive livestock farming (poultry, pigs and goats) in these areas this may impose a significant and new threat to public health. The recent (autumn 2009) outbreak of Q-fever in a goat farming area in the Netherlands has made this all the more clear. Under these circumstances it is wise to keep a close watch on the health of especially rural populations.

Most studies dealing with urban–rural health differences in Western Europe are based on people's perceived general health and/or are limited to specific health problems or focus on specific subgroups in the population (see for instance: [Iversen et al., 2005], [Koskimaki et al., 1998], [Lehtinen et al., 2003], [Minelli et al., 2007], [O'Reilly et al., 2007], [Olowokure et al., 2006] and [Paykel et al., 2003]). Very few studies on urban–rural health differences cover the whole population and the whole range of health problems. Besides, data are often collected on the basis of questionnaires or health interview surveys, which are time consuming and expensive. Also, real time health monitoring (necessary given the current health threats) is not a viable option using health interview surveys.

Routine data from GP electronic medical records may resolve this problem, especially in health care systems where virtually all inhabitants are listed with a GP, where GPs are usually the first to consult for all health problems and specifically in countries where GPs have a gatekeeping role for secondary care such as the Netherlands and the UK. Using GP electronic medical records for investigating geographic health differences has obvious advantages above other data sources such as health interviews (expensive) mortality or hospital data (only serious health problems).

The purpose of this paper is to identify rural–urban differences in the prevalence of specific (clusters of) diseases by using GP-based routine electronic medical records and thereby to assess the potential of such data for monitoring urban–rural health differences. The outcome of these analyses may be influenced by variations in the availability of health services and help seeking behaviour. On the other hand, EMR data may render more valid results because they are based on diagnoses made by doctors. Both types of data have their limitations. Therefore, we compare the results of this analysis data from health interview surveys in order to test the validity of the outcomes from EMR data.

Differences between EMR data and self reported health have been investigated before. Self reported prevalence of for example diabetes appeared to largely coincide with EMR data. With respect to asthma/COPD and heart failure the agreement was moderate compared to the medical records. For myocardial infarction the results varied across studies (Klungel et al., 1999; Mohangoo et al., 2006; Okura et al., 2004). It is unknown, however, to what extent this affects urban–rural differences. The second purpose of this paper is to investigate whether urban–rural differences are congruent between self-reported health measures and primary care EMRs.

The following research questions will be addressed:

Which health problems presented to GPs can be identified as typical for urban or rural areas (as based on routine GP electronic medical records)?

To what extent do the results of these analyses correspond with similar analyses based on health interview surveys?

2. METHODS

2.1. Study population

Data were derived from the Second Dutch National Survey of General Practice (DNSGP-2). The DNSGP-2 was conducted in 2000–2002 in 104 general practices consisting of 195 GPs and 385,461 listed patients (2.5% of the population of GPs and 2.5% of the total Dutch population (Westert et al., 2005)). Patients are representative for the Dutch population with respect to age, gender and type of health care insurance (Westert et al., 2005). GPs are representative for the Dutch population of GPs with respect to university of education, urbanicity, practice type (single handed or not, dispensing or not) and gender. Among participating GPs there was a slight overrepresentation of age 45–54 and of doctors from group practices compared to single handed practitioners. Data comprising all morbidity presented in all consultations that

took place during a 12 month period in these practices were extracted from their computer systems. In addition, for all health problems presented, GPs indicated whether this was a new or an existing health problem, in order to be able to distinguish incident from prevalent cases.

Practices recorded all morbidity during a period of 12 months. The first practice started the registration in the second quarter of 2000, the last practices started the registration in the second quarter of 2002 (Schellevis et al., 2004).

The data on self-reported health were collected in 2001 via face-to-face interviews by a subset of the listed patient population of the general practices that participated in the DNSGP-2. Per full-time GP at least 80 patients were interviewed, resulting in 12,699 respondents (response rate 64.5%). To avoid seasonal influences, the interviews were spread over the four trimesters of the year. In comparison with the Dutch population (data for January 2001 from Statistics Netherlands), there is a slight overrepresentation of females (54.0% of the respondents, compared to 50.5% in the Dutch population) and an under-representation of the age-group 20–39 (22.9% in the study population, compared to 30% in the Dutch population) and there are slightly more persons evaluating their health as 'good' in the study population (84% compared to 80.5% in the Dutch population).

2.2. Operationalisation

2.2.1. Patients

Patients in our study are all individuals listed in one of the practices participating. This includes persons that did not actually consult their GP in the study period. Since virtually all residents of the Netherlands are listed with a GP, this can be regarded as a sample of the population.

2.2.2. Episodes of care

Morbidity was recorded using International Classification of Primary Care (ICPC). Consultations concerning the same health problem were clustered into episodes of care by a team of medical students (Biermans et al., 2008), resulting in 949,220 episodes. An episode of care is defined as the period from the first presentation of a health problem or illness to a health care provider until the completion of the last encounter for that same health problem or illness (Schellevis et al., 2004).

2.2.3. Disease clusters

The ICPC coding system distinguishes of more than 700 complaints or diseases in 17 chapters that are named after medical tract (e.g. respiratory, musculoskeletal, urinary tract). We considered clustering of diseases necessary in order to provide a manageable overview of the results. For this study we chose to use a clustering of diseases based on type of disease rather than medical tract. This clustering (see Appendix A) has been used in previous studies and is based on communalities in type of health care needed, type of health complaints and impairments ([De Bakker et al., 2005] and [Verheij et al., 1992]). Disease clusters with a prevalence of less than 0.5% were not taken into account. As a result, the categories Congenital disorders and Disabilities were not included in the analyses. The category Other was also removed because the included diagnoses were too diverse. This resulted in the following diseases clusters to be included in this study:

Acute somatic diseases	Social problems
Traumata	Prevention
Infections	Mental disorders
Chronic diseases	Side effects
Neoplasms	Fear of diseases

The cluster 'side effects' refers to adverse effects of treatment or medication. The most prevalent disease clusters (traumata, chronic diseases, acute somatic diseases and infections), were subdivided into more detailed disease groups, based on the medical tract or organ involved. A more detailed description of disease clusters is presented in Appendix A.

2.2.4. Self-reported health status

In the health interview surveys respondents were asked whether in the past two weeks they had suffered from acute complaints like headache, fatigue, palpitations of the heart, dizziness, insomnia, excessive sweating, tinnitus, impaired hearing, fever, sore throat, a stuffy nose, earache, coughing, short of breath/tightness of the chest, a touch of flu, stomach-ache, nausea, pain on the chest, warts, itching, diarrhoea, heartburn, abdominal pain/cramp, constipation, weight gain, local redness of the skin, local swelling of the skin, pain in the neck/shoulder/upper back, low back pain, pain in (one of the) elbows/wrists/hands, pain in (one of the) hips/knees, other complaints. Responses were dichotomised into no complaints versus one or more complaints. For mental health problems, the 12-item General Health Questionnaire was used (Goldberg, 1972) in the Dutch version (Koeter and Ormel, 1991). Also GHQ scores were dichotomised (0–1 versus≥2) to identify possible psychiatric cases (Goldberg et al., 1997). In addition, the respondents were asked to evaluate their own health condition on a five point scale (based on SF-36). Having acute somatic health problems was dichotomised into 'good' (comprising the categories 'excellent', 'very good' and 'good') and 'mediocre/bad'. For chronic conditions, the respondents were asked whether they (ever) had: diabetes, stroke, myocardial infarction, other severe heart conditions in the past 12 months, cancer, migraine/severe headache in the past 12 months, high blood pressure in the past 12 months, constriction of the blood vessels in leg or stomach, asthma/chronic bronchitis/COPD/CARA, psoriasis in the past 12 months, chronic eczema in the past 12 months, dizziness with falling in the past 12 months, severe conditions of the intestines (longer than three months), incontinence, serious conditions of the back (slipped disc), arthritis of hip/knee, chronic arthritis, other serious conditions of the neck/shoulder, other severe conditions of elbow/hand/wrist and other chronic conditions. Having a chronic health problem was dichotomised into having none of these chronic conditions and having one or more chronic conditions.

2.2.5. Prevention and influenza vaccination

As it is likely that a future influenza epidemic will start off in rural areas, we decided to also look at influenza vaccination uptake. In the Netherlands, every year influenza vaccination for high risk populations is offered free of charge and is administered by GPs. Influenza vaccination is a seasonal activity that is recorded somewhat differently from other episodes. Dutch general practices use an automatic module in the computerized medical record system that is called the influenza vaccination module (*griepmodule*). This module facilitates the selection and registration of the vaccination status of persons for whom vaccination is recommended. Eligible patients for an influenza vaccination were identified on the basis of information recorded in the GP computer systems, using ICPC codes, indication tags and prescriptions to identify high-risk patients. Subsequently they were invited by GPs to be vaccinated. (Hak et al., 1998; [Tacken et al., 2002] and [Tacken et al., 2004]). Influenza vaccination data for the 2001 influenza season were collected in 50 practices that participated in the DNSGP-2. The vaccination status of patients who are at high risk for influenza according to the immunisation guidelines of the Dutch College of General Practitioners that were valid at that moment ([Van Essen et al., 1993] and [Van Essen et al., 1997]) were added to our dataset (matching on practice no. and patient no.). Information on influenza vaccination status of persons not at risk was not available. The subset of 50 practices did not differ from the other 54 practices in the DNSGP-2 with respect to the following characteristics: number of GPs in FTE, urbanity and number of patients. For the disease cluster prevention we used only the 50 practices (comprising of in total 204.118 patients) for which also influenza vaccination data were available. A more detailed description of the Dutch influenza vaccination programme and the registration of the vaccination event in the computerized EMR system can be found in Appendix B.

2.2.6. Urbanicity

We use the term urbanicity to describe the extent to which an area is urban or rural ([Verheij, 1996] and [Vlahov and Galea, 2002]). Urbanicity refers to the impact of living in urban areas at a given time rather than the process of urbanization. Urbanicity is operationalised as address density, divided into five classes, ranging from rural (less than 500 addresses per km^2) to highly urban (more than 2500 addresses per km^2) (Den Dulk et al., 1992). Urbanicity for every 4 digit postcode area in the Netherlands was obtained from Statistics Netherlands and linked to our dataset using the 4 digit postcode of GP practices. We included all five categories in our analyses but focussed on the difference between the least urban (rural) areas (less than 500 addresses per km^2) and the most highly urbanized areas (urban; over 2500 addresses per km^2) (Den Dulk et al., 1992). The distribution of patients and practices over the different levels of urbanicity is

displayed in Table 1. [Fig. 1], [Fig. 2], [Fig. 3] and [Fig. 4] show the prevalence of the disease clusters of the three categories in between rural and urban as summarized in one figure.

[TABLE 1, FIGURE 1, FIGURE 2, FIGURE 3, FIGURE 4]

2.2.7. Analyses

The difference between rural and urban areas in disease prevalence was analysed with multilevel logistic regression models distinguishing patient and practice level. Outcomes are expressed in terms of odds ratios, with disease prevalence as dependent variable and urbanicity (reference category: urban: over 2500 inhabitants within 1 km radius, dummy variables for each level of urbanity) as independent variable. Males and females were analysed separately. Age was included as confounding variable. Survey data and data from EMRs were analysed in the same way. In order to make the results as comparable as possible, we considered it important to use exactly the same analyses (in practice this implied taking GP-practice as separate level) in our multi-level model. In addition in the literature we found support for the influence of quality and supply of primary care on self-reported health, indicating that the level of GP-practice might influence self-reported health status ([Macinko et al., 2003] and [Starfield et al., 2005]). We compared the subjective 'acute somatic problems' with the cluster 'Acute somatic diseases', the GHQ-score with the cluster 'Mental disorders' and the subjective chronic health problems with the cluster 'Chronic diseases'.

3. RESULTS

3.1. Rural–urban differences in broad disease clusters

For males, traumata, chronic diseases, acute somatic diseases, infections, family planning and neoplasms are more often recorded by GPs in rural areas (see Fig. 1 and Table 2). For females, the prevalence of chronic diseases, infections and traumata was higher in rural areas than in urban areas (see Fig. 2 and Table 2). These differences are to some extent gender specific: the urban–rural difference for traumata was larger for males (odds ratio 3.31) than for females (odds ratio 2.62). For acute somatic health problems, family planning issues and neoplasms, the difference between urban and rural was significant for males only. There was no urban–rural difference in the recorded mental health problems for both males and females.

[TABLE 2.]

The intermediate urbanization levels sometimes show larger differences with either the rural or urban category compared to the difference between rural and urban on which we focus in this study. We do not enter into this matter further.

3.2. Rural–urban differences in more detailed health clusters

The four disease clusters with the largest differences between rural and urban population were further subdivided: traumata, infections, chronic diseases and prevention. The category 'infections' was subdivided into type of infection and part of the body. The categories 'traumata' and 'chronic diseases' were subdivided according to the organ system. In the category 'prevention' the prevention of influenza for the so-called high risk population (influenza vaccination administered by the GP) was selected (see Table 3 and [Fig. 3] and [Fig. 4]).

[TABLE 3.]

3.3. Traumata more detailed

For males, traumata of the eye, skin and musculoskeletal system were more prevalent in rural areas and for females these were traumata of the ear, eye, skin, neurological system and musculoskeletal system.

3.4. Infectious diseases more detailed

For males, GPs in rural areas more often recorded infections of the glands (ICPC-codes A75 and B70-71), ear, respiratory tract and skin infections. For females in rural areas, the same top 4 infection types (glands, ear, skin and respiratory tract) existed for disease categories concerning infections as for males. In addition, for women, urinary tract infections and infections of the eye were more often registered in rural practices.

3.5. Acute somatic diseases more detailed

GPs in rural areas recorded for males more often acute somatic diseases of the musculoskeletal system, acute somatic general or unspecified diseases and acute somatic diseases of the eye. For females the only significant rural–urban difference was recorded for acute somatic diseases of the blood system.

3.6. Chronic diseases more detailed

For chronic diseases, musculoskeletal and ear problems were the most prevalent in rural areas for both males and females. Females more often presented chronic conditions of the circulatory system and the genital system (chapter X and Y, ICPC) rural GPs whereas chronic diseases of the metabolism were presented more often in the rural male population.

3.7. Influenza vaccination

No differences in the prevalence of influenza vaccination were found between the urban and rural so-called high risk populations; neither for males nor for females.

3.8. GP-recorded health issues versus self assessed health indicators

The analyses based on GP electronic medical records give the impression that rural populations are generally less healthy than urban populations. However, health interview surveys render totally different results. Self assessed general health is generally better in rural females (Table 2). And while EMR data show no rural/urban difference in mental health problems, rural residents themselves report a better mental health. Rural males as well as females report fewer acute complaints than urban residents. Yet, EMR data show *more* acute somatic conditions in rural areas (but not for women). Similarly, EMRs in rural practices show more chronic conditions for both males and females and yet rural residents do not more often report such chronic conditions themselves when asked.

4. Discussion and conclusions

Morbidity presented in general practice and recorded in electronic medical records appeared to vary between urban and rural areas. Differences found were always to the disadvantage of the rural areas (traumata, chronic diseases and infections). For some health problems the difference was gender specific: for traumata, the urban–rural difference was much larger in men than in women. For acute somatic diseases, family planning issues (for males this is mainly sterilization) and neoplasms differences were only found in for men (more in rural areas).

In the international literature there is support for our findings indicating a more frequent use of health services and higher disease prevalence in rural areas ([Dempsey et al., 2003], [O'Reilly et al., 2007] and [Ramsey and Glenn, 2002]). Specific health risks in rural areas may relate to the agricultural nature of most of these areas, especially when close contact with animals, working with heavy machinery and heavy physical labour are involved (see for instance Larson and Correa-de-Araujo (Larson and Correa-de-Araujo, 2006)). Working in close contact with animals is sometimes associated with a higher risk of diseases like avian influenza or MRSA. At the time of writing this paper (the beginning of 2010), there is a serious outbreak of Q-fever in the Netherlands, that is spread through goat farming. Working with animals, heavy machinery and heavy physical labour may be associated with a higher risk of traumata and chronic conditions in rural areas (see for instance (Hider et al., 2007; Leff et al., 2003)). This may outweigh high traffic density and industrial labour in urban areas (see for example Cooley and Jones (2002)). Another explanation for the lower incidence of traumata in urban areas could be that hospital emergency departments are more easily accessible and more frequently used in urban areas. Contrary to what is usually reported in the literature, the EMR data did not reveal significant differences in the prevalence of mental health problems.

In sum, primary care data collected through electronic medical records show considerable differences between urban and rural areas, to the disadvantage of the rural areas. Data from health interview survey on the other hand, reveal a different pattern. Rural populations evaluate their health status more often as "good". Fewer rural inhabitants run the risk of having mental health problems and report acute complaints less often. In addition, the rural population does not more often report chronic conditions.

There are several possible explanations for the discrepancy between self reported illness and data based on GP consultations. First, general practice may play a more central role in rural areas. Longer travel distances (even in the densely populated Netherlands) may result in fewer referrals to specialist care in rural areas. For the same reason, patients who are referred may come back under treatment of general practitioners

more quickly. This may be an important explanation for the discrepancies found for chronic diseases, acute somatic problems and mental health problems. Similarly, for urban populations it will be easier to go to a hospital emergency department in case of traumata, while for rural populations, the GP might be the most choice. We presume that better accessibility of more specialised health services in urban areas causes morbidity to 'leak' from general practice into these more specialised services.

An additional explanation may be a difference in attitudes towards health problems which may lead to under-reporting in rural areas. People in rural areas might be less inclined to tell an interviewer about their health problems. This may be particularly true for mental health problems. This explanation, however, is not wholly unproblematic, as the same difference would probably also cause rural populations to be less inclined to visit a doctor for their health problems.

Finally, there may also be methodological differences causing discrepancies in urban–rural variations in health status. The EMR data were collected during a 12 month period, whereas in the interviews people were asked about health problems in the past 2 weeks. Also, the self reported health problems may also include less severe problems, for which people do not visit their GP. However, we find it difficult to envisage how this may explain the discrepancies in outcomes in EMR data and self reported data.

In the light of the newly emerging diseases, and more specifically avian flu (H5N1) and swine flu, influenza vaccination is an important issue for rural areas. No difference was found in influenza vaccination uptake between urban and rural areas, although respiratory infections appeared to be more prevalent in rural areas. At present no systematic information on influenza vaccination uptake among for instance farmers involved in cattle breeding is available in routinely collected data in general practice.

4.1. Limitations

Routinely collected GP electronic medical records give information about health problems presented in general practice, but the aetiology of diseases usually remains unseen. For example, the type of virus causing an infection is usually not routinely recorded by the GP in a way that is useful for research. Also the occupational background of the patients is not available in routinely collected data, making it difficult to distinguish for example the farming population from the non-farming population. Since, for instance, cattle breeding is associated with an increased risk for zoonoses, it is important to monitor these emerging diseases. The recent developments with respect to Q-fever in the eastern part of the Netherlands make this clear. The data recorded at general practice could contribute to giving direction to further research.

Differences between rural and urban areas are often associated with differences in socio-economic background of the population (Auchincloss and Hadden, 2002). As this may have affected our results, we repeated our analyses (not presented here), including socio-economic position (based on the International Socio-Economic Index of Occupational Status (ISEI92, Ganzeboom and Treiman, 1996)) and education. The results were similar to the ones presented here. Although the differences between rural and urban were somewhat smaller they were still significant, except for infections of the skin for males and traumata of the neurological system for females.

An important methodological limitation is the dichotomisation of the outcome indicators. Since for this study we were interested in whether there were urban–rural differences in having health complaints, we decided to use this simplification. In further research, attention for differences in the number of complaints in each disease category between urban and rural inhabitants is recommended.

Our results showed that there is a considerable variation in the influence of GP-level on GP-recorded health complaints. Since this was not the focus of this study, we did not explore this further. However, in future research, the influence of GP and service level characteristics on the difference between EMR and health interviews should be explored further.

In this study, we focussed on health differences between urban and rural areas. However, the sub-urban categories were also included in the analyses. As can be seen in [Fig. 1], [Fig. 2], [Fig. 3] and [Fig. 4], the sub-urban categories do not always show a consistent pattern, in the sense that the prevalence in these categories is in between the prevalence in rural and urban areas. We have no explanation for this.

5. Conclusion

We conclude that routine electronic medical records are a useful source of information on the health of rural (and urban) populations. It is possible to identify health problems that are specific for these two types of areas. The type of health problems in rural areas may relate to the agricultural environment (especially in the Netherlands, where most rural areas are agricultural areas), although, according to recent findings, those

who work as farmers report a better health compared to the working population as a whole (Nielen et al., 2008).

An important advantage of GP EMRs in health systems like the Netherlands and the UK is that they refer to the population as a whole, not to the selected subpopulation e.g. from occupational health sources. In addition, electronic medical records in the Netherlands also hold information on influenza vaccination status of the population. All this can be important for, e.g., monitoring the spread of infectious diseases, since these can spread to family members and neighbours as well, as the recent outbreak of Q-fever clearly points out. Routine recording of additional background information on for example people's profession, in high risk areas may offer better insight into the aetiology of specific rural health problems.

However, our analysis on self reported health problems also points out that there is also a risk in relying on GP data. Even in health systems where GPs are gate-keepers for secondary care, in urban areas the vicinity of other health services (like the emergency department and mental health care institutes) may attract people to go to these services directly.

We recommend that future studies distinguish between diseases that are and are not sensitive to differences in the accessibility of specialised health services and specialised acute care services. Another option to investigate this issue further is to include not only information from general practitioners but also from other health care services, such as out-of-hours services and hospital emergency departments, and see whether the discrepancy in outcomes between self reported health and data from electronic medical records pertains.

APPENDIX A: THE CLUSTERING OF ICPC-CODES IS SHOWN IN TABLE A1 HERE.

Table A1.
Clustering of ICPC-codes into disease clusters.

Congenital disorders		A90, B78-79, D81, F80-81
		H80, K73, L82, N85, R89, S83, T78, T80,
		W76, X83, Y82-84
Acute somatic diseases	General	A01-11, A14-15, A29, A91
	Blood	B01-04, B11, B29, B84-87
	Gastro-intestinal	D01-25, D29, D83-86, D90 D96
	Eye	F01-18 F29 F82-85
	Ear	H01-15, H29
	Circulatory system	K01-07 K29
	Musculoskeletal system	L01-25 L29
	Neurological	N01-19, N29, N89, N90-94
	Respiratory tract	R01-25, N29
	Skin	S01-08, S20-24, S29
	Endocrinal	T01-11, T15, T29
	Urinary tract	U01-14, U29

	Genital system female	X01-21, X29, X84-88
	Genital system male	Y01-10, Y16, Y29
Traumata	General	A80-82, A86, A88-89
	Blood	B76-77
	Eye	F75-79
	Ear	H76-79
	Musculoskeletal system	L72-80, L81, L96
	Neurological	N79-81
	Respiratory tract	R87-88
	Skin	S12-19
	Genital system	X82, Y80
	Other	D79, D80, K72, T74, W75, U80
Infections	Children's diseases	A71-72 A74 D71 N70-71 R71-72
	Glands	A75 B70-71
	Gastro-intestinal	D70, D73, D74, D88
	Eye	F70-73
	Ear	H70-74
	Circulatory system	K70, K74
	Musculoskeletal system	L70
	Respiratory tract	R74-83, R90
	Skin	S09-11, S70-76, S84-85
	Urinary tract	U70, U71, U72
	Genital system female	X70-74, X90, X99
	Genital system male	Y70-75
	Other	A70, A73, A76-A78, B90, L70, N72-73, R70, R73, T70

Chronic diseases	Allergy	A12, R97, S98
	Gastro-intestinal	D72, D82-87, D89-95, D97-99
	Eye	F91-F99
	Ear	H81-H99
	Circulatory system	K75-99
	Musculoskeletal	L83-95, L97-99
	Neurological	N86-88, N99
	Respiratory tract	R91, R93, R95-96 R98-99
	Skin	S86-99
	Metabolism	T12, T81, T82-83, T85-86, T91-93, T99
	Diabetes Mellitus	T87-90
	Kidney	U88-99
	Genital system female	X84-89, X99
	Genital system male	Y86-99
	Other	A99 B80-83, B99
Neoplasms		A79, B72-73, D75-76, L71
		N74, R84, S77, T71
		U75-77, W72, X75-77, Y76
		B74, B75, D77-78
		F74, H75, K71, L71, N75-76, R85, R86, S78-82, T72-73
		U78-79, W73, X78-81, Y77-79, Y85
Pregnancy and birth		W01-06, W15-W21, W29
		W70-71, W77-99,
		A92-A95
Family planning		W10-14, Y13-14

Fear for diseases		A13, A23-27
		B25-27
		D26-27, F27
		H27,K24-27
		L26-27
		N26-27, P27
		R26-27, S26-27
		T26-27, U26-27
		W27, X23-27, Y24-27, Z27
Mental disorders		P01-13
		P15-26, P29
		P70 -99
Social problems		Z01-29
Side effects		A83-87
Prevention		A30-31
		A44-45, A49
		B44-45, B49
		D44-45, D49
		F44-45, F49
		H44-45, H49
		K44-45, K49
		L44-45, L49
		N44-45, N49
		P44-45, P49
	Influenza vaccination	R44 (via special data collection procedure)

		R45, R49
		S44-45, S49
		T44-45, T49
		U44-45, U49
		W44-45, W49, W30-31
		X44-45, X49. X37
		Y44-45, Y49
		Z44-45, Z49
Disabilities		A28, B28, D28, F28, H28, K28, L28, N28
		P28, R28, S28, T28, U28, W28, X28, Y28, Z28
Minor surgery and diagnostic procedures		A32-43 1046-47, A50-69
		B30-43, B46-47, B50-69
		D30-43, D46-47, D50-69
		F30-43, F46-47, F50-69
		H30-43, H46-47, H50-69
		K30-43, K46-47, K50-69
		L30-43, L46-47, L50-69
		N30-43, N46-47, N50-69
		P30-43, P46-47, P50-69
		R30-43, R46-47, R50-69
		S30-43, S46-47, S50-69
		T30-43, T46-47, T50-69
		U30-43, U46-47, U50-69
		W32-43, W46-47, W50-69
		X30-36, X38-43, X46-47, X50-69
		Y30-43, Y46-47, Y50-69
		Z30-43, Z46-47, Z50-69

Other		A16-17, A20, A96, A00, B00, D00, F00, H00, K00, L00, N00
		P00, R00, S00, T00, U00, W00, X00, Y00, Z00

[APPENDIX B.] INFLUENZA VACCINATION IN DUTCH GENERAL PRACTICE

The family physicians that participated in this study invited all their high-risk patients for annual immunisation in accordance with the immunisation guidelines of the Dutch College of General Practitioners ([Van Essen et al., 1993] and [Van Essen et al., 1997]). Box 1 describes the Dutch influenza programme.

Box 1. The Dutch influenza vaccination programme

In the Netherlands, primary health care is mainly provided by GP and nearly all Dutch inhabitants are listed with a GP. The GP staff keep a record of the vast majority of persons, including demographic and medical information.

In the Dutch influenza immunisation guidelines (Van Essen et al., 1997) vaccination is recommended for persons: aged 65 years or older, with cardiovascular disease, pulmonary or renal disease, diabetes or other immune-related disease at any age. Influenza vaccination is free of charge for all Dutch high-risk patients. There is a fee-for-service for the GPs who select, invite and vaccinate the population at risk, and document the vaccinations in the patients' medical records.

Annual influenza surveillance monitoring has been carried out by the National Influenza Centre in collaboration with the Sentinel Practice Network since 1970 (Rimmelzwaan et al., 2000) since 1996, vaccination rates have been monitored yearly by the National Information Network of General Practice (LINH) ([Tacken et al., 2002] and [Tacken et al., 2004]).

B.1. Measurements of influenza vaccination

Eligible patients for an influenza vaccination in 2001 were identified by means of a software module that searches through the EMR and uses ICPC codes, indication tags and prescriptions to identify high-risk patients. Elected patients were registered by means of an influenza indication tag. Details of the stepwise selection procedure have been reported previously (Hak et al., 1998). All relevant data were extracted from the EMR using specially developed software. All data were collected on a patient level. Contacts were defined as events in which a patient received professional advice or help from the family physician or practice assistant, including consultations, phone calls and home visits. Additional data were gathered on age, gender, type of health insurance (social health insurance or private health insurance), indications for vaccination according to the Dutch guidelines (Van Essen et al., 1997) (high-risk (co-) morbidity and/or age 65 years or older) and vaccination status.

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TABLE AND FIGURE

Table 1
Distribution of practices and patients over the levels of urbanity.

	No. of practices	No. of patients
Very strongly urbanised (urban)	22	64.415
Strongly urbanised	24	78.178
Moderately urbanised	20	82.884
Little urbanised	20	87.234
Not urbanised (rural)	18	72.750

Fig. 1. Urban–rural differencesindiseaseprevalencein males (only significant differences areshown).

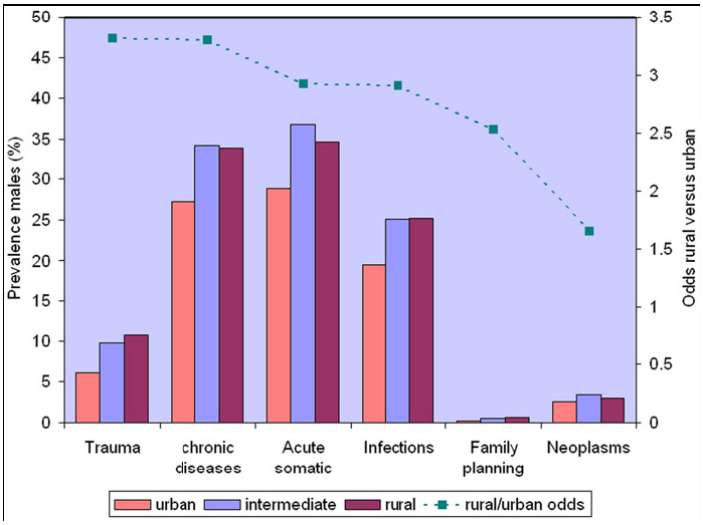

Fig. 2. Urban–rural differencesindiseaseprevalencein females (only significant differences areshown).

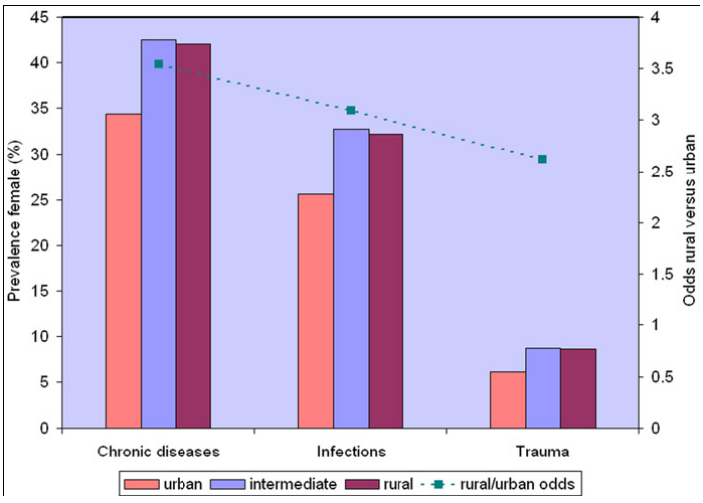

Fig. 3. Urban–rural differencesindiseaseprevalencein males for thediseaseclusterstrauma,infections,chronicdiseasesandacutesomaticdiseasesindetail(only significant differencesareshown).

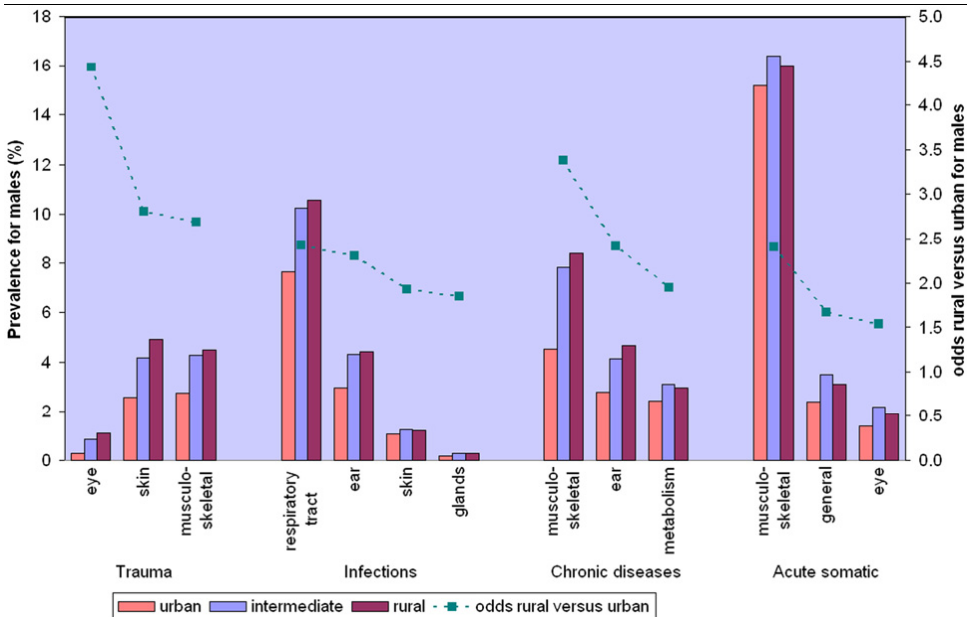

Fig. 4. Urban–rural differencesindiseaseprevalencein females for thediseaseclusterstrauma,infections,chronicdiseasesandacutesomaticdiseasesindetail(only significant differencesareshown).

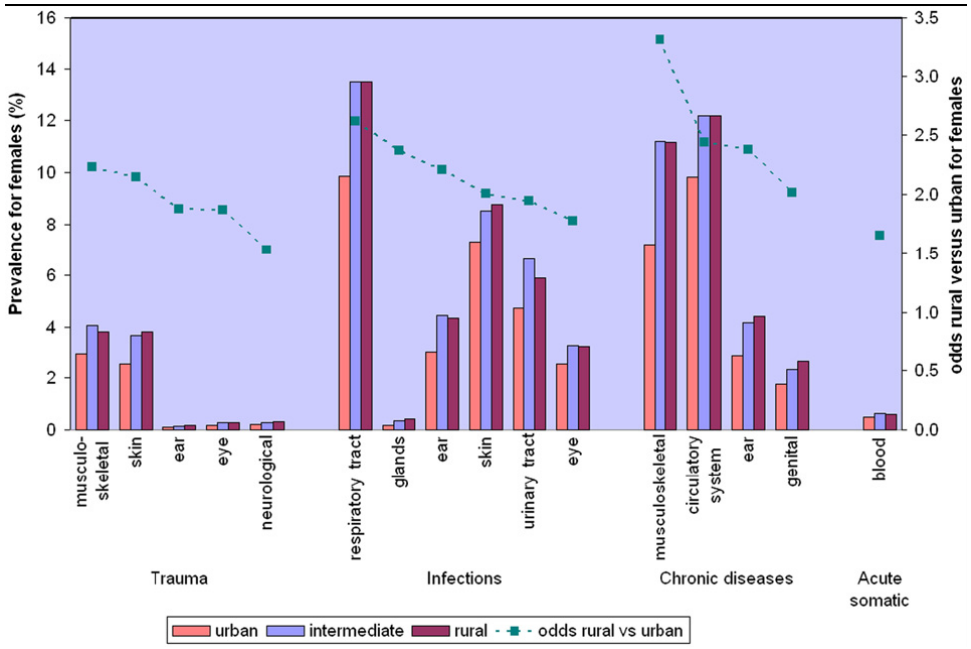

Table 2
Urban–rural differences in health problems presented to general practice and self-reported.

	Odds ratio	95% Confidence interval		Prevalence (%)		ICC[c]
	rural/urban	lower	upper	urban	rural	
GP-recorded health problems[a]						
Males						
Trauma	3.31	1.70	6.45	6.1	10.7	0.25
Chronic diseases	3.30	1.18	9.21	27.2	33.9	0.45
Acute somatic	2.92	1.04	8.22	28.8	34.6	0.45
Infections	2.91	1.18	7.18	19.5	25.2	0.38
Family planning	2.53	1.66	3.88	0.2	0.6	0.07
Neoplasms	1.65	1.01	2.68	2.5	3.0	0.15
Females						
Chronic diseases	3.54	1.17	10.77	34.4	42.0	0.49
Infections	3.09	1.14	8.34	25.6	32.2	0.43
Trauma	2.62	1.36	5.04	6.1	8.6	0.24
Self-reported health problems[b]						
Males						
Acute somatic problems	0.60	0.42	0.85	85.1	78.3	0.04
Mental health problems	0.63	0.49	0.81	45.2	39.5	0.01
Chronic health problems	n.s.			51.8	47.6	0.01
Perceived general health (% good)	n.s.			77.2	80.3	0.01
Females						
Acute somatic problems	0.48	0.31	0.73	91.0	84.7	0.07
Mental health problems	0.67	0.55	0.82	44.9	39.1	0.00
Chronic health problems	n.s.			63.4	57.0	0.02
Perceived general health (% good)	1.52	1.18	1.98	72.7	80.2	0.02

[a] Presented are significant odds ratios at level $p < 0.05$; prevalence is age standardized.
[b] Acute complaints: 0=no complaints, 1=1 or more acute complaints; GHQ ≥ 2: 0=no, 1=yes (possible psychiatric case); Chronic condition: 0=no chronic condition, 1=1 or more chronic condition(s); Perceived general health: 0=mediocre or bad, 1=good, very good, excellent; Prevalence is age standardized.
[c] ICC=Intra-class correlation coefficient.

Table 3
Detailed urban–rural health differences presented to general practice[a].

	Odds ratio	95% CI		Prevalence (%)		ICC[b]
	rural/urban	Lower	upper	urban	rural	
Males						
Trauma: eye	4.43	2.93	6.69	0.3	1.1	0.07
Trauma: skin	2.81	1.64	4.81	2.6	4.9	0.17
Trauma: musculoskeletal	2.69	1.59	4.54	2.7	4.5	0.17
Infections: respiratory tract	2.42	1.20	4.86	7.7	10.6	0.27
Infections: ear	2.30	1.41	3.77	2.9	4.4	0.15
Infections: skin	1.93	1.02	3.66	6.7	7.9	0.23
Infections: glands	1.85	1.09	3.13	0.2	0.3	0.09
Chronic disease: musculoskeletal	3.38	1.84	6.24	4.5	8.4	0.22
Chronic disease: ear	2.41	1.42	4.12	2.8	4.7	0.17
Chronic disease: metabolism	1.95	1.11	3.42	2.4	2.9	0.19
Acute somatic: musculoskeletal	2.40	1.10	5.42	15.2	16.0	0.33
Acute somatic: general	1.67	1.01	2.75	2.4	3.1	0.15
Acute somatic: eye	1.54	1.01	2.37	1.4	1.9	0.11
Females						
Trauma: musculoskeletal	2.23	1.31	3.79	3.0	3.8	0.17
Trauma: skin	2.15	1.27	3.61	2.5	3.8	0.16
Trauma: ear	1.88	1.12	3.16	0.1	0.2	0.05
Trauma: eye	1.87	1.13	3.08	0.2	0.3	0.08
Trauma: neurological	1.53	1.00	2.33	0.2	0.3	0.06
Infections: respiratory tract	2.62	1.21	5.64	9.8	13.5	0.31
Infections: glands	2.37	1.19	4.73	0.2	0.4	0.20
Infections: ear	2.21	1.32	3.7	3.0	4.3	0.31
Infections: skin	2.01	1.02	3.94	7.3	8.8	0.26
Infections: urinary tract	1.95	1.05	3.64	4.7	5.9	0.22
Infections: eye	1.71	1.07	2.75	2.5	3.2	0.14
Chronic disease: musculoskeletal	3.31	1.62	6.79	7.21	11.17	0.28
Chronic disease: circulatory system	2.44	1.11	5.37	9.82	12.17	0.32
Chronic disease: ear	2.38	1.41	4.04	2.87	4.41	0.17
Chronic disease: genital	2.02	1.25	3.26	1.78	2.67	0.14
Acute somatic: blood	1.65	1.05	2.58	0.50	0.60	0.10

[a] Presented are significant odds ratios at level $p < 0.05$; prevalence is age standardized.
[b] ICC=Intra-class correlation coefficient.