Measuring burden of disease in two inner London boroughs using Disability Adjusted Life Years

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ABSTRACT

Background This paper uses the Disability Adjusted Life Year (DALY) to estimate disease burden at a local level and relates this to programme budget (PB) data.

Methods We estimated DALY using the global burden of disease (GBD) template. For years of life lost, local mortality data were used and for years of life with disability, the GBD estimates from World Health Organization EURO A region (including the UK) were used. We used PB data to analyse how healthcare expenditure matched disease burden.

Results In 2005 the burden of disease in Lambeth was estimated at 36,368 DALYs (13,515 DALYs lost per 100,000) and in Southwark was 34,196 DALYs (13,244 DALYs lost per 100,000). There were gender and area differences. The ranking is different when mortality and morbidity are combined compared with mortality alone. We estimated that the average spend per DALY lost in 2005 was £11,066 in Lambeth and £9,390 in Southwark.

Conclusions We used a pragmatic approach to estimate overall disease burden providing a local, more comprehensive picture with important differences in spend by disease and health authority area. However, a more detailed approach to support decisions about prioritization based on modelling interventions that impact on avoidable burden of disease is recommended.

Keywords burden of disease, disability adjusted life year, prioritization, programme budget

Background

Over the last 20 years, the measurement of population health status has received growing attention stimulated by the World Health Organization’s Global Burden of Disease (GBD) project.1 The classification and measurement of population health status remains an important area of research and development.2,3 Summary measures of population health are a way of devising, as a single numeric, the impact of mortality and morbidity on health. Their development and use present complex challenges including methodological, ethical and political issues.4,5

In this paper we report on the use of the Disability Adjusted Life Year (DALY) at a local level in Lambeth and Southwark PCTs to describe the health state of the population and its use to support prioritization. Lambeth and Southwark are two neighbouring inner London PCTs. Both boroughs cover very diverse populations south of the Thames and like many London boroughs there are a range of communities living and working within them. The population structures in general are younger, with both boroughs having higher levels of deprivation although there are pockets of affluence. The populations of the two boroughs have similar health needs.

Traditionally, assessing the state of the health of populations involves using multiple measures to assess the disease burden in the area with reports produced using mortality statistics and a variety of estimates of morbidity, e.g. hospital admissions, outpatient attendance and prevalence estimates. Life expectancy or mortality rates are often used locally but summary measures that combine mortality and morbidity, such as the DALY or other measures, are rarely used at a local level.

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The DALY was developed in the 1980–90s. In 1993 the Harvard School of Public Health in collaboration with the World Bank and World Health Organization (WHO) assessed the GBD using this summary measure. Since then several burden-of-disease studies have been carried out mainly at a global and national level and less so at regional or local levels using the DALY. The DALY is a population-level summary measure and it aims to estimate the difference between actual health and some stated ideal goal or norm for population health. DALYs for a given disease or health condition are calculated as the sum of the years of life lost (YLL) due to premature mortality in the population and the equivalent ‘healthy’ years lost due to disability (YLD) as shown in the formula below:

\[
\text{DALY} = \text{YLL} + \text{YLD}
\]

**Methods**

The aim of this study was to assess and describe the general burden of disease in the London boroughs of Lambeth and Southwark using the DALY and to assess if this measure supports planning and prioritization of health services at the PCT level by combining it with programme budgeting (PB) data.

The approach used to calculate DALYs is based on the methods used in the South and West DALYs project and on the methods used in the GBD Study.

**Calculating YLLs**

To calculate YLL in each of the boroughs, the GBD DALY template was used. This is a Microsoft Excel spreadsheet that contains the formulae to calculate YLLs. The user inputs a minimum amount of data (i.e. local demography and mortality by sex and age groups). One adjustment was made to the template—for average age of death. The GBD study uses the actual average age of death in each age group. For simplicity we used the mid-point of each age group as a proxy for the average age of death. However, in reality the difference between the two methods was small.

The GBD template uses the standard expected YLL using the Coale and Demny West Model 26 life table. This is an idealized estimate of life expectancy that combines potential YLL with period life tables. This is an internationally recognized standard used in most burden of disease studies. Using this life table the template then calculates an average standard expected YLL for each of the age groups.

Mortality data for each borough for the year 2005 were obtained (source of data: National Statistics Public Health Mortality Files 2005). The numbers of deaths in each sex and 5-year age groups for 2005 was calculated for all the ICD10 chapters using the underlying cause of death. Infants who had a Wigglesworth code recorded rather than an ICD10 code were all assigned to the perinatal chapter. Counts of the local populations were calculated for each age and sex group using National Statistics mid-year population estimates for 2005.

**Calculating YLDs**

The GBD project calculated YLDs for the different regions of the world. There are no disability weight calculations for different diseases in England. As an approximation we used the GBD calculations for YLD for the EURO A region (which includes the UK) estimated by the WHO for the local YLD estimates. However, the WHO GBD project categorizes diseases in a slightly different way to that of ICD10 chapters. The YLDs from the EURO A region of the WHO GBD study were assigned by the researchers to the ICD10 chapters using as best a fit as possible. The diseases that did not exactly fit into an ICD10 chapter are shown below. The main effect of this on this study was that some diseases that would normally be included in the nervous system chapter were included in the mental health chapter.

The GBD morbidities that did not exactly fit into one ICD10 chapter

- ‘Other STDs’ (in GBD were a mixture of infectious and genito-urinary diseases) were assigned to the infectious diseases chapter.
- ‘Meningitis’ (in GBD were a mixture of infectious and nervous system diseases) was assigned to the infectious diseases chapter.
- ‘Other nutritional disorders’ (in GBD study were a mixture of diseases of blood and endocrine) were assigned to the diseases of blood chapter.
- ‘Endocrine disorders’ (in GBD study were a mixture of endocrine and diseases of blood) were assigned to the endocrine chapter.
- ‘Alzheimer and other dementias’ (in GBD were a mixture of mental health and nervous system diseases) were assigned to the mental health chapter.
- ‘Other neuropsychiatric disorders’ (in GBD were a mixture of mental health and nervous system) were assigned to the mental health chapter.

**Calculating DALYs**

DALYs were calculated for Lambeth and Southwark by summing the YLLs and the YLDs. DALY’s were calculated using both a 3% discounting rate and no discounting although in this paper we only report the discounted
estimates. The WHO GBD template allows for variations in the parameters relating to discounting time and age weighting. Both of these are subject to debate about whether they should be included in the model or not. Each year of future life is discounted on the basis that this reflects individual preferences for benefits sooner rather than later. The original GBD study weighted a healthy life lived at very young and old ages lower than other ages. This is very controversial and a number of studies have criticised age weighting for a range of reasons and suggested that uniform or no weighting be used. We did not apply age weighting in estimating the DALY for this reason.

Programme budgeting

PB is a retrospective appraisal of resource allocation, broken down into meaningful programmes, with a view to tracking future resource allocation in those same programmes. PB has been applied in the NHS and in 2002 the Department of Health (DH) initiated a PB Project, with the aim to develop a primary source of information to give a greater understanding of ‘where money is going’ and ‘what we are getting for the money we invest in the NHS’. In our study we analyse PB data and the DALYs we had calculated to see how current expenditure matched disease burden.

In the PB methodology, expenditure measured in the UK pounds (£) was mapped to programmes of care based on medical conditions. While most of the PB categories reflected the ICD10 chapter headings there were some differences and again as close a match as possible was made by the researchers. Comparing the ICD10 chapters to PB data some adjustments to the disease grouping were made as follows:

- In the PB data costs for gastro-intestinal systems problems and dental problems were combined to match with ICD10 chapter digestive system which includes dental problems.
- In the PB data costs for trauma and injuries and poisonings were combined to match with ICD10 chapter external causes.
- The ICD chapter congenital malformations were added to the perinatal chapter to match with the neonatal conditions PB cost data.

We plotted a scatter diagram of PB data (£) and DALYs (by ICD 10 chapter) for the year 2005. We estimated the average cost per DALY and a line representing this information was added to the plot to identify areas where spend was greater or less than average cost per DALY.

Results

Fig. 1 shows the total current burden of disease for Lambeth and Southwark for 2005 broken down by ICD10 chapter, and split by YLL and YLD. If just mortality (YLL) had been used, the order of magnitude by ICD chapters of burden of disease would be different from that using the DALY. For example, the largest proportions of YLL in both Lambeth and Southwark are from circulatory diseases and neoplasms, however, when the YLD component is included mental disorders (including dementia) become the largest burden for both of the boroughs. Musculoskeletal conditions also come higher in the ranking.

Calculating DALYs by gender revealed male and female variation in the burden of disease (Table 1). The ranking of the top five disease chapters in terms of DALYs was the same for both genders with the exception of females in Southwark where cancers were the second greatest burden of disease and circulatory diseases were the third burden. For males in both boroughs external causes were the 6th largest disease burden; for females it was musculoskeletal conditions. Diseases of the nervous system were also a much bigger burden for females than they were for males.

Overall the total burden of disease was greatest in Lambeth in 2005, with 36 368 DALYs lost compared with 34 196 in Southwark. Lambeth also had a slightly higher rate of DALYs lost with Lambeth having a higher loss in females compared with males and the opposite in Southwark.

Comparison of the total burden of disease by ICD chapter against the expenditure in 2005 based on the PB data for each of the PCTs is shown in Fig. 2. The line representing the average spend per DALY in the figures attempts to show the areas where spend is greater or lesser than the estimated average spend per DALY in the local population. In both boroughs this analysis shows that while mental disorders represent a large burden of disease a correspondingly large amount of money is being spent in this area. Major outliers appear to be neoplasms, circulatory diseases and infectious diseases in both boroughs and neonatal and congenital malformation in Southwark.

Discussion

Main findings of this study

This study is the first analysis that has attempted to use DALYs to measure the burden of disease in Lambeth and Southwark. While the two local public health departments continuously monitor the health status of the local
population, this is the first time the DALY has been used to describe morbidity and mortality patterns. The total burden of disease in 2005 in Lambeth was estimated at 36,368 DALYs (13,515 DALYs lost per 100,000 population) and in Southwark was 34,196 DALYs (13,244 DALYs lost per 100,000 population). In other words, among each 1000 people in Lambeth and Southwark during 2005, an estimated 13.5% and 13.2% years of healthy life were lost. There were gender differences in the overall DALYs lost with Lambeth women having higher losses compared with men and in Southwark men having higher losses. There were also some differences in the ranking of DALY by specific disease. In particular, accidents had a higher loss of health for men and musculoskeletal disease for women. This study also shows that the ranking of total current disease burden is very different when mortality and morbidity are combined with mental disorders being the highest followed by circulatory disease and neoplasms for both boroughs compared with mortality alone. Musculoskeletal conditions also are ranked higher. This highlights the importance of considering non-fatal conditions when estimating burden of disease. Area differences showed that Lambeth had a slightly higher burden from circulatory disease compared with Southwark but lower burden for respiratory disorders. We estimated that the average spend per DALY lost in 2005 was £11,066 in Lambeth and £9,390 in Southwark. In general as the disease-specific burden increases the current spend also increases. However there are some outliers in both
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DALYs calculated for 2005 discounted by 3% and using Standard LE
boroughs. Outliers with higher than average spend include: infectious diseases, genito-urinary disorders and pregnancy. Outliers with a lower than average spend per DALY include: circulatory disorders, neoplasms, respiratory disorders and ear problems. There are also interesting differences in the amount spent by Lambeth compared with Southwark despite similar levels of burden of disease. To assess appropriateness of programme spend more detailed economic evaluation is required. One approach could be marginal analysis which is an appraisal of added costs and benefits when resources are increased or resources are utilised differently in a PB.23

What is already known on this topic
A number of studies have reported on total burden of disease using the DALY at a global, national or regional level in developed and developing countries. Other studies have focused on risk factors or disease-specific burden.8–14,17,24–40 All of these show the impact of either fatal and non-fatal conditions or risk factors in terms of disease burden. These studies provide comprehensive assessments of health status at a population level and have been used to inform priority setting and health policy debates. More recently methods to assess avoidable and avoided burden through interventions are being developed.41

What this study adds
This study provides a detailed assessment of the size and impact of health problems in two inner city populations in terms of disease and injury using a summary measure of health. It combines this with the information on health expenditure detailing the current use of these resources. Local health economies will have a statutory duty to carry out a Joint Strategic Needs Assessment in partnership with

Fig. 2 (a and b) Lambeth and Southwark DALY compared with Programme Budget Spend.
Analyses described in this paper can provide some of the information required for such assessments. Such information also help PCTs in developing their (5 year) commissioning strategy and in identifying key priorities. However PCTs themselves would not have capacity to undertake this detailed technical task of the modelling suggested. It is recommended that PCTs should collaborate at a regional level and set up panels with the relevant technical expertise required coming from Public Health Observatories and academic public health units and health economists in addition to other stakeholders.

**Limitations of this study**

There are a number of limitations to the present study. We assumed that the YLD estimates for EURO A region (which includes the UK population) is generalizable to the Lambeth and Southwark populations. We could have potentially estimated YLD by searching the epidemiological literature for individual diseases but this would have been very time-consuming given the resources at our disposal. In the absence of disability weights for the UK population we thought this was a pragmatic approach. We made some adjustments to the spreadsheet models from WHO to estimate the DALY. These were minor and again pragmatic changes due to the way data was available to us. There is much debate and criticism on the construction, valuation and use of the DALY in the literature. This cannot be detailed in this paper but to summarize people have questioned and critiqued the use of social values such as age weights and the derivation of disability weights. Discounting is used to reflect the importance people place on loss of health currently compared with the future. We have only estimated DALY at ICD chapter heading level. More detailed work could be done to estimate DALY at specific disease level that would take account of differences in disability weights (severity) and mortality outcomes. Clearly different treatments and/or public health interventions are not equally cost effective and the average or marginal costs of these interventions will not be equal. Detailed modelling would need to be done, where the impact of interventions in terms of benefits and costs is assessed. One important limitation of this would be lack of detailed epidemiological information and/or routine health survey data and cost data for specific diseases and interventions for use in modelling.

Although we recognize these limitations in using the DALY we believe that it is a useful measure to use at a local level to quantify overall burden of health lost due to disease in a specific period as a single measure. It also highlights the need for ongoing research into methods for constructing and using summary measures of health as well as data gaps.

A disadvantage of simply measuring the total burden of disease as we have done is that it does not give information as to what is preventable or can be avoided through interventions. This would require more detailed modelling as discussed above. There is an increasing literature on the use of the DALY to estimate ‘avoidable burden’ and cost effectiveness evaluations both in terms of measuring the risk of getting future disease as well as through using different interventions.

**Conclusions**

We have used a pragmatic approximation to estimate the DALY to measure the burden of disease in two inner city boroughs. This has provided a local more comprehensive picture of the total burden of disease although there are important limitations to this approach as outlined above. Although this approach gives a crude picture of health need in relation to current spend and has uncovered differing priorities and differential healthcare spend, a more detailed approach is required to support decisions about prioritization based on modelling interventions and measuring ‘avoidable’ burden of disease. In the context of debates about value for money and choices that have to be made there is an urgent need to consider generalized approaches such as the “Disease Control Priorities in Developing Countries” for priority setting in the UK context.

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**Authors contribution**

HD conceived the idea behind the paper and wrote the background, discussion sections and edited the final versions. KP analysed the data and wrote the methods and results section. Both have read and approved the final version.
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