

What is the effect of reduced street lighting on crime and road traffic injuries at night? A mixed-methods study

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Scientific summary

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Scientific summary

Background

Local authorities across England and Wales, and in many other countries, are reducing the amount of street lighting at night in order to save energy costs and reduce carbon emissions. Concerns have been raised about the impact of this on crime, fear of crime and road traffic injury, although there are also hypothetical positive effects on well-being from reduced light pollution. Little is known about the impact of reduced street lighting on public health or about public concerns about the impacts of reductions on well-being.

Objectives

1. To conduct a rapid appraisal to map public views on the impact of reductions in street lighting on well-being using data from ethnographic visits, a household survey and documentary sources.
2. To provide evidence on the impact of street lighting energy-saving schemes on two important public health outcomes, namely crime and road traffic injury. The interventions evaluated were switching off street lights permanently, switching lights off for part of the night, dimming the lighting level, changing from yellow to white light and trimming the period during which lights are switched on, as well as common combinations of these.
3. To develop a structured framework for a cost–benefit analysis (CBA) of street lighting reduction schemes, based on recommendations from the literature about the challenges of economic evaluations of large-scale public health interventions.

Methods

Rapid appraisal

Eight case study areas in England and Wales were selected to include a range of local authorities, geographical areas and street lighting changes. Within these areas, focused ethnographic visits collected a range of data, including in-depth interviews with lighting professionals, residents and workers; intercept interviews; field notes from 'walk-arounds' and documentary data. A survey of households in one area compared attitudes and behaviours between those in streets affected and those in streets not affected by part-night lighting.

Impact of street lighting on crime and road traffic injury

For the impact of street lighting reductions on crime and road traffic injury, local authorities in England and Wales were requested to provide data on the locations of street lights where street lighting reduction or energy saving had been implemented (or planned), with the month and year that the changes had been introduced. Outcome variables were based on all police-reported road traffic injuries (data from STATS19, the official data set of personal injury road collisions and casualties that occur on the public highway in the UK) and crime (Police.uk website). The data sets on street lighting reduction, crime and road traffic injuries were linked to a road segment database that included all classified and unclassified roads. Links were also made to census data using the lower super output area (LSOA) within which each road was located. From the combined data set, counts of crime and road traffic injuries for each road segment were generated by year and month. Detailed crime data were also obtained from one police force to use in a methodological substudy to determine the optimum use of the Police.uk data. This substudy found that the Police.uk crime data are reliable when analysed at middle super output area (MSOA) and LSOA levels, but not when analysed at postcode or street level. The statistical method used for the main study was a controlled

interrupted time series analysis that compared changes in counts of crime and traffic injuries on streets and in areas before and after street lighting changed. Road traffic injuries were analysed at street segment level. Regression models were used to estimate changes in daytime and night-time collision rates associated with each lighting intervention. The ratio of night-time and daytime changes was considered the best estimate of changes in night-time collisions following lighting interventions. Police.uk crime data were found to be reliable when analysed at MSOA and LSOA levels, but not at postcode or street level. For crime, analyses were, therefore, conducted using proportions of total km of road in each MSOA with each lighting intervention. Regression models controlling for yearly and monthly trends were fitted in each geographical region and police force and estimates were pooled in random-effects meta-analyses. We explored inequalities by estimating associations in subgroups based on thirds of areas according to the Index of Multiple Deprivation. Rate ratios (RRs) were calculated as the measure of association.

Economic evaluation

The scope of our CBA comprised infrastructure, maintenance and energy consumption costs and any associated changes in crime and road traffic injuries, using estimates from the other components of this study. Our CBA framework considered two scenarios over different time horizons: one in which street lighting is switched off between 12 a.m. (midnight) and 6 a.m. for a proportion of street lights in a typical local authority and one in which lighting is maintained.

Public engagement

The rapid appraisal was designed specifically to engage the public and to identify which 'publics' might have an interest in the topic and so it would have been difficult to identify a 'representative' of the public before the project was complete. We did, however, include a range of stakeholders in the project advisory group, including representatives from lighting professionals and local government.

Results

Rapid appraisal

We mapped the main domains of interest to the public (road safety, fear of crime, reduced mobility, being able to the night sky and sleep quality), noting that, for the majority of respondents, reductions in lighting went unnoticed. However, for a few, switching off lights tapped into deep-seated anxieties about darkness, modernity 'going backwards' and lack of faith in local governance. The strong and polarised views identified in public domains such as newspaper letters were not reflected in more deliberative settings, where residents were likely to reflect on both positive and negative effects of street lighting reduction. Reported well-being impacts were marginal. Although unpopular, switch-off and part-night lighting had little impact on mobility. Well-being outcomes of proposed changes in street lighting are likely to be mediated by place, in terms of both expectations of how localities should be lit and how lighting authorities are trusted to balance the best interests of their communities, and negative outcomes may be mitigated to some extent through deliberative consultation.

Impact of street lighting on crime and road traffic injury

The street lighting interventions analysed were switch-off, part-night lighting, white light and dimming. We obtained data from 62 local authorities in England and Wales, which, collectively, account for a total of over 30,000 km of road affected by lighting changes by 2013. Switch-off had been introduced on a total of 946 km of road, part-night lighting on 12,101 km, white light on 15,833 km and dimming on 10,519 km.

We found weak evidence that the proportion of road length in an area with reduced street lighting was associated with crime and little evidence that it was associated with road traffic injury. In summary:

- Switch-off (permanently turning street lights off) was not associated with an increase in night-time traffic collisions [RR 0.97, 95% confidence interval (CI) 0.82 to 1.15] or crime (RR 0.11, 95% CI 0.01 to 2.75); however, the results are imprecise because of the small number of areas in which switch-off was implemented, and so should be treated with caution.
- Part-night lighting (e.g. street lights are switched off between 12 a.m. and 6 a.m.) was not associated with an increase in night-time traffic collisions (RR 0.95, 95% CI 0.84 to 1.07) or crime (RR 0.96, 95% CI 0.86 to 1.06).
- Replacing conventional yellow lighting with white light was not associated with an increase in night-time traffic collisions (RR 1.01, 95% CI 0.93 to 1.09) and was associated with a reduction in crime (RR 0.89, 95% CI 0.77 to 1.03), although estimates were imprecise.
- Dimming of conventional yellow light or white light was not associated with an increase in night-time traffic collisions (RR 1.00, 95% CI 0.91 to 1.10) and was associated with a reduction in crime (RR 0.84, 95% CI 0.70 to 1.02), although estimates were imprecise.

These RRs estimate change in outcomes associated with 100% implementation of the street lighting energy-saving intervention in an area. To assist with interpretation, if dimming was applied to street lights on 10% of total road kilometres in an area, the estimated change in crime in the area would be equivalent to $0.84^{0.10} = 0.98$ (i.e. a 2% decrease in crime) with a 95% CI from 0.96 to 1.00 (i.e. between a 4% decrease and no change in crime). If applied to street lights on 50% of roads, the change would be $0.84^{0.50} = 0.92$ (i.e. an 8% decrease in crime) with a 95% CI from 0.84 to 1.01 (i.e. between a 6% decrease and a 1% increase in crime).

Economic evaluation

We found that after estimating the monetised value of impacts on crime and road traffic injuries, part-night lighting regimes may represent a large net benefit to the local authority. However, there is considerable uncertainty around the estimates and our model was unable to include potentially important effects of part-night lighting, such as fear of crime or reduced mobility.

Discussion

The strengths of this study were that it comprised data from 62 local authorities and was adequately powered to detect plausible differences in the main outcomes; it utilised a rapid appraisal to provide context and an interrupted time series analysis which defended against some confounding. However, as with all evaluations of natural experiments, the study is not without its limitations. The data sources used in this study are known to be incomplete as a result of under-reporting. However, in order for under-reporting to affect the results of our analysis there would have had to be differential changes over time in the recording of crime and road traffic injuries in the streets where lighting has been changed, compared with streets without changes to street lighting, which seems unlikely. We found good evidence for associations with crime types that are more likely to be reported to the police for insurance claims, specifically burglary and theft of vehicles.

The Police.uk data are altered to protect the anonymity of victims and this introduces the potential for misclassifying crime locations. We conducted a reliability study that compared these data with detailed police-recorded crime data and we identified the spatial level at which counts of crime using both sources are in good agreement. Our analyses were then conducted at this level of spatial resolution. Thus, although we are reasonably confident in the direction of the associations between street lighting reductions and crime, we must remain cautious about their relative magnitudes as the effects are measured at area, rather than street segment, level.

We could not take into account the potential impact of other road safety or crime prevention initiatives, such as, for example, improved road markings, policing interventions or closed-circuit television. If such measures were introduced more often in streets where lighting has been changed than elsewhere, it is possible that some of the associated changes in crime in areas where lighting has been changed may be attributable to these other measures. It is likely that such confounding will account for part of the observed associations within the areas where street lighting was changed, compared with other areas.

We found no convincing evidence for associations between street lighting reductions and road traffic injuries. In designing the study we had estimated the hypothesised effect of reducing street lighting on casualties (a 32% increase) by using the inverse of the relative risk estimated in a Cochrane systematic review. To achieve 90% power to detect an increase of 32% above pre-intervention injury levels at the 5% significance level, we required there to be 1500 night-time injuries on intervention roads during 10 years before lighting reduction and 150 injuries 1 year after. For our analysis of switch-off, we were able to include over 1700 night-time casualties on roads before street lighting was reduced (during 2000–10) and 298 night-time casualties after street lighting was reduced (during 2011–13). It is possible that we did not have sufficient statistical power to detect smaller associations; however, for other street lighting interventions, such as part-night lighting and dimming, the numbers of night-time casualties included in our analysis were sufficiently large.

It is also possible that the numbers of pedestrians, cyclists, motorcyclists and car drivers who use and travel within the streets and areas where street lighting was reduced declined at the same time as the lighting was reduced, resulting in fewer road casualties in those streets and areas. If so, any increase in hazard to pedestrians and cyclists due to lower lighting conditions may have been obscured by a reduction in numbers of people exposed to road injury risk at night. However, findings from the rapid appraisal suggested that impacts on mobility from part-night lighting and switch off were minimal.

Interpretation

Using data from a range of settings in the UK, including urban, rural, deprived and affluent areas, we explored associations between changes to street lighting and crime and road traffic collisions in these areas.

In the context of reported concern about street lights going out at night, this study found little evidence of harmful effects of switch-off, part-night lighting, dimming or changes to white light/light-emitting diodes on road collisions or crime in England and Wales. However, decisions about street lighting are made by local authorities, balancing a range of consequences of lighting regimes, for residents who may be concerned about the withdrawal of public goods, as well as the implications of dark streets at night. Indeed, the household survey in part 1 found strong evidence that residents in neighbourhoods where part-night lighting had been introduced felt less safe walking alone at night. The evidence from this study can be used to include important public health considerations in decisions about street lighting, but cannot be used to recommend strategies, given that each locality will have a different mix of needs.

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