Traffic Injury Prevention, 6:127–134, 2005

ISSN: 1538-9588 print / 1538-957X online
DOI: 10.1080/15389580590931590

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Cycle Helmets and Road Casualties in the UK

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Objectives: *Bicycle helmets have been advocated as a means of reducing injury among cyclists. This assertion, derived from a number of case controlled studies carried out in hospitals, conflicts with results from population level studies. In the Western countries where these case control studies have been performed, it appears that cycling morbidity is dominated by sports and leisure users. The generalizability of studies on helmet effectiveness in relation to utilitarian transport cycling is not clear. This study therefore considers population level data for reported road traffic injuries of cyclists and pedestrians.*

Methods: *Generalized linear and generalized additive models were used to investigate patterns of pedestrian and cyclist injury in the UK based on the police reported "Stats 19" data. Comparisons have been made with survey data on helmet wearing rates to examine evidence for the effectiveness of cycle helmets on overall reported road casualties. While it must be acknowledged that police casualty reports are prone to under-reporting, particularly of incidents involving lower severity casualties the attractive feature of these data are that by definition they only concern road casualties.*

Results: *There is little evidence in UK from the subset of road collisions recorded by the police corresponding to the overall benefits that have been predicted by the results of a number of published case controlled studies. In particular, no association could be found between differing patterns of helmet wearing rates and casualty rates for adults and children.*

Conclusions: *There is no evidence that cycle helmets reduce the overall cyclist injury burden at the population level in the UK when data on road casualties is examined. This finding, supported by research elsewhere could simply be due to cycle helmets having little potential to reduce the overall transport-related cycle injury burden. Equally, it could be a manifestation of the "ecological fallacy" where it could be conceived that the existence of various sub-groups of cyclists, with different risk profiles, may need to be accounted for in understanding the difference between predicted and realised casualty patterns.*

Keywords Cycle Helmets; Generalized Linear Models; Simpson's Paradox; Ecological Fallacy

Bicycle helmet wearing has been made compulsory in several jurisdictions, either for children or all age groups. Examples include Australia, New Zealand, the Czech Republic, and Spain as well as a number of states in the United State and Canada (Towner et al., 2002). Recent attempts to introduce such legislation in the UK failed. Analyses following legislative change indicate that legislation does not lead to 100% helmet wearing. These population level studies also fail to show clear evidence of reduction in head injury (Robinson, 1996; Scuffham et al., 2000; Robinson, 2001).

Conversely, a systematic review (Thompson et al., 2001) and a meta-analysis (Attewell et al., 2001) have highlighted the potential for cycle helmets to reduce morbidity from certain types of head injury. However, the generalizability of these case control studies, as well as the scientific basis of claims made about the implications of this research remain contested. One problem lies in the specificity of the injury reduction potential, Rivara et al. (1997) found evidence to suggest the potential for reduction of certain types of head injury but no significant evidence that injury could be reduced overall.

Another problem is found in differences in definition of the "at-risk" population. While being the world's most ubiquitous vehicle, in many Western states the bicycle has been largely relegated to recreational and leisure use. As a result, Thompson et al. (1989), for example, found predominantly child casualties, mainly injured in single vehicle incidents dominating the injury burden at the study hospital. Many of these injuries would most likely have arisen from recreational and leisure use. While that is undoubtedly an important issue for an injury prevention practitioner, it has much less relevance in terms of transport policy. This study therefore considered police collected data on casualties arising from road collisions to see whether the predicted savings seen from a general increase in helmet wearing have been realised.

DATA

Data on road casualties were first collected in the UK in 1919 but a formalized regime was not established until 1949 (Wilding, 2002). Arrangements are made by the local processing authority (which may be the Police, Local Authority or sub-contractor

Received 25 August 2004; accepted 20 December 2004.
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depending on local arrangements) to return these data to the Department for Transport. The resulting raw data are referred to as "STATs 19 data," summaries of the information are published annually (Department for Transport, 2001). The reliability of the STATs 19 data requires careful consideration. One of the earlier accounts which considered the reliability of STATs 19 data by comparing it with hospital records, is now over three decades old (Bull & Roberts, 1973) and 25 further studies were reviewed by James (1991). In addition, the Transport Research Laboratory have conducted a long term study in Scotland matching hospital records with Stats 19 reports (Keigan et al., 1999) and similar work has been reported in England (Cryer et al., 2001).

In addition to under-reporting, there is also a definitional problem. Much cycling in the West is carried out as an off-road leisure activity, collisions in this environment would clearly not be considered to be road traffic related. However, for the purposes of evaluating helmet efficacy, it should be noted that the consensus appears to suggest that single vehicle collisions, collisions involving more vulnerable road users, young road users and less seriously injured road users all tend to be under-reported. Nevertheless, estimates of fatalities are assumed to be reliable and estimates of serious collisions considered to be almost reliable.

In terms of these data, in the UK a child is defined as aged under 16. While a fatality is defined as anyone dying within 30 days of a road collision believed responsible for their death, the UK definition of "serious casualty" is rather vague: it currently only lists a set of "Examples of Serious Injury," these are given as "Fracture," "Internal Injury," "Severe Cuts," "Crushing," "Burns" (excluding friction burns), "Concussion," "Severe general shock requiring hospital treatment," "Detention in hospital as an in-patient, either immediately or later," or, finally, as "Injuries to casualties who die 30 or more days after the accidents from injuries sustained in that accident." This rather vague and non-medically assessed specification has been criticized.

Disaggregated Helmet Wearing Rates

Four very similar surveys attempting to provide detailed information on helmet wearing have been conducted in the U.K. (Gregory et al., 2003). Overall, the proportion of cyclists observed wearing helmets in these standardized surveys has increased. The first survey in 1994 suggested a 16% ($n = 27,417$) wearing rate, this had risen to 17.6% ($n = 27,783$) in 1996, 21.8% ($n = 26,230$) in 1999, and most recently 25.1% ($n = 26,174$) in 2002. However, there is extremely important information in the fine details. For example, cycle helmet wearing rates appear higher in females than in males, and in adults than in children. Children are defined in this survey as 0–16 years. Significantly, wearing rates appear to be declining in male children; if any group stands to gain from an injury prevention intervention in this context it is this group. Male cyclists surveyed outnumber female by almost 4:1 (18,921:5,302) such that the overall wearing rate among children has declined. While these surveys claim limited representativeness of the cycling population as a whole, this does tend to suggest that males are considerably more exposed to cycle injury than females by virtue of the relative size of the population.

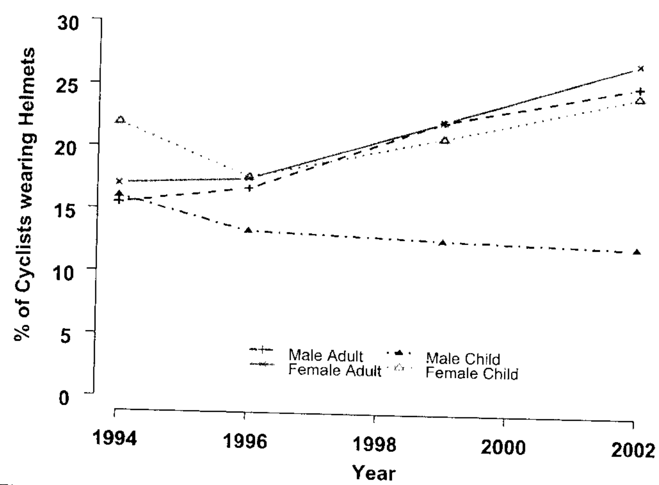

Figure 1 Cycle Helmet Wearing rate in the UK (1994–2002) amongst four sub-groups of cyclists—source TRL578.

Some of the other features of this survey will be considered later, for example, helmet wearing was observed to be lower in the off-road context than on-road. At this stage it is instructive to consider the disaggregated helmet wearing rates by age and gender. Figure 1 indicates the overall wearing rates as a percentage of the total in each subgroup for adult and child, male and female cyclists. Wearing rates appear to have increased similarly in three groups, but have fallen slightly among male children. While it may be suggested that the changes in helmet wearing in the UK are relatively small (an increase of only 10%) this needs to be contrasted with the large predicted benefits of helmet wearing from a number of case studies (Thompson et al., 2001) and the consistently divergent pattern between male child cyclists and the other three groups.

RESULTS

All model fitting and graphical procedures have been carried out using the R software environment (R Development Core Team, 2004). Standard statistical procedures are followed, including comparison of Deviance and the use of Wald tests to assess model fit (McCullagh & Nelder, 1989).

The Implications of Under-Reporting

Table I lists injuries according to the other road users involved. It is immediately apparent that the severity ratio, defined as the proportion of all casualties that were fatal or serious, for cyclists involved in collisions with cars is around 1 in 8, which rises to 1 in 3 for cyclists injured in collisions involving heavy goods vehicles. The severity ratio for single vehicle collisions appears particularly high: presumably this is a feature of under-reporting whereby many slight collisions involving no vehicle other than a pedal cycle are clearly not being reported. This results in a bias when comparing police casualty data with hospital casualty data: lower severity collisions involving no other road users are more likely to be missing. For completeness, it may be noted

Table I Numbers of cyclists killed, seriously or slightly injured according to what other road users were involved (reported in *Road Casualties Great Britain* for 2002)

Cyclists in collision with:	Killed	Serious injury	Slight injury	All injury	Severity ratio
No other participant	13	130	234	364	0.39
Pedestrian	1	9	28	37	0.27
Other pedal cycle	0	16	42	58	0.28
Moped	0	5	63	68	0.07
Motorbike	0	41	205	246	0.17
Car	65	1,718	12,266	13,984	0.13
Bus	4	53	326	379	0.15
Light Goods Vehicle	7	119	649	768	0.16
Heavy Goods Vehicle	27	90	262	352	0.33
Other	2	21	137	158	0.15
Three or more vehicles	11	116	430	546	0.23

that additionally, 3 pedestrians were killed, 4 seriously injured, and 163 slightly injured in collisions with pedal cycles, with a further 1 pedestrian killed, 1 seriously injured, and 37 slightly injured in multiple vehicle collisions in which a pedal cycle was involved. However, there is no reason to anticipate major rapid short term changes in terms of reporting practice. It is therefore quite likely that comparison of casualty reports over a relatively short period of time (less than a decade) is reasonable.

Fatality Rate Since 1990 in the UK

It is generally considered that fatalities are reported accurately in the "Stats 19" system. It is reasonable to consider the casualty rate over time and to compare pedal cyclists (where we have an increase in helmet wearing) with pedestrians, where we have constant (and zero) helmet wearing. The most appropriate way of modelling these data is by means of a generalized linear model (Nelder & Wedderburn, 1972).

$$y_{it} \sim Poisson(\lambda_{it} o_{it}) \qquad (1)$$

Where y_{it} denotes the number of fatalities, i denotes whether the fatalities are to pedestrians or cyclists, t denotes the year, and o_{it} is the estimated amount of travel by either mode. In the UK, travel data is obtained from the National Travel Survey. There are some problems with definition, for example, short journeys on foot are not recorded, but as with under-reporting it seems reasonable to believe that there would be no short term changes in recording practice between different groups (such as pedestrians and cyclists) therefore the comparison seems valid. In this model specification, λ_{it} is the Poisson mean. Interest therefore revolves around modelling λ_{it} over time to see specifically whether there is any evidence of a difference in the slope for pedestrians and pedal cyclists. It should be noted that this simple relationship may only apply over a limited range, for example, Jacobsen (2003) indicates the need for a mass of pedestrians and cyclists to give some measure of herd protection implying that this model could collapse below a certain level of travel by either mode. This does not appear to have been an issue with these data, results of fitting this model are given in Table II.

Table II Parameter estimates from fitting a Generalized Linear Model with Poisson errors and log link to the pedestrian and pedal cyclist fatality data

	Estimate	Std. Error	z value	Pr(>|Z|)
Intercept	1.869916	0.024960	74.915	<2e-16
Year	−0.046717	0.002265	−20.622	<2e-16
Pedestrian	0.118741	0.022812	5.205	1.94e-07

This model could be fit with a Null deviance of 492.537 on 23 degrees of freedom and a Residual deviance: 29.254 on 21 degrees of freedom. This is suggestive of only modest over-dispersion and so it was not felt necessary to consider a negative-binomial model. Inspection of the diagnostics highlighted the relatively low number of cycle casualties in 2000 as the only possible influence point on model fit. Including an interaction term between the temporal slope (Year) and the factor (Pedestrian) only improved the deviance by 0.697 for the loss of a degree of freedom, and the Wald test implied that the additional term was not significant. These data therefore provide no evidence that the fatality rate (per unit of exposure) for pedal cyclists has declined any more rapidly than the fatality rate for pedestrians, despite the significant increase in helmet wearing over this time period. A graphical depiction of these data, and the selected model are given in Figure 2.

Severity Ratio

Within the "Stats 19" data it is possible to consider the fit of a generalised linear model to the severity "ratio." This has been defined earlier as the proportion of killed and seriously injured casualties amongst all casualties reported in the Stats 19 system and can be modelled as πit, the "ratio" for year t and group i assuming $r_{it} \sim$ Binomial$(\pi_{it} n_{it})$ where r_{it} is the number of killed and seriously injured casualties in year t for group i, n_{it} is the corresponding total number of casualties of any severity. Again, while there may be concerns around under-reporting, it is difficult to see how in a relatively short period of time these would affect cyclists more than pedestrians (or vice versa).

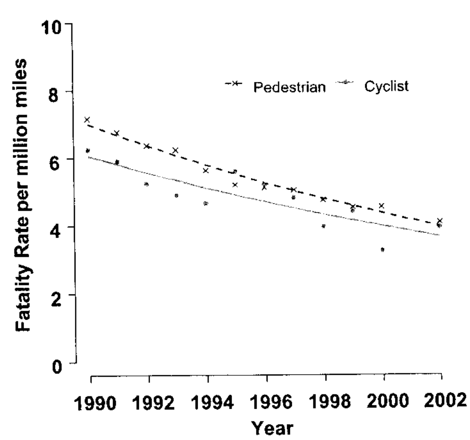

Figure 2 Observed fatality rate (points) and modelled rate (lines) for pedestrian and pedal cycle casualties reported via the "Stats 19" system.

Table III Conventional generalized linear model with binomial errors and logistic link function fitted to data on severity ratio of male and female pedestrians and cyclists

	Estimate	Std. Error	z value	Pr(>|Z|)
Intercept	−1.722109	0.032452	−53.066	<2e-16
Year	−0.028334	0.006937	−4.084	4.42e-05
Female Pedestrian	0.631698	0.035127	17.983	<2e-16
Male Cyclist	0.061755	0.036107	1.710	0.0872
Male Pedestrian	0.720896	0.034253	21.046	<2e-16
Year: Female Pedestrian	−0.010181	0.007480	−1.361	0.1735
Year: Male Cyclist	0.006668	0.007704	0.865	0.3868
Year: Male Pedestrian	0.002831	0.007295	0.388	0.6980

While we have the problem that the male casualty counts are combined for adults and children, there is no evidence that the severity ratio for pedestrians is declining any more rapidly than the severity ratio for pedal cycles.

A number of models can be considered here, for example including or omitting an interaction term between the Mode-Gender grouping (Male Pedestrians, Male Cyclists, Female Pedestrians, Female Cyclists) and time.

$$\pi_{it} = \beta_0 + \beta_{Mode:\,Gender} + \beta_{year} + \beta_{year:\,Mode/Gender} \quad (27\text{ df}) \quad (2)$$

$$\pi_{it} = \beta_0 + \beta_{Mode:\,Gender} + \beta_{year} \quad (24\text{ df}) \quad (3)$$

A model fitted to these data with an intercept for each term and a common time trend has a null deviance of 7003.803 on 31 degrees of freedom and a residual deviance of 63.596 on 24 degrees of freedom. Table III gives results for fitting this model, while Wald tests suggest that none of the interaction terms (mode and time) are significant, removing these terms increases the residual deviance to 82.333 saving only 3 degrees of freedom. The observed data and the model predictions are illustrated in Figure 3.

Table IV Parametric estimates from fitting generalized additive model to severity ratio data (reflecting different overall levels of severity ratio)

	Estimate	Std. Error	t ratio	Pr(>|Z|)
Intercept	−1.8469	0.01544	−119.6	<2.22e-16
Female Pedestrian	0.5878	0.01668	35.24	<2.22e-16
Male Cyclist	0.089194	0.01715	5.201	1.9858e-07
Male Pedestrian	0.73238	0.01626	45.05	<2.22e-16

It can actually be suggested that the various non-significant interaction terms are artifacts due to a non-linear time trend. An alternative approach which allows for a degree of smoothing over time is to fit a generalized additive model (Hastie & Tibshirani, 1990):

$$\pi_{it} = \beta_0 + \beta_{Mode:\,gender} + f(\beta_{year})$$

where a smooth function is applied to β_{year}. This model can be fit using the mgcv library (Wood, 2000) and requires only a single, shared smooth term for the time component which requires an effective degrees of freedom of 3.011. Fixed parameter estimates are given in Table IV and a graphical depiction of the model predictions are given in Figure 4.

General Decline in Cycling Casualties

It is possible to consider a number of models for these data, for example.

$$\pi_{it} = \beta_0 + \beta_{gender} + \beta_{year} + \beta_{year:\,modals} \quad (27\text{ df}) \quad (4)$$

$$\pi_{it} = \beta_0 + \beta_{subgroup} + \beta_{year:\,Child} \quad (26\text{ df}) \quad (5)$$

$$\pi_{it} = \beta_0 + \beta_{year} + \beta_{subgroup} + \beta_{year:\,subgroup} \quad (24\text{ df}) \quad (6)$$

However, the effect on deviance in choosing between the three models is modest which would tend to favor the more

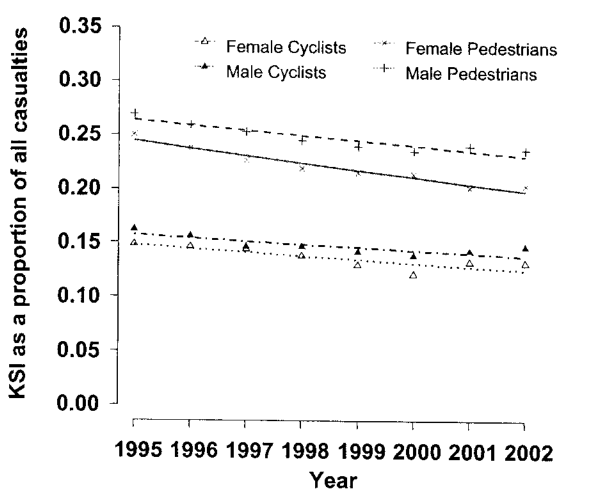

Figure 3 Graphical summary of data and model predictions for conventional generalized linear model with binomial errors and logistic link function fitted to data on severity ratio of male and female pedestrians and cyclists.

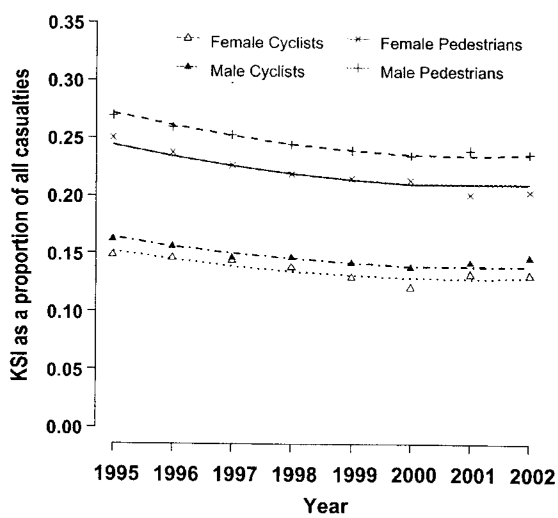

Figure 4 Severity ratio data and model predictions from generalized additive model with binomial errors and logistic link function.

Table V Results of fitting generalized linear model with binomial errors and logistic link to data indicating the proportion of male, female, child, and adult casualties that are pedal cyclists

	Estimate	Std. Error	z value	Pr(>|Z|)
Intercept	−1.731409	0.024249	−71.403	<2e-16
Female Child	−0.187785	0.044911	−4.181	2.90e-05
Male Adult	1.027722	0.020826	49.348	<2e-16
Male Child	0.818405	0.036938	22.156	<2e-16
Year	−0.015085	0.003858	−3.910	9.22e-05
Year: Child	−0.032139	0.007036	−4.568	4.93e-06

parsimonious model. However, Wald tests certainly suggest that the $\beta_{year:Child}$ interaction term is significant. Table V gives the results of fitting such a model, the null deviance was 4274.094 on 31 degrees of freedom and the residual deviance of 48.436 on 26 degrees of freedom. Inclusion of the interaction term $\beta_{Year:Child}$ indicates that the reports of casualties are falling less rapidly for adults than for children, and that the proportion of cyclists among male and female child casualties are falling at a similar rate. This model is depicted graphically in Figure 5 along with the corresponding data. This is meaningless without comparative exposure data, however the helmet surveys (Gregory et al., 2003) consistently suggest that around 3 out of 4 observed child cyclists are male. A summary of the relevant data is given in Table VI. Whilst these data are inadequate in terms of fully understanding exposure, it is plausible to suggest that for the time period considered here, the ratio of the overall relative exposure of male child cyclists to female child cyclists is constant. What is very clear over this period however is that the proportion of male child cyclists wearing helmets has fallen considerably. The apparent similarity in reported casualties in both these groups needs to be interpreted in this context.

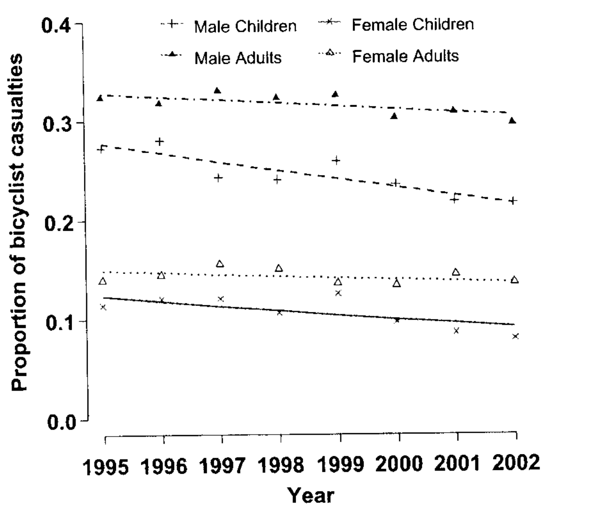

Figure 5 Proportion of cyclist casualties among groups of cyclists and pedestrians.

Table VI Number of male and female child cyclists sampled: source TRL 578

Year	Males	Females	Percent Males
1994	1036	389	73%
1996	1326	415	76%
1999	1122	426	72%
2002	1183	385	75%

DISCUSSION

This study reports an analysis of a problematic dataset, the UK Stats 19 data. It cannot be over-emphasized that we are not analyzing casualties, we are analyzing police reports of casualties—an administrative abstraction of reality. It is not impossible that the "Stats 19" are subject to such vast and irregular under-reporting that they are useless. However, if the official benchmark data set were incapable of answering such an important question there are clearly serious problems and it seems unreasonable to dismiss the official benchmark road safety dataset in the UK so lightly. It is therefore impossible to avoid the issue that there is no evidence of a safety gain for cyclists over and above that of pedestrians. These data fail to show any differential improvement in fatality rates or severity ratios concomitant with an increase in helmet wearing among cyclists and conversely demonstrate no observable injury pattern accounting for the different helmet wearing trend among young males. This is entirely consistent with pre-legislative analysis from New Zealand (Scuffham & Langly, 1997) as well as post-legislative research described in the introduction. Given also that individual level analysis (Rivara et al., 1997) can find evidence for reduction in head injuries but no evidence for injuries overall this may all seem unsurprising. Nevertheless, there are no shortage of claims for broader effectiveness of helmets (Towner et al., 2002). Given the strength of such claims, it seems reasonable to anticipate some detectable injury reduction in the Stats 19 data even though the information on head and non-head injury is undifferentiated.

The discrepancy between these findings and those of previously reported studies may well lie confounding factors. The case control studies indicating that helmets have a protective effect are heavily influenced by large numbers of children, and large numbers of casualties who have fallen off their bikes. For example, Maimaris et al. (1994) consider 288 collisions with other vehicles and 662 falls. Many of these confounding factors will in some way relate to the level of choice different cyclists have over the level of risk they accept or take. Risk compensation has been more extensively argued about than specifically researched in association with cycle helmets. The arguments in this context have been set out by Adams and Hillman (2001), and certainly the exposure adjusted studies they suggest certainly merit further attention given the possibility that risk per cyclist increases post-legislation. However, this study clearly cannot do anything to advance discussions on risk compensation in any way.

What would be entirely consistent with these data and with the predictions made by the case control studies is to firmly reject the idea that there can be a "typical" or "average" cyclist. It is clear that cyclists exhibit a range of behaviors and these affect either the level of risk they take or the level of risk that is imposed upon them. For example, the requirement to mix in traffic is clearly an imposition of risk, the decision to go through traffic lights at red is risk taking. If there are disparate groups of cyclists who tend to have distinct risk profiles but different helmet wearing rates within these groups then clearly the effect on injury risk of an individual within any one of these groups wearing a helmet will be very different from the population level injury risk.

There is implicit evidence to suggest relationships between risk profile and helmet wearing in Gregory et al. (2003) who indicated that peak wearing rates for adults were higher than off-peak, that London cyclists were more likely to wear helmets and that recreational route riders were less likely to wear helmets. If this is the case, the observed safety benefit of cycle helmets will be at least in part a feature of the cyclists who choose to wear them.

This argument is similar to those put forward by Lardelli-Claret et al. (2003). Indeed, over a decade ago, Spaite et al. (1991) suggested that some of the apparent safety benefit of cycle helmets should be attributed to the riding habits of helmeted cyclists and not to the helmets themselves. While case control studies at an individual level can demonstrate some safety benefit in wearing a helmet to an individual, this finding is confounded by the lower risk strategy of helmeted cyclists. Therefore the results of case control studies cannot be extrapolated to the population level.

However, another confounding factor in the relationship is the unavoidable fact that the biomechanics of cycle helmet design are very limited and result in a product that can only protect against certain injuries. Depreitere et al. (2004) highlighted the lack of protection for the temple, Rivara et al. (1999) highlight problems with wearing inadequately fitting helmets and Curnow (2003) highlighted the modest understanding of the biomechanics of brain injury that has been incorporated into cycle helmet design standards. Even if it were possible to remove the design restrictions placed on it by the nature of cycling, there is no real data on the envelope of safety provided by cycle helmets under a range of injury circumstances.

The case control studies supporting helmet wearing may also have dealt with larger numbers of lower severity collisions, for example, Thomas et al. (1994) included 17 casualties whose bicycles were damaged beyond repair out of 345 casualties. It may well be that these numbers are inadequate to infer helmet behavior in a transport injury which involves collision with a motorized vehicle.

The case-mix of casualties seen in the case control studies are just not represented in the Police data. An extreme example is given by Gilbert and McCarthy (1994) who highlighted the over-representation of heavy goods vehicles in cycle fatalities in London: a collision type that will regularly offer impact energy well in excess of anything against which a cycle helmet can offer protection. Indeed, reiterating Curnow's (2003) concern about helmet design, there is no clear evidence as to the size and direction of kinetic energy involved in any bicycle-vehicle interaction to give any information as to where helmet protection may be either useful, likely to be overwhelmed or just irrelevant.

It cannot be over-emphasized that this analysis is susceptible to the "ecological fallacy" and that we cannot assume that relationships at the aggregate level will be the same as relationships at the individual level. Simpson's paradox is an extremely well understood statistical phenomena (Samuels, 1993) and given the huge potential for confounding here merits careful attention in study design. Indeed, the research on hormone replacement therapy indicate that such biases are by no means a theoretical concern, observational studies in this area have been entirely contradicted by randomized controlled trials (Lawlor et al., 2004).

Nevertheless, the unavoidable conclusion is that there has been no population level benefit from an increase in cycle helmet wearing and this finding needs to be explained. Assessing the effectiveness of helmets with observational data is compounded by the probability of a given cyclist having a collision, before any consideration can be given to whether it is the type of collision that could be ameliorated by a helmet and whether the helmet is effective in doing so. With the subgroup of collisions analyzed here (those road collisions that are reported to the police) there is less evidence for the effectiveness of helmets than for other studies. We would suggest that this is because the safety envelope for the helmet is being dominated by the collision risk. The type of cycling and risk-taking or risk-imposed circumstances of the cyclist need careful consideration when making claims for cycle helmet effectiveness.

The importance of this argument is that it suggests little or no benefit can be accrued from legislation. MacPherson et al. (2001) noted that helmet legislation had not increased wearing rates to 100%. If it is reasonable to assume, albeit in very general terms and in a voluntary context such as the UK, that the non-wearing group contains a disproportionately large number of higher risk cyclists then even with a theoretical perfect helmet design increasing helmet wearing will have only a modest impact on population level casualty rates. The injury burden will tend to be dominated by those cyclists who, whether by their behavior or by their need to travel, are subject to higher levels of risk, hence to the very collisions that are least protected by helmet wearing. There is clear potential for victim-blaming if the evidence on cycle helmet efficacy is over-used to suggest that these cyclists should have been wearing a helmet. It is as easy to increase the percentage of cyclists wearing a helmet by reducing the denominator (the number of cyclists) as it is to increase the number of helmeted cyclists (Robinson, 1996).

One final concern, even with a "perfect" helmet, are the costs. In terms of financial costs, in the UK Kendrick and Royal (2003) have highlighted differences in wearing rates in deprived areas. Serious questions have to be raised as to the cost of asking children in deprived areas to pay the cost of mitigating injury when the injury risk is imposed by motorized vehicles and the effectiveness of cycle helmets in traffic conditions is not clear. There are also opportunity costs associated with helmet promotion both in terms of broader perceptions of cycling as well as the effort not spent in actually reducing collision risk in the first place. There is evidence of this very irony when comparing this analysis of Stats 19 data with data on helmet wearing in the UK. The case control studies suggest that lower severity injuries arising from cycle use dominated by children and leisure use may be protected by cycle helmets: the very circumstances where helmet wearing is the lowest. More clarity in terms of when and where helmets may be effective should be introduced in advocacy programs to correct this balance and to refocus efforts on primary safety and the promotion of cycling as a serious constituent of transport policy.

The conclusion cannot be avoided that there is no evidence from the benchmark dataset in the UK that helmets have had a marked safety benefit at the population level for road-using pedal cyclists. Clearly, this cannot be extrapolated to non road-using pedal cyclists, arguably it is leisure cyclists (or children playing, falling and at risk of minor head injury) who provide the mass of evidence in case control studies for the apparent effectiveness of cycle helmets. Health practitioners who have concerns about leisure use of bicycles may have justified interest in injury prevention across the whole spectrum of cycling activity.

However, as yet there seems little evidence to suggest that helmet wearing has any more than a very modest role in terms of Transport policy. Transportation practitioners therefore need to concentrate on primary safety, to prevent collisions occurring. This has the dual benefit of reducing the number as well as the severity of casualties. While it may be desirable for individuals to wear helmets (especially if they are likely to fall off their bikes), the circumstances when helmets may be effective are not clear. In particular, the evidence that cycle helmets are effective in traffic collisions is much weaker and questions need to be answered as to why cycle helmets rather than traffic management are proposed as the answer to cyclist injury. It is very striking that in the case of both cyclists and pedestrians the injury rates are decreasing over time, effort clearly needs to be spent reinforcing these trends rather than diverting into areas currently unsupported by the evidence base.

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