A quasi-experimental, longitudinal evaluation of a school-based bicycle helmet campaign for children age 4–8 years in the Netherlands

Marjolein Boele-Vos\textsuperscript{a}, Charles Goldenbeld\textsuperscript{a}, Maura van Strijp-Houtenbos\textsuperscript{a}, Jacques J. F. Commandeur\textsuperscript{a,b}, and Divera A. M. Twisk\textsuperscript{c}

\textsuperscript{a}SWOV Institute for Road Safety Research, The Hague, The Netherlands; \textsuperscript{b}Department of Econometrics and Operations Research, Faculty of Economics and Business Administration VU University Amsterdam, Amsterdam, The Netherlands; \textsuperscript{c}Queensland University of Technology, Brisbane, Australia

ABSTRACT

Head injury severity may be reduced by a helmet, however, helmets are not mandatory in the Netherlands. Yet public support for voluntary use of helmets for children is high. This study evaluated the effect of a five-year school-based campaign (4- to 8-year-olds) on helmet-wearing rates and identified its success and failure factors. We compared observed helmet-wearing rates before the campaign, with yearly rates during programme, and related those to wearing rates in a control area. Parents, together with their children, completed questionnaires on self-reported helmet wearing, attitudes, beliefs, and barriers. Results showed that observed helmet wearing increased in the first campaign year but varied in later years. This variation in rates coincided with variations in campaign intensity over the years. Factors associated with self-reported helmet wearing were age, with higher wearing rates for younger children than older children, and parental rules for helmet use. Children and parents are positive toward helmet use when children are perceived to be less competent cyclists. The most important reason for not wearing helmets is that peers do not wear helmets. Overall, parents and children seem to be influenced by the norm in the Netherlands that children above a certain age cycle without a helmet.

KEYWORDS

Evaluation; follow-up; free bicycle helmet; school-based campaign

1. Introduction

Bicycle helmets, known to provide protection against serious head injuries after a bicycle crash (Elvik, 2013; Olivier & Creighton, 2016; Olofsson, Bunketorp, & Andersson, 2017), are not mandatory for cyclists in the Netherlands and helmet use among cyclists is low. Currently, there is little public support for the introduction of legislation (Aarts, Eenink, Weijermars, Knapper, & Schagen, 2014). However, public support does
exist for the promotion of voluntary use of bicycle helmets. Especially for groups that are at risk, such as children (Aarts et al., 2014).

In the Netherlands children start cycling at an early age. The learning process is one of trial and error. Children relatively often sustain head injuries in bicycle crashes. Of all child cyclists (age 0–12 years) injured in crashes with a motorized vehicle, about 60% sustain serious head injuries, compared to 47% of all cyclists. The risk of head injuries in bicycle crashes not involving motorized vehicles is extremely high for the very young (age 0 – 5 years). In this category, 90% of all hospitalised young cyclists sustain serious head injuries (SWOV, 2016). Annually more than 300 child cyclists, between ages 0 and 12 years, are hospitalised with serious head/brain injury (Maximum Abbreviated Injury Scale (MAIS2+)) (SWOV, 2016). Given the high injury rate and long-term consequences of head injuries among children (Weijermars, Stipdonk, Aarts, Bos, & Wijnen, 2014), successful promotion of voluntary bicycle helmet use will prevent injuries and save lives.

Previous studies have shown that promotion programmes are important interventions for increasing voluntary helmet use (Royal, Kendrick, & Coleman, 2007). Three systematic reviews of nonlegislative interventions, in countries other than the Netherlands, have been performed (Owen, Kendrick, Mulvaney, Coleman, & Royal, 2011; Royal et al., 2007; Towner et al., 2002) with the aim to identify the effectiveness of such programmes and which components contribute most to their effectiveness (Royal et al., 2007). All three reviews, performed in a timeframe of a decade, come to similar conclusions. The Cochrane review (Owen et al., 2011), the most recent review, identified 29 studies that evaluated bicycle helmet programmes for schoolchildren. Although the programmes varied on various aspects the authors were able to draw the following conclusions regarding the effectiveness of the campaigns on observed helmet wearing. All studies show that promotion increased helmet use, and the largest effect is achieved among young children (age 12 and younger). School-based and community-based bicycle helmet campaigns that provided free helmets increased helmet wearing in the short term. But the effect may decrease over time with increasing child age. Therefore, they call for studies that investigate the effect of interventions over time with increasing child age (Owen et al., 2011). The aim of the present study is to contribute to this knowledge gap and to perform a five-year longitudinal evaluation of a bicycle helmet campaign in the Netherlands.

In the past, few programmes have attempted to promote helmet use in the Netherlands. For instance, two small-scale interventions were performed in the 1990s (Seijts, Kok, Bouter, & Klip, 1995; Steenbakkers, Goldenbeld, Dijkman, & Venema, 1996) in the previous century. Both studies were carried out on primary schools and provided helmets for free,
and children were asked to wear the helmets on every bicycle ride. To identify factors that play a role in bicycle helmet wearing, Seijts et al. (1995) performed a questionnaire study in three schools in three different Dutch cities. Although the bicycle helmet was worn frequently at the beginning of the study, helmet use decreased rapidly. During follow-up, three months after the start, almost none of the children wore the helmet. The study identified two factors that played a role in not wearing a helmet. First, the helmet was reported as uncomfortable to wear (hairdo and warmth) and inconvenient to store after a bicycle ride. The second reason was the negative reactions from their social environment, such as social pressure from children from other schools and from adults. Also, Steenbakkers et al. (1996) reached similar conclusions. Initially, children and their parents were positive about wearing the bicycle helmet and agreed on safety being an important reason to wear a helmet. However, negative reactions from the social environment were the most important reason to stop wearing the helmet. Therefore, Steenbakkers et al. recommended promoting future voluntary helmet use by Dutch children on a more national level, with a programme that addresses both image and social acceptation of the bicycle helmet. A future programme should also include traffic education activities in schools and involve parents of young children.

In line with previous recommendations (Owen et al., 2011; Seijts et al., 1995; Steenbakkers et al., 1996), the Province of Zeeland, together with the Zeeland Regional Traffic Safety Body in the Netherlands launched the school-based bicycle helmet campaign ‘Wanna look cool? Wear a helmet’ (in Dutch: Coole kop, Helm op!) to stimulate voluntary helmet use and to reduce head injuries among children. The campaign ran from 2010 to 2015 and provided free helmets complying with the European standard EN-1078 norm, introduced education for children and provided information for teachers and parents. The first year of the campaign was aimed at children in Grades 1 to 4 (4- to 8-year-olds). In the following years, at the start of each new school year in autumn, all new children in the first grade received a free helmet. This strategy ensured that all school children between ages 4 to 12 years in the Province of Zeeland would have received a free bicycle helmet by the end of the campaign in 2015.

This five-year longitudinal evaluation study aims to answer two research questions:

1. What is the effect of the campaign on bicycle helmet-wearing rates of child cyclists in traffic in Zeeland, and how does it change over time, and when children get older?
2. Which factors play a role in children wearing a bicycle helmet in Zeeland?

The study assesses the effect of a school-based bicycle helmet campaign. This paper reports the effects of the programme over its five-year lifetime, by comparing observed helmet-wearing rates before the intervention, with annual rates during the intervention. To control for external influences, wearing rates in the intervention area were compared to those in a control area, where no intervention had taken place. Also factors potentially influencing helmet-wearing rates were investigated.

2. Method

2.1 Experimental and control area

The study population was that of children residing in the province of Zeeland during the years 2010 to 2015, who were between ages 4 to 8 years, and attended a primary school in this region (experimental schools). Children residing in another region about 200 kilometres to the west of the Province of Zeeland represented the control area (Figure 1). The criteria to select this control area were:

- the area is not influenced by the bicycle helmet campaign in Zeeland
- the area has a similar degree of urbanisation as Zeeland

![Figure 1. The Netherlands with (left) Zeeland (experimental area) and the control area (right).](image)
the size of the villages in the area is similar to Zeeland; for example, the distance between homes and schools are comparable.

- the area has a similar injury surveillance system\(^1\) as Zeeland\(^2\) (Panneman, Adriaensens, & Blatter, 2016).

In the experimental and in the control area, 40 locations were randomly selected for direct observation of helmet use: 20 locations near schools and 20 locations near sports facilities, playgrounds, and busy bicycle routes. The questionnaire study was carried out in the same 20 schools in both areas.

### 2.2 Bicycle helmet campaign

The bicycle helmet campaign in the experimental area started in the school year of 2010–2011. Adjustable helmets – complying with EN1078 – and rucksacks (to carry the helmet) were distributed for free to children in level 1 to 4 (ages 4–8 years) in schools throughout the Province of Zeeland. The distribution of the helmets in the first year was combined with additional supporting activities, such as teaching material, information letters for parents, and a theatre show in schools showing the children the benefits of wearing a helmet.

Over the five years, the execution of the campaign has been changed considerably. For instance, during the second and the third year of the campaign the additional supporting activities were not carried out. Fortunately, none of the experimental schools in the research area dropped out of the campaign. Table 1 shows the campaign activities and timeline.

### 2.3 Evaluation design

Two data collection methods were used namely observations of helmet-wearing rates and a self-reporting questionnaire to gather information on attitudes and beliefs of parents and their children concerning helmet wearing. The corresponding research activities and a timeline are shown in Figure 2.

### 2.4 Instruments

#### 2.4.1 Observation study

An observation form was developed to record helmet presence, its correct use, and rider characteristics in terms of age and gender. During peak hours, a voice recorder and a handheld counter could be used instead of the observation form. Observers stood near the entrance of the school and/or near the bicycle parking (racks or stands), and were visible to the (cycling) public. The observations near schools were performed during
| School year | 2010–2011 | 2011–2012 | 2012–2013 | 2013–2014 | 2014–2015 |
|------------|-----------|-----------|-----------|-----------|-----------|
| **Distribution helmets** | Grade 1–4 | Grade 1 | Grade 1 | Grade 1 | Grade 1 |
| Campaign activities | • Theatre show for Grades 1–4 | No campaign activities | No campaign activities | • Theatre show for Grades 1–4 | • Theatre show for Grade 1 |
| | • Campaign mascot cheques on helmet use | | | • Promotional activities: Bicycle helmet party with treats for Grades 1–4 | • Promotional activities for Grades 5–8 |
| | • Teaching material with craft sheets, DVD for children and read-aloud book | | | • Good intentions card for parents of children in Grade 1 \( ^{a} \) | |
| | • Information letters for parents | | | • Promotional activities for Grades 5–8 | |
| | • Promotional activities: Photo competition | | | • Free bicycle helmet and rucksack | |
| **Campaign material** | • Free bicycle helmet and rucksack | • Free bicycle helmet and rucksack | • Free bicycle helmet and rucksack | • Free bicycle helmet and rucksack | • Free bicycle helmet and rucksack |
| | • Promotional material for Grades 1–4 | | | • Promotional materials: Key ring with mascot for Grade 1, posters for Grades 5–8 | • Promotional materials: Toothbrush with mascot for Grade 1 |

*Note. \(^{a}\)With the good intentions card, parents signed a contract promising to have their children wear bicycle helmets.*
peak hours, on weekdays, and just before school hours (08.00–09.00h). The observations near sports and play areas were done on Saturday and during different time periods (09.00–12.00 h, 13.00–14.00 h, 14.00–15.00h). Observers were trained in the correct use of the instruments (observation form, voice recorder, and handheld counter), how to select the observation points, how to estimate the age groups and how to assess the wearing correctness of the helmets. The observation form also showed images of correct helmet wearing. Helmets were registered as correctly worn if the helmet sat level on the head, its rim less than one or two finger widths above the eyebrow, and if the chin strap was fastened (e.g., Hagel, Lee, Karkhaneh, Voaklander, & Rowe, 2010).

The observation study was conducted in October/November every year of the bicycle helmet campaign, except for 2013. Due to financial restraints, the observations in that year were limited to schools in the experimental area only. Observation locations near schools were the same each year. However, near sports and play areas, this was not the case, because some of those needed to be reconsidered due to low numbers of child cyclists passing these locations.
2.4.2. Representativeness and reliability of observations

To obtain reliable data and sufficient statistical power, helmet wearing of at least 800 cycling children needed to be observed each year. This was achieved in all years for the school locations in the experimental and in the control area, but for the sports and play areas this was not the case (Table 2).

2.4.3. Questionnaire study

During the campaign parents and their children participated in the questionnaire study. The questionnaire contained items on helmet wearing, attitudes, motives and other factors that might influence helmet wearing such as the child’s age and school grade level, and distance from home to school, bicycle use for other purposes than cycling to school, and parents’ helmet rules. After the introduction of the campaign, the questionnaire was pre-tested in the experimental area just before the summer holidays in 2011. Schools were contacted and asked to invite parents to participate in the questionnaire study. The response rate of the pilot was low (15%). To increase the response rates parents of children were contacted personally starting school year 2012–2013. The questionnaire study consisted of two parts. The first part was a paper-and-pencil questionnaire that was distributed to all participating schools to gather demographic variables of parents and their children: parents that were willing to participate in an online questionnaire also provided their contact details. The second part was an online questionnaire for which the parents were invited personally.

2.4.4. Paper-and-pencil questionnaire

At the start of each school year, from 2012 onwards all experimental schools \((n = 20)\) and schools in the control area \((n = 20)\) were invited to participate by distributing the paper-and-pencil questionnaire to all parents of children who had received the free bicycle helmet in the experimental area and to all parents and children in the same grades in the control area. This questionnaire consisted of questions concerning age, gender, cycling frequency and helmet use of the children. At the end of the questionnaire

| Table 2. Number of observed cycling children (4–8 years) in experimental and the control area. |
|---|---|---|---|---|---|
| Area | Location | Pretest 2010 | Posttest 2011 | 2nd Posttest 2012 | 3rd Posttest 2013 | 4th Posttest 2014 |
| Experimental | School | 891 | 670 | 747 | 795 | 690 |
| | Sports/Play | 321 | 314 | 156 | 168 | |
| Control | School | 456 | 712 | 490 | 596 | 181 |
| | Sports/Play | 138 | 467 | 109 |  | |
parents could indicate if they were willing to participate in the online questionnaire. Once parents had returned the completed paper-and-pencil questionnaire to the respective school, they were rewarded for their participation with a lottery in which they could win a gift voucher of 100 euro. The school that returned the highest number of completed questionnaires was awarded 500 euro in cash to be used for educational purposes in 2012 and 2013 and a traffic education course in 2014. Not all schools participated, for reasons including a too heavy workload. The mean response rate for participating parents for the experimental area was 29% and for the control area 27% (see Table 3 for an overview).

### 2.4.5. Online questionnaire
Parents that indicated that they were willing to complete the online longitudinal questionnaire received an invitation with a link to this questionnaire. They were instructed to complete the questionnaire for their child who had received a bicycle helmet during the campaign. The questionnaire contained items on cycling behaviour and self-reported helmet use. The children (with the help of their parents) and the parents could indicate whether they agreed with statements (attitudes) on bicycle helmets and could specify their motives to (not) wear helmets. In addition, the questionnaire contained items about parental rules (i.e., if parents impose strict rules on helmet wearing) and beliefs about children’s helmet wearing. Parents and children in the control area could indicate whether their children would wear a helmet if they got one for free. The questions relating to attitudes and motives were derived from earlier work by Berg and Westerling (2001).

Respondents who completed questionnaires were awarded a 5-euro gift voucher. To increase response rates, parents were encouraged to participate in every campaign year to ultimately receive a gift voucher of 50 euro. However, response rates for the online questionnaire in the experimental and the control area remained low, 9% on average (See Table 3).

### Table 3. Questionnaire response rates.

| Grade | Area | School years |
|-------|------|--------------|
|       |      | 2012–2013    | 2013–2014 | 2014–2015 |
|       |      | 1–5          | 1–7       | 1–8        |
| Participating schools | Experimental | 17 (85%) | 17 (85%) | 15 (75%) |
| Total population | Control | 3 (15%) | 8 (40%) | 14 (70%) |
| Paper-and-pencil | 2145 | 386 | 2665 | 1645 | 3048 | 2408 |
| Online | 723 (34%) | 144 (37%) | 868 (33%) | 364 (22%) | 606 (20%) | 504 (21%) |
| Paper-pencil | 229 (11%) | 61 (16%) | 228 (9%) | 95 (6%) | 254 (8%) | 166 (7%) |

Note. *Number of children that received a helmet.
2.5. Data analysis

2.5.1. Observation study
The data analyses primarily focussed on the prime target group of the campaign, namely, children between ages 4 to 8 years, who were riding a bicycle. A logistic regression was used to predict helmet wearing (yes/no) observed in the years 2010, 2011, 2012, and 2014 from the following independent variables and all possible interactions between independent variables, namely,

1. Condition: Experimental versus control area
2. Location: near school versus sports and play areas
3. Year: 2010 versus 2011, 2010 versus 2012 and 2010 versus 2014.

A series of hierarchical logistic regressions were performed to investigate the effect of condition (experimental vs. control area), time (year), location, and the combination of time and location on helmet usage. For details concerning the investigation of such interactions with hierarchic logistic regression models we refer to Jaccard (2001).

2.5.2. Questionnaire study
Only completed online questionnaires (see Table 3) of children who had received a bicycle helmet for free were analysed. Parents and their children who had missed this crucial element of the campaign were excluded from the analyses of the questionnaire data. Kendall’s tau was used to investigate the association between the ordinal variables self-reported helmet use (four categories reduced to never and always) and parental rules (having rules for helmet wearing or not), and between self-reported helmet use and grade (ranging from Grade 1 - Grade 8). In this case, it was decided to use significance level of $\alpha = .01$ in order to correct for capitalisation on chance.

3. Results

3.1 Effect of the campaign on observed bicycle helmet wearing
Figure 3 shows the changes in helmet use over time in the experimental and control area aggregated over locations (i.e., near school and sports and play area). Helmet use of the targeted age group in the experimental area increased in 2011 (the first campaign year) compared to the pretest in 2010, whereas this was hardly the case in the control area.

The percentages in Figure 3 are derived from the frequencies in Table 4.

The results of the logistic regression analysis in Table 5 show that the change in frequency of helmet use in the experimental area in 2010 and
2011 was significantly different from that change in the control area ($b = 1.77$, $df = 1$, Wald = 10.71, $p = .001$). Specifically, we see that compared with the control area the helmet use in 2011 in the experimental area was almost six times higher than in 2010 (odds ratio [OR] = 5.89, 95% confidence interval [CI] [2.04, 17.04]).

However, compared to the year 2010 changes in helmet use in the experimental and control area in later years (2012 and 2014) are no longer significantly different ($b = -0.153$, Wald = .08, $p = .772$ for 2012; $b = .84$, Wald = 1.68, $p = .195$ for 2014). See Table 5 for an overview.
3.1.1. Correctness of helmet wearing
In 2012 and 2014 the observation form also included the observation of correct wearing of the helmet. Of all children wearing a helmet, nearly two-thirds wore the helmet correctly. Those who wore it incorrectly wore it either too low or too high on the head.

3.2. Which factors are associated with bicycle helmet use?

3.2.1. Self-reported helmet-wearing rates
Parents in the experimental area were asked whether their child wore a helmet on every trip. Figure 4 shows that in the first years of the campaign children always wore their helmet (25%) or wore it most of the time (22%). However, as the campaign progressed, these percentages decreased steadily.

Children in the experimental area were also less likely to wear a helmet when they grew older and advanced to higher school grades. Figure 5 shows the helmet-wearing rates by school grade in each of the study years showing that in each school year helmet-wearing rates in Grades 1 and 2 were the highest with approximately 70% of the children usually or always wearing a helmet. In Grades 4 and 5 this rate decreased to 10%–20%, and in Grade 8 no one wore a helmet. This change is significant, $\chi^2(6)=76.31; p<0.001$, and evident throughout the campaign period.

3.2.2. Self-reported and expected cycling frequency after receipt helmet
Helmet wearing did not affect cycle frequency. For the vast majority of children that usually or always wears a helmet (85%), the cycling frequency does not differ from that of the period before they started using the helmet. A small proportion (1%) cycles slightly less or (4%–11%) cycles slightly more than before.

Eighty-five percent of the parents in the control area expected that the cycling frequency of their children would be unchanged should they receive a bicycle helmet for free. Figure 6 shows the self-reported cycling frequency amongst helmet-wearing children in the experimental area and children in the control area. Because the degree of cycling frequency does not vary over the years, data have been aggregated.

3.2.3. Influencing factors
Table 6 shows that helmet use is significantly associated with grade and with parental rules for helmet wearing. There is a significant association between self-reported helmet use and grade. More self-reported helmet use was reported for children in lower grades than in higher grades. The analysis also showed a significant association between self-reported helmet use
and the rules parents impose for helmet use. When parents have rules for helmet wearing, self-reported helmet use is higher. These patterns did not change over the campaign years.

3.2.4. Attitudes towards bicycle helmets

Generally, parents and children are less positive towards the bicycle helmet as their children grow older and advance to higher grades. A larger proportion of children (23%–35%) in Grades 4 and 5 agree with the statement that “the bicycle helmet is uncomfortable” when compared to young children (4–6%). Also, more children in Grade 3 and higher (16–37%) agree with the statement that “the bicycle helmet is not necessary” when compared to children in Grade 1 and 2 (0–9%). Figure 7 shows the percentage of children in Grades 1 to 5 that agree with these statements.

Parental attitudes towards the use of bicycle helmets also shift as their children grow older and advance to higher grades. Just like their children,
more parents of older children agree with negative statements on bicycle helmets than parents of younger children.

3.2.5. Motives (not) to wear bicycle helmets

Generally, the motives for children to wear a helmet and for parents to let their children wear a helmet are less positive as children get older and advance to higher grades at school. The three most commonly given
reasons by children to wear and not to wear the helmet are shown in Table 7. Children and parents were allowed to give more than one answer. The results reveal that the younger the child, the more positive the motives. Young children often say they wear a helmet because ‘it is safe’ and that their ‘parents like them to wear a helmet.’ The very young children (Grade 1) mention that the bicycle helmet is ‘beautiful.’

The most important reason for older children (Grade 3 and higher; i.e. age range 7- to 8-year-olds) not to wear their helmet is because ‘their friends do not wear helmets.’ Other often mentioned reasons among older children are that the bicycle helmet is ‘uncomfortable’ and ‘not necessary’.

Parents that have their children wear helmets often have young children. The most frequently mentioned motive to have their children wear helmets is ‘the lower risk of serious head injury,’ especially by parents of children in Grades 1 and 2. Parents also often mention that a ‘bicycle helmet is necessary.’ This motive is mentioned less often when children get older. Parents of children in Grade 5 do not mention this reason any longer.

Table 8 shows the percentages of parents’ motives. The most frequently mentioned reason for parents not to have their children wear helmets anymore is that their ‘children’s friends do not wear helmets. This is most often mentioned by parents with children in Grade 5. Another reason is that children are seen as ‘sufficiently careful’ – please confirm if the opening quote mark is added correctly ‘sufficiently careful’ and bicycle helmets therefore not being needed anymore.

### 4. Discussion

This five-year longitudinal evaluation study investigated the effect of a school-based bicycle helmet campaign among 4- to 8-year-olds on helmet-wearing rates and identified its success and failure factors. The evaluated programme provided free helmets and education for each child, as well as information for their parents. The evaluation study compared observed helmet-wearing rates before the intervention, with yearly rates during the five-year programme, and related those to the rate changes in a control area.

| Table 7. Children’s motives (not) to wear bicycle helmets defined by school grades. |
| --- |
| **Positive motives** | Grade | Share of children % | Grade | Share of children % |
| "The bicycle helmet is safe" | 1–4 | 36–62 | 5 | 17–24 |
| "My parents like me to wear a helmet" | 1–4 | 33–62 | 5 | 14–21 |
| "The bicycle helmet is beautiful" | 1 | 40–53 |
| **Negative motives** | Grade | Share of children % | Grade | Share of children % |
| "My friends do not wear a helmet" | 2 | 21–24 | 3–5 | 31–62 |
| "Bicycle helmet is uncomfortable" | 2–3 | 13–25 | 4–5 | 30–44 |
| "I do not need a bicycle helmet" | 4–5 | 20–44 |
Parents together with their children also completed questionnaires on self-reported helmet wearing, attitudes, motives, and barriers for helmet use.

The results show that observed bicycle helmet use in the experimental area increased significantly in the first year of the campaign, when the distribution of the free helmets was combined with additional supporting activities and information for parents but varied in later years. After the first year of the campaign, nearly five times as many young children (ages 4–8 years) were observed wearing a bicycle helmet; an increase from 3.3% to 15.7%. This behavioural effect is larger than is usually achieved in voluntary health promotion campaigns, which usually range around 3% to 5% (Renes et al., 2011). The variation in helmet usage rates in later campaign years coincided with variations in campaign intensity. In year 2 and 3 of the campaign, only free helmets were provided to the children in Grade 1. Other campaign activities, such as education for children and information for parents were stopped after the first year. International reviews of helmet campaigns (Owen et al., 2011; Royal et al., 2007) have also shown that these elements are important for a successful bicycle helmet campaign. Moreover, a recent French study (Richard, Thélot, & Beck, 2013) that analysed voluntary helmet use in France following public awareness campaigns also showed that helmet use among cyclists (ages 15–75 years) increased by a factor of three, from 7.3% in 2000 to 22% in 2010 with greater helmet use for people reporting being well informed on health topics.

The results of self-reported helmet use were consistent with the results on observed bicycle helmet use. As the campaign progressed the percentages of self-reported helmet use decreased steadily. The questionnaire study also indicated that a majority of the children in Grades 4 to 8 do not wear bicycle helmets. This is an important barrier for long-lasting behavioural effects. Based on the motive analysis, helmet use, or the lack of it, by the children’s peers appears to be an important factor. Parents and their children seem to be guided by what they perceive as normal. One of the main reasons for not wearing helmets is the same-age friends not wearing helmets, especially in higher grades. Several psychological theories

| Grade child | Share of parents | Grade child | Share of parents |
|-------------|-----------------|-------------|-----------------|
| 1–2         | 50–79           | 3–5         | 19–41           |
| 1–2         | 45–62           | 3–5         | 11–37           |
| 1–4         | 21–48           |             |                 |
| 2–4         | 10–27           | 5           | 29–43           |
| 2–5         | 9–21            |             |                 |
| 1–4         | 8–23            | 5           | 15–36           |

Table 8. Parents’ motives (not) to have their children wear bicycle helmets defined by school grades.
emphasise that adults and children are influenced by other people’s behaviour and the perceived underlying social norm (Berkowitz, 2004; Cialdini, 2007). Note that the campaign was based on the premise that if all children would wear helmets, helmets would become the norm. Such a shift in norms did not happen. Evaluation of previous Dutch bicycle helmet campaigns also showed that social norms are important to children and but that these were also hard to change (Seijts et al., 1995; Steenbakkers et al., 1996). In these studies, children reported that they stopped wearing their bicycle helmets because of negative reactions from the social environment. As children grow older, social norms probably play a role in their decisions about whether to wear a helmet.

The reduction of injury risk was the most important factor for parents to have their children wearing helmets, when children were young. However, as children grow older, this motive became less important. These age-related change in parental perceptions was reflected in lower self-reported helmet-wearing rates in older age groups. Parents believed that children by age 7 (Grade 4) have become ‘safe’ cyclists. Also, the perceived familiarity with the regular cycling routes may contribute to this higher level of confidence, leading to the perception of helmets no longer being needed. Unfortunately, these parents may be overestimating their children’s cycling skills and be underestimating the risk of head injuries. Accidents statistics show that the share of children with serious head injuries in single-bicycle crashes increase from age range 0–5 years to age range 6–11 years (SWOV, 2016).

Parenting style was also shown to be a factor. Self-reported helmet wearing was higher among children whose parents imposed strict and clear rules. In our study, however, only one quarter of parents did. Nearly three-quarters of the parents did not enforce such rules for helmet wearing. Research examining parenting variables and estimations of children’s bicycle helmet use also identified parental rules as an important factor (Ross, Brinson, & Ross, 2014). Their study (Ross et al., 2014) also found that parents reported stricter helmet rules for children as beginning cyclists than for children who were already more experienced.

The age-related decline in helmet use is also supported by observations in previous studies (Berg & Westerling, 2001; Ross et al., 2014). Age was also the single dominant predictor of helmet use in a school-based survey in 26 countries among children aged 11, 13, and 15 year-old (Klein, Thompson, Scheidt, Overpeck, & Gross, 2005). Klein et al. (2005) explained that younger children are more likely to comply with prosafety messages from their parents or other children than older children do. A Cochrane review on nonlegislative bicycle helmet interventions also concluded that the promotion of helmets is more effective for younger children than for
older children and young people (Owen et al., 2011). In this respect, the findings of our study are not different.

4.1. Strengths and weaknesses

To our knowledge, this is the first study that evaluated the longitudinal effect of a voluntary bicycle helmet campaign in the Netherlands. Additional strength of this study was the use of a comparable control area without helmet use campaign activities. The use of a control area enabled the investigation of helmet usage of children without the support of a bicycle helmet campaign. As bicycle helmet–wearing rates increased in the experimental but not in the control area, we have reason to believe that this increase was the result of the campaign. Although respondents of the study did not differ beforehand on aspects such as age, distribution of grades or distance from home to school, we cannot totally exclude that other, nonobserved, differences between the two research areas could also have influenced bicycle helmet usage. As the observation study also used a pretest, the increased helmet use in the first year of the campaign can be attributed to the campaign.

It is also an advantage that the effect of the campaign on helmet use has not only been measured with self-reported helmet use, but also with observed helmet use. Previous studies have shown that owning a (free) helmet does not always result in wearing a bicycle helmet (Ross et al., 2014).

Our study also had some limitations. In 2013, due to financial constraints, the observation study was only performed near schools in the experimental area. Therefore, it is not possible to attribute the increase in helmet use solely to the campaign in this year. Despite the efforts to commit parents to participate in follow-up questionnaires for several years with a reward system and personalised, repeated contact, the questionnaire study had low response rates throughout the campaign. The low response rates may reflect a lack of interest in bicycle helmets by parents and/or schools. Not all schools were prepared to participate, for reasons including a too heavy workload. Although the time to complete the questionnaire was relatively short (5–10 minutes), questionnaire study had low response rates. The generalizability of the results of this study is therefore limited.

5. Conclusion

The aim of the bicycle helmet campaign was to promote voluntary helmet use in young children in an experimental area. This five-year longitudinal evaluation study showed that bicycle helmet use increased in the first year when distribution of free helmets was combined with additional campaign
activities such as education and information for children, parents, and teachers. This behavioural effect was not sustained in the following campaign years. Factors associated with self-reported helmet wearing were children’s age, perceived cycling skills, parental rules and social norms. Parents and children seem to be influenced by the norm in the Netherlands that children above a certain age cycle without a helmet.

Notes

1. The Dutch Injury Surveillance System (LIS) records statistics of people being treated at the Emergency Care Departments of a selection of hospitals in the Netherlands, following an accident, violence, or self-inflicted injury.
2. This information is relevant for the study of the Dutch Consumer Institute which assessed the effect of head injuries of bicycle crashes during the bicycle helmet campaign.

Acknowledgements

This study was facilitated by the Dutch Ministry of Infrastructure and Environment. The authors would like to thank all people at the Province of Zeeland that kindly assisted in the execution of this evaluation. Finally, the authors would like to acknowledge the voluntary contribution of all the participants in the research.

References

Aarts, L. T., Eenink, R. G., Weijermars, W. A. M., Knapper, A., & Schagen, I. N. L. G. V. (2014). Soms Moet er Iets Gebeuren Voor er Iets Gebeurt: verkenning Van Mogelijkheden om de Haalbaarheid Van de Verkeersveiligheidsdoelstellingen te Vergroten. [Achieving the Road Safety Targets; Exploring the Opportunities for Increasing the Feasibility]. (R-2014-37a).
Berg, P., & Westerling, R. (2001). Bicycle helmet use among schoolchildren: The influence of parental involvement and children’s attitudes. Injury Prevention, 7(3), 218–222. doi: 10.1136/ip.7.3.218
Berkowitz, A. D. (2004). The social norms approach: Theory, research, and annotated bibliography. Retrieved from http://www.alanberkowitz.com/articles/social_norms.pdf
Cialdini, R. B. (2007). Influence: The psychology of persuasion. New York: Harper Collins.
Elvik, R. (2013). Corrigendum to: “Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001” [Accid. Anal. Prev. 43 (2011) 1245–1251]. Accident Analysis & Prevention, 60, 245–253.
Hagel, B. E., Lee, R. S., Karkhaneh, M., Voaklander, D., & Rowe, B. H. (2010). Factors associated with incorrect bicycle helmet use. Injury Prevention, 16(3), 178–184. doi: 10.1136/ip.2009.023994
Jaccard, J. (2001). Interaction effects in logistic regression. Thousand Oaks, CA: Sage: Sage University papers series on Quantitive applications in the social sciences 07-135.
Klein, K. S., Thompson, D., Scheidt, P. C., Overpeck, M. D., & Gross, L. A. (2005). Factors associated with bicycle helmet use among young adolescents in a multinational sample. Injury Prevention, 11(5), 288–293. doi:10.1136/ip.2004.007013
Olivier, J., & Creighton, P. (2016). Bicycle injuries and helmet use: A systematic review and meta-analysis. *International Journal of Epidemiology, 46*(1), 278–292. doi:10.1093/ije/dyw153.

Olofsson, E., Bunketorp, O., & Andersson, A.-L. (2017). Helmet use and injuries in children’s bicycle crashes in the Gothenburg region. *Safety Science, 92*, 311–317.

Owen, R., Kendrick, D., Mulvaney, C., Coleman, T., & Royal, S. (2011). Non-legislative interventions for the promotion of cycle helmet wearing by children. *Cochrane Database Syst Rev, 2011*(11), Cd003985. doi:10.1002/14651858.CD003985.pub3.

Panneman, M., Adriaensens, L., & Blatter, B. (2016). Fietshelmcampagne Zeeland. Onderzoek Naar Effect, Kosten en Baten [Bicycle Helmet Campaign Zeeland 2011–2015, Investigating Effect, Costs, and Benefits]. Rapport 639, 2011–2015.

Renes, R. J., Putte, B. V D., Breukelen, R. V., Loef, J., Otte, M., & Wennekers, C. (2011). Gedragsverandering via campagnes. Literatuuronderzoek in opdracht van het Ministerie van Algemene Zaken, Dienst Publiek en Communicatie [Behaviour change through campaigns].

Richard, J.-B., Thélot, B., & Beck, F. (2013). Evolution of bicycle helmet use and its determinants in France: 2000–2010. *Accident Analysis & Prevention, 60*, 113–120.

Ross, L. T., Brinson, M. K., & Ross, T. P. (2014). Parenting Influences on Bicycle Helmet Rules and Estimations of Children’s Helmet Use. *The Journal of Psychology, 148*(2), 197–213. doi:10.1080/00223980.2013.771131

Royal, S., Kendrick, D., & Coleman, T. (2007). Promoting bicycle helmet wearing by children using non-legislative interventions: systematic review and meta-analysis. *Injury Prevention, 13*(3), 162–167.

Seijts, G. H. P., Kok, G., Bouter, L. M., & Klip, H. A. J. (1995). Barriers to wearing bicycle safety helmets in the Netherlands. *Archives of Pediatrics & Adolescent Medicine, 149*(2), 174–180. doi:10.1001/archpedi.1995.02170140056009

Steenbakkers, M., Goldenbeld, C., Dijkman, A., & Venema, A. (1996). Promotie vrijwillig gebruik van fietshelmen in de Bollenstreek: de resultaten van een project bij twee basisscholen. [Promotion of voluntary helmet use]. Intern rapport 154.

SWOV. (2016). Bicycle helmets. SWOV factsheet. Retrieved from https://www.swov.nl/en/facts-figures/factsheet/bicycle-helmets.

Towner, E., Dowswell, T., Burkes, M., Dickinson, H., Towner, J., & Hayes, M. (2002). Bicycle helmets: A review of their effectiveness: a critical review of the literature. Road Safety Research Report No. 30.

Weijermars, W. A. M., Stipdonk, H. L., Aarts, L. T., Bos, N. M., & Wijnen, W. (2014). Verkeersonveiligheid. [Road Safety Assessment 2000–2012; Causes and Consequences of Road Unsafety], Verkeersveiligheidsbalans 2000–2012; Oorzaken en gevolgen van (R-2014-24).