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The effect of a yellow bicycle jacket on cyclist accidents

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ABSTRACT

This study is the first randomised controlled trial (RCT) of the safety effect of high-visibility bicycle clothing. The hypothesis was that the number of cyclist accidents can be reduced by increasing the visibility of the cyclists. The study design was an RCT with 6793 volunteer cyclists – 3402 test cyclists (with a yellow jacket) and 3391 control cyclists (without the jacket). The safety effect of the jacket was analysed by comparing the number of self-reported accidents for the two groups. The accident rate (AR) (accidents per person month) for personal injury accidents (PIAs) for the test group was 47% lower than that of the control group. For accidents involving cyclists and motor vehicles, it was 55% lower. The study was non-blinded, and the number of reported single accidents was significantly lower in the test group than in the control group. This is likely a result of a response bias, since the bicycle jacket was not expected to affect the number of single accidents. To compensate for this bias, a separate analysis was carried out. This analysis reduced the effect of the jacket from 47% to 38%.

1. Introduction

Cycling is regarded a healthy and environmentally friendly means of transport (Hosking et al., 2011). However, cyclists are an exposed road user group. In 2010, nearly 2000 cyclists were killed in traffic accidents in the EU, corresponding to 7% of all traffic fatalities (Candappa et al., 2012). In Denmark, the risk of cyclist accidents is significantly higher than for other road user groups (Hansen and Jensen, 2012), and the risk is most likely even far greater than reflected by the official Danish accident statistics. Research suggests a degree of under-reporting of bicycle personal injury accidents (PIAs) in Denmark of up to 86% for severely injured and 94% for slightly injured in the official Danish accident statistics (Janstrup et al., 2016). Similarly, de Geus et al. (2012) and Heesch et al. (2011) found that accident rates among cyclists and the degree of under-reporting are both high.

A review study from The Cochrane Library (Kwan and Mapstone, 2009) studied randomised controlled trials (RCT) to assess the effects of increasing pedestrian and cyclist visibility. The study found 42 studies comparing the visibility with and without visibility aids. These studies showed that fluorescent materials improved drivers' detection during the day, while lamps, flashing lights and retroreflective materials improved the detection at night. The review found no studies that measured the effect of increased visibility on the number of accidents. Wood et al. (2013) also found that fluorescent and retroreflective materials improved cyclists' visibility. Tin Tin et al. (2013) shared the same hypothesis, but could not confirm this.

Several studies have assessed the effect of conspicuity aids for cyclists on the accident rate (AR) (Chen and Shen, 2016; Hagel et al., 2014; Heesch et al., 2011; Hoffmann et al., 2010; Lacherez et al., 2013; Madsen et al., 2013; Miller, 2012; Teschke et al., 2012; Thornley et al., 2008; Tin Tin et al., 2014, 2013; Wood et al., 2009). Most of these studies found no significant results and were not RCT studies. Madsen et al. (2013), however, conducted an RCT to assess the effect of running lights for cyclists and used self-reported accidents to estimate the effect. They found that the number of accidents decreased by 61%. In a study of 9 years of cycling accidents in Seattle, Chen and Shen (2016) observed a lower likelihood of injuries for bicyclists wearing reflective clothing.

Herslund and Jørgensen (2003) suggested that increasing the visibility of cyclists could reduce the number of 'looked but failed to see'-accidents between motorised vehicles and cyclists. This view was supported by a Finnish study of vehicle-bicycle accidents which concluded that accidents occur because motorists notice the cyclist too late (Räsänen and Summala, 1998).

82% of all Danish multiparty accidents involving cyclists occur in daylight (The Danish Road Directorate, 2017). Thus, it is important to find measures that can reduce the number of cyclist accidents in daylight, for instance the use of fluorescent materials which could improve

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Fig. 1. The bicycle jacket.

the detection by drivers as shown by Kwan and Mapstone (2009). The objective of this study was to assess the potential of achieving a reduction in accident occurrence by increasing cyclists' visibility using a yellow bicycle jacket (Fig. 1). The hypothesis of this study was that the use of high-visibility clothing on the upper body of a cyclist would improve cyclists' visibility and consequently lead to a reduction in the number of multiparty PIAs. Furthermore, it was hypothesised that the safety effect would be higher in winter than in summer, and higher in daylight and twilight than in the night time.

2. Method

2.1. Study design

The effect of the jacket was tested in an RCT with self-reporting of accidents. This reporting method was chosen because as mentioned above, the degree of underreporting of personal injury bicycle accidents in Denmark is very high. Participants were randomly assigned to a test and a control group. The test group participants agreed to the condition of wearing the reflective bicycle jacket every time they would ride their bicycles during the study period, i.e. for one full year. During that same year, the control group would wear their regular bicycle garments.

2.2. Participants

Participants were recruited from across Denmark via newspapers, direct email contact and radio and TV interviews. Furthermore, people who had signed up could recommend others to participate, and the former then participated in a lottery to win a prize. A detailed description of the recruitment for the study and the practical execution is available in Hansen et al. (2014).

In total, 11,202 cyclists signed up for the study. Only cyclists who would ride their bicycle at least three times a week in the summer and who were at least 18 years old when signing up were recruited. 366 registrations were rejected because they failed to meet the criteria, see Fig. 2. The cyclists were stratified on the jacket size (S-XXXL) since the jackets were produced in advance and therefore limited in amount. Thus, not all cyclists who signed up were selected to participate.

8042 participants were randomly assigned to the test and control groups. Of these, 6793 participants confirmed their participation (test group, n = 3402, control group, n = 3391). The test group participants received the yellow bicycle jacket to wear during the study period, while the control group used their regular bicycle garments with the prospect of receiving a yellow bicycle jacket after the completion of the study.

The demographic characteristics of the participants and the overall Danish population are shown in Table 1. The mean age of the participants was 46 years, i.e. approx. 2.5 years below that of the average Danish population. They used their bicycles almost every day both summer and winter, and their typical destination was work/education. Although they frequently rode their bicycles, 80% of the participant households had at least one car, compared to only 60% of the Danish population in general. The test and control groups shared similar characteristics. However, the study participants in the two groups differed by one year in age and slightly in the frequency of their daily use

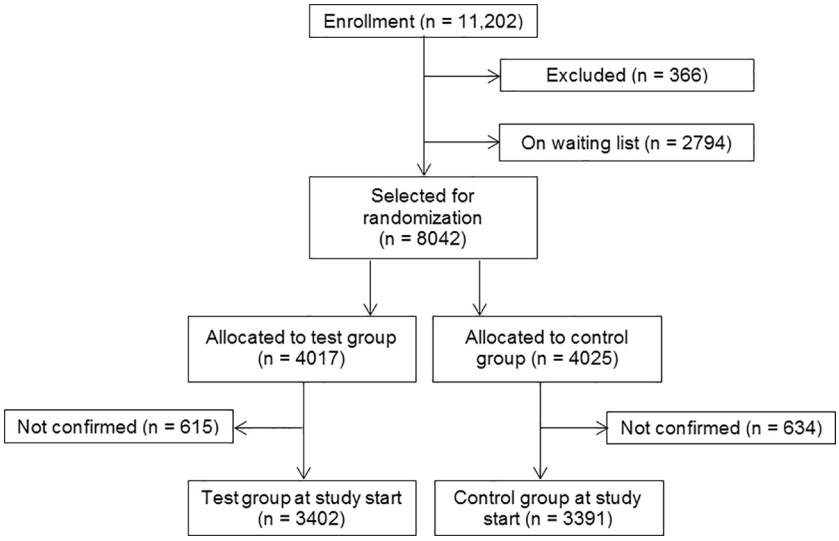

Fig. 2. Flowchart for recruitment.