Effectiveness of two interventions in preventing traffic accidents: a systematic review

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Key words: Traffic accident, prevention, intervention, visibility, graduated driver licensing

Parole chiave: Incidenti stradali, prevenzione, interventi, visibilità, patente progressiva

Abstract

**Background:** The prevention of road traffic accidents should be considered a serious public health concern, since they are the eighth leading cause of death globally and the main cause of death for young people aged 15–29. Evidences from many countries show that successes in preventing road traffic injuries can be achieved through concerted efforts at national level. The aim of our study was to assess the effectiveness of two interventions to prevent road traffic accidents: the introduction of graduated driver licensing (GDL) and the interventions to improve pedestrian and cyclist visibility.

**Methods:** Our search started with a scoping review on the interventions to prevent road traffic accidents to allow the development of a logical framework of traffic accidents. Specific and answerable questions formulated according to PICO scheme and combinations of keywords were used to perform a systematic search in the following databases: Pubmed, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (DARE), Health Evidence, Transport Research International Documentation (TRID) and Google. References of selected papers were searched. Only systematic reviews and meta-analyses were eligible. No temporal limits or linguistic filters were applied.

**Results:** 160 systematic reviews and meta-analyses were found for the question of the introduction of GDL program and 188 on the improvement of visibility in cyclists and pedestrians. After selection, four papers were included in qualitative synthesis for each question. All included studies underwent quality evaluation. GDL programs seem to be effective in reducing crash rates among young drivers, in particular in 16 year-old. Programs with more restrictions seem also to reduce fatal events.

To improve visibility of pedestrians and cyclists, street lighting has been suggested as an intervention able to improve driver’s visual capabilities and ability to detect roadway hazards and to prevent car crashes. Visibility aids (fluorescent materials, lamps, flashing lights and retroreflective materials) have the potential to increase visibility and enable drivers to detect pedestrians and cyclists earlier.

**Conclusions:** The two interventions seem to be effective, but further examinations are needed to measure long-term effects. It is necessary to provide feasible studies in local context to estimate the impact of introduction of GDL programs or of some of their components and to improve interventions to increase visibility of pedestrians and cyclists.
Introduction

Road traffic injuries are the eighth leading cause of death globally with an impact similar to that caused by many communicable diseases, such as malaria; for young people aged 15–29, they represent the leading cause of death (1).

Approximately 1.24 million people die every year on the roads worldwide, and another 20 to 50 million suffer from nonfatal injuries as a result of road traffic crashes (2). In high-income countries, most of those people killed or injured in road traffic crashes are drivers and passengers of four-wheeled vehicles. In low-income and middle-income countries, however, “vulnerable road users” – pedestrians, cyclists and motorcyclists and users of public transportation vehicles – are a higher proportion of road users, and consequently they represent a larger proportion of those injured or killed on the roads (3).

The cost of dealing with the consequences of these road traffic crashes runs to billions of dollars. Current trends suggest that by 2030 road traffic deaths will become the fifth leading cause of death unless urgent action is taken (4).

In Europe, annually, road crashes result in almost 120 000 fatalities and 2.4 million injuries and road traffic injuries are the leading cause of death among adolescents and young adults (5). Pedestrians, cyclists and users of motorized two-wheelers constitute 39% of all deaths in road crashes. They are more likely to be more seriously injured. High vehicle speeds and urban design place these road users at increased risk. The costs of care and rehabilitation are considerable, and societal costs have been estimated at up to 3% of gross domestic product (6).

Prevention of road traffic accident should be considered a serious public health concern and involves many actors at local, national and international level.

Evidences from many countries show that dramatic successes in preventing road traffic injuries can be achieved through concerted efforts at national level. The complexity of a traffic accident prevention agenda is due to the many and different factors which can lead to traffic injuries. Positive responses in traffic accident control depend on implementation of a number of (proven to be) effective measures concerning not only with the safety of the road user, but also the vehicle safety, the road environment and the post-crash cares (2).

The aim of our study was to assess, through a systematic review approach, the effectiveness of interventions to prevent road traffic accidents; in particular, we focused on two types of interventions: the introduction of graduated driver licensing (GDL) and the interventions aimed at improving pedestrian and cyclist visibility.

Materials and methods

We conducted a scoping review on the interventions to prevent road traffic accidents, and we searched and found evidences of the effectiveness of two specific preventive interventions: 1) introduction of GDL and 2) measures to improve cyclist and pedestrian visibility. The restriction of research is due to the interest in evaluating two interventions which have been not implemented in our local context yet. Furthermore these two kinds of intervention can involve a wide part of road users and can be realized in a shorter time in comparison to other actions, thanks to the possibility of introducing and regulating them by law.

GDL provides the practical experience needed to move novice learner drivers along the learning curve minimizing their risk of crashing. GDL systems include three different stages of licensure: beginner, intermediate and final. A beginner stage comprises a
mandatory minimum learner permit period during which driving is only allowed under the supervision of an experienced adult driver. This is followed by an intermediate period allowing unsupervised driving, during which exposure to high risk conditions is limited by restrictions on the number of passengers and nighttime driving. A final license stage allows unrestricted driving, at last exposing novices to the full range of driving risks (7).

We started developing a logical framework of traffic accidents problem to show modifiable determinants, to organize, group and select the interventions, to identify the different phases of the potential Public Health Program to be developed for the considered health issue and to choose the outcomes used to define success for each intervention (figure 1) (8). The different phases of the Public Health Program in our logical framework were based, in part, on Haddon’s matrix (9).

Then we formulated specific and answerable questions for listed interventions and specify the Population, Intervention, Comparison and Outcome, according to the PICO scheme in the Cochrane Handbook for Systematic Reviews of Interventions (10). We have substituted Comparison with Condition of Interest, because it fitted better in our questions’ formulation, in line with authors who have already rearranged PICO scheme (11).

We searched in the following databases: Pubmed, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (DARE), Health

Figure 1. Logical framework
Figure 2. Question formulation on GDL introduction (A), improvement of cyclist and pedestrian visibility (B) and Pubmed query construction.
Evidence (that searches in the following electronic databases: MEDLINE, EMBASE, CINAHL, PsycINFO, BIOSIS, SPORTDiscus and Sociological Abstracts and through handsearch and reference list search), Transport Research International Documentation (TRID), that combines the records from TRB’s Transportation Research Information Services (TRIS) Database and the OECD’s Joint Transport Research Centre’s International Transport Research Documentation (ITRD) Database, and Google. References from selected papers were searched too.

To perform the search in the above cited electronic databases, both specific queries related to PICO scheme and combinations of keywords were used, such as: prevent* AND traffic accident*, prevent* AND traffic injur* prevent* AND car crash*, (traffic OR injur* OR prevent*) AND visibility, graduated driver licensing.

In figure 2 (A and B) are illustrated the questions dealing with the two interventions under consideration and the keywords used to search on Pubmed. The search strategy on Pubmed was built by selecting groups of keywords for each part of PICO. Each group was combined to others through the Boolean operator AND.

In the case of introduction of GDL the search strategy on Pubmed was: (law OR legislation OR enforcement OR graduat* OR licens* OR “graduated driver licensing”) AND (“traffic accident” OR injur* OR road* OR death*) AND (commun* OR driv* OR licence*) AND (motor* OR vehicle* OR automobil* OR car*).

For the question on the improvement of cyclist and pedestrian visibility the search strategy was: (efficacy OR effectiveness* OR interv* OR prevent* OR visibilit* OR street OR lightin* OR protetc* OR device* OR “protective devices” OR clothing OR color* OR “audiovisual aids” OR environmental OR design*) AND (“traffic accident” OR injur* OR road* OR death*) AND (commun* OR rid* OR pedestrian*) AND (bicycl* OR walk*).

Studies were eligible for inclusion if: they were published from the originating date of the database to June 3rd, 2013; they were secondary studies, systematic reviews and meta-analyses published in all languages, and they were relevant to the interventions, the populations and the outcomes defined in our questions.

For quality evaluation of included papers, the quality assessment of Center for Reviews and Dissemination (CRD) and the score of quality of Health Evidence were considered. When these were not available, two reviewers applied the Quality Assessment Tool of Health Evidence (12) and a final rating for each review or metanalysis was assigned depending with the ten quality criteria of the tool: strong (8 to 10/10), moderate (5 to 7/10), or weak (1 to 4/10).

**Results**

**Introduction of GDL program**

As shown in figure 3A, we found in total 160 systematic reviews and meta-analyses. Of the four papers included in qualitative synthesis, one (13) was evaluated as strong for its quality, two (14, 15) moderate and one weak (16).

A synthesis of the main features of selected studies are provided in Table 1A.

In Zhu et al. metanalysis (2013) (14), 12 studies were examined, 11 of which from US and one from Canada, considering a population of 16, 17 and 18 year-old drivers. Although not all the included primary studies used the same outcomes, authors pooled age-specific ratios from each study to summarize the association between GDL presence and crash rates. GDL policies are associated with a 22% reduction in crash rates among 16 year-old drivers, but only a 6% reduction for 17-year-old drivers. GDL is not associated with crashes among 18
Figure 3. Flow diagram of studies selection on GDL introduction (A) and on improvement of cyclist and pedestrian visibility (B).
year-old drivers, but these findings should be considered exploratory because there were few studies to summarize data for older teens.

In Russell et al. systematic review (2011) (13), 34 studies were included which discuss the implementation of GDL programs in US, Canada, New Zealand, and Australia. GDL programs seem to be effective in reducing crash rates among young drivers, although the magnitude of the effect varies. Among the 16 year-old drivers, the median decrease in crash rates during the first year was 15.5%. There was a median decrease in injury crash rates of 21%.

Shope (2007) (15) analyzed 27 studies from USA and Canada and concluded that GDL resulted in reductions in accidents involving young novice drivers. Most studies in individual states reported that introduction of graduated driver licensing was associated with reductions in crashes of a percentage between 19% and 39%. Reported reductions for 16-year-old ranged from 5% to 73%. All nationwide studies reported that graduated driver licensing was associated with at least some significant reductions in fatalities or crashes.

Foss and Evenson’s systematic review (1999) (16) had the aim to determine whether graduated driver licensing systems and nighttime curfews reduce motor vehicle crashes, fatalities or injuries among young drivers. Two of the seven included studies found a reduction of 7-8% in teen driver crash injuries attributable to the program. Four studies of either a general curfew or a nighttime driving restriction for teens found substantial crash reductions during restricted hours, with 23-25% lower crash injuries and fatality rates for curfews beginning prior to midnight. One study found no change in late night crashes before and after a 1am-6am night driving restriction. Authors did not report inclusion and exclusion criteria of studies, how methodological quality was assessed and how the data extraction was done. However the authors’ conclusions seem to follow from the evidence presented.

A paper by Vanlaar et al. (2009) (17) was considered pertinent by full text, but not included in qualitative synthesis because it’s a pooled analysis of original data, not a meta-analysis as classified in Pubmed. In fact this study takes into account national data and processes them through a meta-analytical approach, while Zhu in his metanalysis (13) uses data coming from published studies. In any case we will illustrate Vanlaar study’s results without applying the same tool used for quality evaluation of the other studies because it is neither a systematic review nor a meta-analysis.

According to Vanlaar (17), several GDL program components have an important impact on the relative fatality risk of novice drivers. The target group of the study was composed by 16, 17 and 18-year old driver, while the comparison group was 25-54 drivers. Data come from US and Canadian jurisdictions. It’s not clear how the primary studies were found and selected.

Interventions to improve visibility of cyclists and pedestrians

As shown in figure 3B, for the question on the improvement of visibility in cyclists and pedestrians we found 188 papers, after removal of duplicates. In the end four systematic reviews were selected, two of them (18, 19) are evaluated as strong according to the criteria of Health Evidence, one (20) is rated as moderate and the last one (21) as weak.

In table 1B the main characteristics of selected reviews and meta-analyses are summarized on improvement of pedestrian and cyclist visibility.

Beyer and Ker (2009) (18) aimed to assess the effects of street lighting on injuries caused by road traffic crashes. Seventeen controlled before-after studies conducted in high-income countries were included, and the authors’ conclusions suggest that street
Table 1 - Main characteristics of selected reviews and meta-analyses on GDL introduction program (A) and on improvement of pedestrian and cyclist visibility (B).

<table>
<thead>
<tr>
<th>Review citation Year searched Synthesis method</th>
<th>N. of primary studies and location</th>
<th>Type of included studies</th>
<th>Outcome(s)</th>
<th>Results</th>
<th>Quality Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zhu et al., 2013 1991-2011 Systematic review +metanalysis</td>
<td>12 USA, Canada</td>
<td>Studies from individual states or provinces reporting counts of crashes, injuries or deaths as outcome and providing age-specific incidence rate ratios. Times series, controlled before-after and observational studies.</td>
<td>Crash rates, fatality crash rates and injury crash rates of teenage drivers.</td>
<td>Reduction of crash rates among 16-years old drivers: 22%; reduction among 17 years old: 6%; little association between GDL and crash rates among 18 year old drivers.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Russell et al. 2011 From inception of consulted databases to May 2009; update of search in TRASPORT database in September 2009 Systematic review</td>
<td>34 USA, Canada, New Zealand, Australia</td>
<td>1) studies comparing pre- and post-implementation of a GDL program within the same jurisdiction; 2) comparisons between jurisdictions with and without GDL; 3) both. Controlled before-after and observational studies.</td>
<td>Primary outcomes: overall crash rates of teenage drivers; secondary outcomes: rates of injury crashes, hospitalizations, fatality crashes, night-time crashes, alcohol crashes, traffic violations and the amount of property damage.</td>
<td>Among 16-years old drivers, the median decrease in per population adjusted overall crash rates during the first year was 15.5%. There was a decrease in per population adjusted injury crash rates (median -21%). Results for all teenage drivers, rates per licensed driver, and rates adjusting for internal controls were generally reduced when comparing within jurisdictions.</td>
<td>Strong</td>
</tr>
<tr>
<td>Shope, 2007 2002-2006 (papers) Systematic review</td>
<td>27 USA, Canada</td>
<td>Studies containing post-GDL driving outcomes or impact data, which were primarily, but not exclusively, crash data. Pre-post comparison, times series, time series with comparison, trend analysis.</td>
<td>Crash rates, fatality crash rates and injury crash rates of teenage drivers.</td>
<td>Most studies in individual states reported reductions in crashes of between 19% and 39%. Reported reductions for 16-year-olds ranged from 5% to 73%. All of the nationwide studies reported that GDL was associated with at least some significant reductions in fatalities or crashes.</td>
<td>Present</td>
</tr>
<tr>
<td>Foss and Everson, 1998-1996 (papers) Systematic review</td>
<td>7 USA, New Zealand 1992-1996 (papers) Systematic review</td>
<td>Studies examining the effects of either 1) a comprehensive graduated driver licensing system or 2) nighttime driving restrictions/curfews. Ecological studies.</td>
<td>Motor vehicle crashes, crash-related injuries, hospitalizations, fatalities and traffic violations.</td>
<td>Two studies found a sustained 7%-8% reduction in teen driver crash injuries. Four studies of either a general curfew or a nighttime driving restriction for teens found substantial crash reductions during restricted hours, with 23%-25% lower crash injury and fatality rates for curfews beginning prior to midnight. One study found no change in late night crashes before and after a 1 am 6 am night driving restriction took effect.</td>
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E3P group evaluation
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<th>Review citation</th>
<th>N. of primary studies and location</th>
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<th>Outcome(s)</th>
<th>Results</th>
<th>Quality Assessment</th>
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<tr>
<td>Beyer and Ker 2009</td>
<td>17 USA, UK, Australia, Germany</td>
<td>Controlled before-after studies.</td>
<td>Primary outcomes: number of crashes, number of injury crashes and number of fatal crashes in the control and intervention group. Secondary outcomes: road traffic speed, perceived road user safety.</td>
<td>Three trials compared street lighting with an area control on total crashes; pooled rate ratio (RR) = 0.45. Two trials compared street lighting with an area control on total injury crashes (all severities); RR = 0.76. Eleven trials compared street lighting with a day-time control on total crashes; pooled RR = 0.68 (95% CI 0.57 to 0.82). Six trials compared street lighting with a day-time control on total injury crashes; pooled RR = 0.68 (95% CI 0.61 to 0.77). Four trials compared street lighting with a day-time control on fatal crashes; pooled RR = 0.34 (95% CI 0.17 to 0.68).</td>
<td>/ Strong /</td>
</tr>
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<td>Kwan and Mapstone, 2009</td>
<td>35 studies (42 trials) USA, UK, Australia, Netherlands, South Africa, Israel, Canada, Sweden, Finland</td>
<td>Randomised controlled trials.</td>
<td>Primary outcomes: pedestrian and cyclist-motor vehicle collisions and injuries (fatal and non fatal); secondary outcomes: drivers’ reaction times, recognition times, detection distances, recognition distances and frequency of successful object detection and recognition.</td>
<td>Trials assessing the effect of visibility aids on pedestrian and cyclist-motor vehicle collisions and injuries were not found. 42 trials reported the effect of visibility aids on drivers’ responses. Fluorescent materials in yellow, red and orange colours improve detection and recognition in the daytime. For night-time visibility, lamps, flashing lights and retroreflective materials in red and yellow colours increase detection and recognition. Retroreflective materials enhance recognition, in particular when arranged in a “biomotion” configuration, taking advantage of the motion from a pedestrian’s limbs.</td>
<td>/ Strong /</td>
</tr>
<tr>
<td>Kwan and Mapstone, 2004</td>
<td>29 (37 trials) USA, UK, Australia, Canada, Holland, Sweden, Finland</td>
<td>Randomised controlled trials and controlled before-after trials.</td>
<td>Pedestrian and cyclist deaths and injuries, observers’ reaction, detection and recognition times, detection and recognition distances, frequency of detection and recognition.</td>
<td>Pedestrian and observer’s detection and recognition improved with visibility aids. For daytime, fluorescent materials in yellow, red and orange colours enhanced detection and recognition. ‘Biomotion’ markings enhanced recognition. Increased intensity of roadway lighting can increase pedestrians’ visibility at night and reduce nighttime pedestrian crashes. Parking restrictions (removal of on-street parking, implementation of diagonal parking) and bus stop relocation can be effective. Crosswalk pavement markings’ effectiveness depends on setting.</td>
<td>/ Moderate /</td>
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<tr>
<td>Retting et al, 2003</td>
<td>7 Australia, Israel, USA</td>
<td>Before-after studies (with and without control) and cross-sectional studies.</td>
<td>Pedestrian-vehicle crashes and nighttime pedestrian vehicle crashes.</td>
<td>Drivers’ and observers’ detection and recognition improved with visibility aids. For daytime, fluorescent materials in yellow, red and orange colours enhanced detection and recognition. ‘Biomotion’ markings enhanced recognition. Increased intensity of roadway lighting can increase pedestrians’ visibility at night and reduce nighttime pedestrian crashes. Parking restrictions (removal of on-street parking, implementation of diagonal parking) and bus stop relocation can be effective. Crosswalk pavement markings’ effectiveness depends on setting.</td>
<td>/ Weak /</td>
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lighting may prevent road traffic crashes, injuries and fatalities. Moreover, street lighting has been suggested as a relative low-cost intervention with the potential to prevent traffic crashes, able to improve a driver’s visual capabilities and ability to detect roadway hazards. It’s also argued that it could have an adverse effect on road safety: drivers may feel safer because lighting gives them improved visibility which could result in increasing speed and reducing concentration.

Kwan and Mapstone in a Cochrane review (2009) (19) looked for studies which showed how effective visibility aids are protecting for pedestrians and cyclists. Main results show that fluorescent materials in yellow, red and orange colors improve detection and recognition in the daytime. For night-time visibility, lamps, flashing lights and retroreflective materials in red and yellow colors increase detection and recognition. Retroreflective materials enhance recognition, in particular when arranged in a ‘biomotion’ configuration, taking advantage of the motion from a pedestrian’s limbs. In conclusion, visibility aids have the potential to increase visibility and enable drivers to detect pedestrians and cyclists earlier and public acceptability of various effective strategies which improve visibility would merit further development.

In a previous review of Kwan and Mapstone (2004) (20) investigating the effects of visibility aids on the occurrence of pedestrian and cyclist-motor vehicle collisions and injuries, and driver’s responses in detection and recognition, the conclusions are similar to those illustrated in the Cochrane review in 2009: drivers’ and observers’ detection and recognition improved with visibility aids.

Retting and coll. (2003) (21) provided a review and assessment of engineering modifications to the built environment that can reduce the risk of pedestrian injuries, considering three categories of countermeasures: speed control, separation of pedestrians from vehicles and measures that increase the visibility and conspicuity of pedestrians. Regarding the improvement of visibility, from the studies included in the review it results that increased intensity of roadway lighting can increase pedestrians’ visibility at night and it is associated with significant reductions in nighttime pedestrian crashes. Other interventions examined in the review are bus stop relocation, diagonal parking and crosswalk markings. The results need to be considered with caution because of the weakness of the review.

Discussion and conclusions

The two kinds of considered interventions seem to be effective, but further examinations are needed to measure long-term effects. It is necessary to provide feasibility studies in local context to estimate the impact of laws or rules both to introduce GDL programs and to improve interventions to increase visibility of pedestrians and cyclists.

In particular, for introduction of GDL the examination of local context features and legislations is a primary step. In the reviews included in our study it is underlined how it is difficult to generalize the results of the introduction of GDL programs in different jurisdictions, where legislation for drivers, driving age or GDL program components are different. The introduction of GDL implies to choose a combination of components of GDL (22), that can differ from a context to another, as well as a new educational pathway for novice drivers provided by driving schools and an increased awareness and participation by parents (23). It could be useful to study the impact of introduction of GDL in European countries through a systematic review approach. In Italy, for novice drivers some restrictions are provided for by law regarding speed limits for the first three years and limitations of the vehicle
power for the first year of license; infractions are punished by penalty fees.

In regard of interventions to improve visibility in cyclists and pedestrians, public acceptability of strategies would depend on their ease of application, maintenance and cost.

Also compliance of targeted populations can be increased by particular measures, that can consist not only in the introduction of rules but also in incentives or educational interventions (24). Whether visibility aids will make a worthwhile difference needs careful economic evaluation alongside research effort to quantify their effect on pedestrian and cyclist safety (20).

Maybe the heterogeneity of interventions and rules undertaken in different countries to improve visibility is probably due to a not evidence-based policy. In Europe some countries, such as Germany and the Netherlands, have supplementary regulations regarding mandatory equipment to ensure cyclists’ visibility. Bicycles must have one white reflecting device visible from the front, orange pedal reflectors visible from the front and the rear, two wheel-mounted orange spoke reflectors on each wheel, arranged at an angle of 180° and visible from the side, or continuous white circular retro-reflector strips on the tyres or on the spokes of the front and rear wheels; one additional red large-surface reflector on the rear and mudguards to prevent mud from reducing the visibility of lights and reflectors (25).

When discussing on public health interventions there are two important aspects to consider. The first one is that it is often not difficult to find evidence of the effectiveness of an intervention, but it is difficult to understand which component or combinations of components composing the intervention are more effective than others. This is due to the complexity of public health interventions, which usually include actions on various aspects and disciplines (education, legislation, environment, infrastructures…).

The second aspect is the adaptation and the translation of the recommendations, coming from the evidence of effectiveness, in a context taking into account cultural background, social norms, geographical setting, involvement of all concerned sectors or actors, role of local leadership, infrastructures etc (26). For the introduction of GDL the first aspect must be considered, for the improvement of visibility the second aspect is more relevant.

We tried to adopt the standardized methodology used for systematic reviews to provide a review of reviews (27, 28), even if nowadays there are not specific rules in conducting this type of studies. Furthermore, in absence of specific inclusion or exclusion criteria for this kind of studies we decided not to exclude low quality systematic reviews, but on the other side to guarantee an objective evaluation of the effectiveness of interventions, narrative reviews - in which the opinion of the author could affect selections of papers and results - and grey literature were not considered.

Reviews and meta-analyses on GDL program introduction present peculiar features because of the primary studies considered. In fact, randomized controlled trials are not available and hardly feasible, especially regarding public health interventions, so to assess effectiveness must be taken into account controlled before-after studies or controlled interrupted time series or at least these kinds of studies without a control group. It could weaken the evidence of intervention effectiveness, although observational studies commonly have results that are similar to those of randomized controlled trials and in some instance may provide better evidence (29).

The strengths of this study consist in providing to policy makers a summary of evidence (30) on the effectiveness of the two interventions, though it does not provide also the way of implementing these, and to have used a standardized and reproducible method to find evidence.
In conclusion, it is necessary to monitor the evidence related to these interventions to assess long term impact of their improvement; further studies are required, also in Italy, to understand how to adapt recommendations on these kinds of interventions in different contexts.

References


