Evaluating Worksite-Based Interventions that Promote Safety Belt Use

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Objective: The objective of this study was to evaluate the effectiveness of worksite-based interventions in increasing the use of safety belts among employees.

Search Strategies: Using the Cochrane Collaboration search strategy, we searched in electronic databases, review articles, U.S. government documents, and reports of research agencies.

Selection Criteria: Studies had to be evaluations of worksite-based interventions with a clear description of the program. The outcomes evaluated were the percentage of drivers using their safety belts before and after the intervention and (when possible) after a follow-up period. Safety belt use had to be measured in an objective manner, and a comparison group was necessary.

Results: Forty-eight interventions met the selection criteria. All interventions increased safety belt use among employees, and in 16 the increases were significant ($p<0.05$). In 15 of the 33 interventions in which follow-up observations were reported, safety belt use continued significantly higher than at baseline. Different strategies (and combinations of strategies) were used across interventions. Interventions incorporating incentives seemed to have stronger effects in increasing safety belt use.

Conclusions: All reviewed interventions had a positive impact on increasing driver use of safety belts. However, it is important to note the low baseline safety belt use existing at the time when the studies took place, the short-term duration of most interventions, and the short-term follow-up reported (if any). More rigorous research in contemporary worksites is needed.

Medical Subject Headings (MeSH): accident prevention, injury prevention, review literature, seatbelts, workplace, intervention studies, wounds and injuries (Am J Prev Med 2000;18(4S):11–22)

The effectiveness of properly used safety belts in reducing mortality and morbidity in the event of a motor vehicle crash has long been established. Specifically, studies show that the risk of fatal injuries to drivers is reduced by 45% when protected by a shoulder and lap belt.[1]

Front-seat safety belts have been available in motor vehicles in the United States since 1968. However, seatbelt use among U.S. drivers was low throughout the 1970s. Roadside observational studies conducted during those years identified less than 10% of drivers using their lap shoulder belts[2]; crash reports from those same years indicate an even lower safety belt use rate of less than 5%.[3] Contrary to other countries, where primary laws mandating the use of safety belts by front-seat occupants were passed as early as 1970, U.S. officials debated whether to pass such laws and during this period chose to promote safety belt use using alternative means.[4]

Among the most promising strategies considered at that time was the implementation of worksite-based programs to increase safety belt use among employees. Motor vehicle crashes accounted for a large proportion of death and nonfatal injuries that occurred to workers. The National Highway Traffic Safety Administration (NHTSA) urged employers and researchers to find creative and effective ways to increase safety belt use rates through worksite-based programs.[5] An extensive literature documents the efforts to educate employers on the benefits of implementing such programs.[6–12] All programs used strategies aiming to educate employees, change attitudes and perceptions, or modify their behaviors regarding safety belt use both on the job and outside the job. Ideally, these programs would also increase the employees' families' safety belt use. Most programs were stand-alone interventions in which the sole focus was the use of safety belts among employees. However, a few programs integrated safety belt use with other health-related issues in general "health promotion/wellness" programs.[7,13,14]

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Despite these worksite-based programs and other efforts, safety belt use by the U.S. population in the late 1980s was only about 45%.[15] This, together with a change in attitudes regarding legislation of safety measures, prompted the mandate of safety belts. These laws, although more effective in increasing safety belt use in the U.S. population,[4] have not been as effective as anticipated. Safety belt use in the United States in 1996 was approximately 60%.[16] This still low safety belt use rate, together with the fact that motor vehicle crashes continue to be the leading cause of on-the-job deaths, injuries, and lost productivity to U.S. employers (with costs to them of $55 billion),[17,18] have renewed interest in worksite-based interventions that promote the use of safety belts.

Focusing on promoting safety belt use among workers is particularly important at this time. Worksite-based approaches could prove particularly effective given the higher base rate of safety belt use at present. The scientific literature regarding worksite-based programs has continued to grow during the last decade.[19–24] The U.S. Occupational Health and Safety Administration proposed mandatory safety belt use for more than 35 million workers who drive on the job.[25] More recently, NHTSA has again urged employers to implement programs to increase safety belt use among its employees.[26]

In light of the renewed relevance of the topic, this review was conducted to investigate which (if any) types of worksite-based interventions were effective in increasing occupant (specifically driver) use of safety belts.

Materials and Methods

Search Strategy for Identification of Studies

Beahler et al.[27] provide a more detailed description of the search strategies used. In particular, for this review we searched the following electronic databases from 1966 to the present: MEDLINE, EMBASE, ERIC, Sociofile, PsycINFO, the Expanded Academic Index, Occupational Safety and Health (NIOSHTIC), TRIS, and PAIS. Additionally, we searched reference lists of the identified documents as well as reviews and studies from the Cochrane International Register of randomized controlled trials, the Consumer Product Safety Commission, the National Safety Council, the National Highway Traffic Safety Administration, the National Transportation Safety Board, and the Insurance Institute for Highway Safety.

Inclusion Criteria

Studies had to evaluate the effectiveness of a clearly defined worksite-based intervention that promoted the use of safety belts either directly (i.e., the focus of the intervention was to increase safety belt use) or indirectly (i.e., the focus of the strategy was to increase safety and/or health behaviors in general). The intervention had to (1) take place in a defined population (i.e., all workers or a subset of them); (2) have a comparison group (e.g., the same drivers before the intervention or a different group of drivers); and (3) have an objective outcome (i.e., the proportion of drivers observed using a safety belt).

Types of Participants

Since the goal was to evaluate worksite-based interventions that promoted the use of safety belts among drivers, interventions had to target, at a minimum, employees who drove to and from work.

Types of Interventions

The review included worksite-based interventions that sought, directly or indirectly, to modify behavior among employees regarding safety belt use. The interventions had to aim to raise safety belt use at all times, not just during work. These could be single-strategy interventions (e.g., education only) or multi-strategy interventions (e.g., education plus incentives).

Outcome Measures

The primary outcome of interest for this review was the proportion of drivers observed using their safety belt (or, in some studies, the shoulder portion of their safety belt). At a minimum, all the included studies did such evaluation observing vehicles entering or exiting the workplace parking lots. Studies that used self-reported behaviors were not included.

Included Documents

Forty-eight interventions in thirty-five companies, summarized in twenty-five documents, met the inclusion criteria.[28–52] (Four additional documents[5,53–55] were not included because they duplicated information in already included documents.) Three reviewers abstracted the documents using standardized data collection forms. A pilot test of the abstracting process was implemented to clarify terms and to ensure consistent data collection among the three reviewers.

Statistical Analysis

Using the data presented in the reports, we computed the percentage differences between before (i.e., baseline) and after the intervention, the percentage differences between the longest follow-up data reported and the baseline, and the statistical significance of the different proportions (baseline vs. after intervention, baseline vs. follow-up). The statistical significance could be calculated only for those interventions where the researchers reported the number of observations on which they based the percentage of safety belt use. Statistical significance was defined at the $p<0.05$ level. Stata was used for the computations.[56] Meta-analysis was not done because most of the studies differed in the content of the intervention, the baseline safety belt use rates and follow-up time periods (if any).

Results

Eighteen of the twenty-five documents were published journal articles and the remaining seven were technical

reports. All but seven of the interventions[38,40,42,50,52] occurred during the 1980s and all but one[51] occurred in the United States. Table 1 presents the companies where the interventions occurred as well as the company location, intervention target population, type of intervention(s), and selected results and conclusions. Summarizing the content of all 48 interventions is quite complex given the different number of interventions provided at each location, the different strategies built within each intervention and the different degree of detail provided in the documents.

All but eight interventions used a combination of strategies. Among these eight single-strategy interventions, five consisted of education,[29,33,37,40,41] one of incentives,[32] one of information,[36] and one of a health appraisal questionnaire in which safety belt use was queried.[33] Among the multi-strategy interventions, incentives were the most frequently used co-strategy. There were several reports in which researchers evaluated the relative efficacy of different attributes of the incentives—for example, individual vs. group incentives, immediate vs. delayed, based on individual performance vs. based on group performance, or combinations of these three attributes.[28,30–32,34,35,37,39,41,43,48,52] Obtrusive observations (i.e., observers wearing bright-colored vests and clearly visible to drivers) and educational programs including lectures, discussions or "awareness sessions" were the next most common co-strategy. Obtrusive observations were reported in 23 interventions,[29–31,34,35,37,41,46,48,51,52] whereas educational presentations were reported in 22 interventions.[34,35,37,42,43,47,51,52] Other forms of education, whether in the form of reading materials (e.g., newsletters, pamphlets), displays (e.g., posters, banners), and reminders of the safety belt program were also frequently incorporated as co-strategies.[28–30,33–37,39–41,46,48,50,52] Involvement by the company's middle- and high-level management personnel[28,35–37,39,41,42,51] and feedback strategies regarding safety belt use rates[31,34,39,41,42,47,51] were also reported as co-strategies.

At the time when most of the interventions took place, state-level safety belt use laws were rare. Only ten interventions occurred in states with such laws.[31,33,36,38,43,51] In another seven interventions, the companies also had enacted policies to mandate the use of safety belts while driving on the company's premises, while driving the company's vehicles, and/or while driving during company-related business.[32,43,52]

Some interventions addressed other issues related to safety belt use, such as employees' attitudes regarding use of front-seat occupant safety belts. Some interventions also evaluated other safety-related behaviors (e.g., use of protective glasses) or health-related behaviors (e.g., exercise and diet). These other findings are beyond the scope of this review paper and are not discussed here.

Methodologic Quality of Studies

Only one of the reviewed studies (describing four interventions) was a randomized controlled trial.[41] Twenty-six interventions used a quasi-experimental design in which populations exposed to the intervention were compared to either one control population,[29,32,35–38,40,41,43,51] two control populations,[33] or three control populations.[47] In 12 of these quasi-experimental studies, the controls were (purposefully or inadvertently) exposed to some type of intervention.[32,35–38,41,43,47] The remaining 18 interventions were ecologic time series in which the same group of employees was observed before and after the intervention.[28,30,31,34,39,44–46,48,50,52]

In 25 of the 48 interventions, only a subset of workers participated in the intervention. Most commonly, the specific target groups were either blue-collar workers,[35,47,50] workers who parked in selected parking lots,[39,41,44,46] workers who drove through a particular gate into the parking lot,[48] workers who drove company-owned vehicles,[36] or workers who voluntarily attended awareness sessions.[37] The number of workers covered by the interventions varied among studies and was not reported in three interventions.[44,45] Twenty-two interventions were applied to groups of more than 1000 employees,[31–33,35,39,40,46–48,52] whereas 13 interventions targeted groups between 500 and 1000 employees,[28–30,34,36,41,51,52] nine interventions targeted between 100 and 500 employees,[37,38,43,52] and one intervention targeted 51 employees.[50] Although most evaluations reported that the interventions covered blue- and white-collar workers (and sometimes even provided the number and safety belt usage for each subgroup[30,33,35,37,46,47,50,52]), no data are provided regarding their socioeconomic status and there is little information on gender or age distribution.

The interventions also differed in their duration. Without considering the time until follow-up observations (if any), all but four interventions[34,38,40,52] lasted less than 6 months (with some lasting as little as 5 days[47]). Among the four interventions that lasted more than 6 months, only one lasted more than 1 year.[52]

In the evaluation of all 48 interventions, single or multiple observers or cameras (hidden or clearly visible to drivers) recorded data on all or a random sample of drivers driving into or out of the workplace. Only one evaluation included roadside observations.[36] Although the number and representativeness of the locations chosen for observation varied across studies, each study used the same locations, days of the week, and times of the day for the baseline and post-intervention observations to guarantee consistency across measurements. Observers in different locations recorded at least the drivers' use of the shoulder portion of the safety belt. Observations were typically recorded over several days before the intervention took place, several times while the intervention was occurring, immediately after the

Table 1. Selected characteristics of included studies

References	Intervention setting(s)[c]	Study design[a] and background[b]	Intervention(s)	Results (as reported)	Comments
Phillips (1980)[40]	Formica Corp. and Allied Chemical Corp. CT, OH, CA, SC, VA	Quasi-experimental	Education	SB use did not increase in either of the two sites where the intervention was implemented when compared to baseline or control sites	Educational materials from NHTSA were used in the intervention
Geller (1982)[52]	E.I. Du Pont (Berg Elec.), PA Laughlin Air Force Base, TX Blue Cross Blue Shield, NC Exxon Co., CA Teletype Corp., AK Society of Automotive Engineers, PA Arkansas Electric Coop., AK	Pre-post	Int a: education (information) Int b: information + policy enforcement + incentives Int c: education + obtrusive observations + immediate and delayed individual rewards Int d: education + obtrusive observation + immediate individual rewards Int e: education + immediate individual rewards Int f: education Int g: individual immediate rewards	All interventions increased SB use even after termination	Interventions a, b and d took place in companies with policies requiring SB use among employees Document provides little information on the actual content of programs
Geller et al. (1982)[44] Geller et al. (1987)[49]	Virginia Polytechnic Institute and State Univ. Blacksburg, VA	Pre-post	Int 1: Information + delayed individual prize regardless of SB use Int 2: Information + delayed individual reward based on SB use	Only the intervention where rewards were given based on actual SB use increased SB compared to baseline	Long term follow-up was done in a different study[49]
Geller et al. (1983)[30] Geller et al. (1987)[49]	Federal Mogul Blacksburg, VA	Pre-post	Obtrusive observations + reminders + individual immediate rewards	SB increased among all workers, but even more so among salary workers than among hourly workers when compared to baseline	None
Geller (1983)[48]	Radford Ammunition Plant Radford, VA	Quasi-experimental (10%) [Workers driving through one gate only]	Education and direct individual rewards	SB increased in the morning and afternoons while the intervention was in place, and decreased a few weeks after program was ended	The main goal of research was to test response generalizability and maintenance (i.e., the intervention will increase SB use both during the afternoon when rewards are given, and in the morning when they are not

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References	Intervention setting(s)[c]	Study design[a] and background[b]	Intervention(s)	Results (as reported)	Comments
Geller et al. (1983)[47] Geller et al. (1987)[49]	Hubbell Lighting Christiansburg, VA	Quasi-experimental (three controls) (10%) [BC workers only]	Awareness participatory session + obtrusive observations + feedback + individual delayed rewards based on group performance	Involving workers by using participatory sessions increased SB use significantly among them as well as control white-collar workers in same setting compared to baseline and two other controls	The objective was to evaluate whether awareness participatory session (on top of all other strategies) increases SB use even more Three control groups received all strategies but the awareness session This was the last of several experiments[30,48]
Horne and Terry (1983)[39] Geller (1982)[52]	General Motors Technical Ctr. Warren, MI	Pre-post	Managerial cooperation + pledge cards available + delayed individual rewards based on group performance and feedback regarding SB use	The intervention (which was repeated over several years) increased SB use significantly (each time) SB use remained higher after long time	None
Geller (1984)[46]	Radford Ammunition Plant Radford, VA	Quasi-experimental	Delayed individual rewards and obtrusive observations	Rewards increased SB use even after they were interrupted	Obtrusive observations occurred in baseline and follow-up too A previous intervention had occurred in other parking lot gate of same site[48]
Rudd and Geller (1985)[45] Geller et al. (1987)[49]	Virginia Polytechnic Institute and State Univ. Blacksburg, VA	Pre-post	Three waves of information + delayed individual rewards	SB use increased among all subgroups when compared to baseline	This intervention occurred 2 years after two others[44] Long-term follow-up was done in a different study[49]
Cope et al. (1986)[35]	Burroughs Wellcome Co Greenville, NC	Quasi-experimental [BC workers only]	Int 1: education + lecture + pledge card + incentive Int 2: education + lecture + pledge card + no incentive Int 3: education + lecture + no pledge card + incentive Int 4: education + lecture + no pledge card + no incentive Int 5: education + discussion + pledge card + incentive Int 6: education + discussion + pledge card + no incentive Int 7: education + discussion + pledge card + no incentive Int 8: education + discussion + no pledge card + no incentive	All intervention groups showed an increase in SB use when compared to baseline even after a 5-month follow-up Controls (which received nothing) also increased SB Discussion session participants increased SB use even more than lecture participants Pledge cards, incentives, or their absence did not produce different increases	Goal of study was to evaluate relative effectiveness of lecture vs. discussion, pledge cards vs. no pledge cards, and incentives (delayed individual rewards) vs. no incentives Workers were arbitrarily selected to participate in any intervention There seemed to be generalization of program to controls

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References	Intervention setting(s)[c]	Study design[a] and background[b]	Intervention(s)	Results (as reported)	Comments
Cope and Smith (1986)[31]	Burroughs and Wellcome Co. Greenville, NC	Pre-post SB law (32%)	Individual delayed cash rewards and feedback information	SB increased after the intervention and remained significantly higher than at baseline levels 30 weeks after end of program	A few months earlier, a series of interventions occurred in same company[35]
Weinstein et al. (1986)[29]	Johnson & Johnson New Brunswick, NJ	Quasi-experimental	Education (stickers, posters, signs)	SB increased significantly even six months after the end of the intervention when compared to control	None
Simons-Morton et al. (1987)[41]	U. Texas Medical Branch Galveston, TX	Random control trial (13%)	Int 1: education (letters and displays) Int 2: int 1 + obtrusive observations Int 3: int 2 + direct individual rewards Int 4: int 3 + delayed individual rewards and reminders	Ints 1 and 2 did not increase SB use whereas Ints. 3 and 4 did	Authors report that intervention 3 was more cost effective than intervention 4
Eddy et al. (1988)[28]	CIGNA Wilmington, DE	Pre-post SB law	Managerial support, reminders, individual immediate rewards	SB increased after intervention compared to baseline	None
Kello et al. (1988)[37]	Reeves Bros. Curon Cornelius, NC	Quasi-experimental (14%) [Workers selected to attend sessions only]	Int 1: education Int 2: education + pledge card committing for 1 week Int 3: int 1 + pledge card committing for 1 month Int 4: int 1 + pledge card committing for 3 months	All interventions led to increases in SB use compared to baseline The increases in SB use were not different among the three interventions with pledge cards and the interventions without	The goal of the paper was to evaluate the relative effectiveness of alternative committing times when signing pledge cards
McKnight et al. (1988)[43]	Maryland Police MD	Quasi-experimental SB law (13%)	Int 1: education (information only) + education (discussion) + installation in vehicles of a system to proof of SB use during a crash (Implemented in three phases) Int 2: like Int 1 but in different order: information + device + discussion	After all strategies were done, SB use increased when compared to both baseline and control (civilian vehicles were the controls)	Goal was to increase SB use in police vehicles There was a policy in place that required drivers to use SB while operating a police vehicle
Nimmer and Gellar (1988)[34] Geller et al. (1987)[49]	Radford Community Hospital Radford, VA	Pre-post	Voluntary educational sessions, pledge cards, delayed individual rewards based on pledge card signing and SB use, obtrusive observations	SB use increased among all workers and remained higher than baseline even after 4-month follow-up The increase was higher among pledge card signers	None
Rogers et al. (1988)[36]	Florida State Dept. Tallahassee, FL	Quasi-experimental SB law [Drivers of government vehicles only]	Int 1: stickers on dashboards of official vehicles reminding of policy Int 2: Int 1 + signature of memo that summarized policy	SB use increased with both interventions	Mandatory SB policy for state employees in place Controls were drivers in privately owned vehicles

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Table 1. Selected characteristics of included studies

References	Intervention setting(s)[c]	Study design[a] and background[b]	Intervention(s)	Results (as reported)	Comments
Kalsher et al. (1989)[32]	Norfolk Naval Base and Little Creek Naval Amphibious Norfolk, VA	Pre-post	Int 1: delayed individual rewards Int 2: disincentives (warning tickets)	Both interventions increased SB use while entering/exiting or driving in the bases even after termination when compared to baseline	Interventions with disincentives increased even more SB when vehicles entered the gate guarded by Marines
Dunton et al. (1990)[33]	Anonymous (six) PA, IL	Quasi-experimental (two controls) SB law in one of two states	Int 1: Health Risk Appraisal questionnaire Int 2: Int 1 + education	Both interventions increased SB use over baseline and the control even after the interventions were ended The educational strategy did not produce a higher increase	The effects did not change between the state with a SB law and the one without
Grant (1990)[51]	Transport Canada Training Institute Cornwall, Ontario, Canada	Quasi-experimental SB law (65%)	Education (sessions and displays) + obtrusive observations + feedback on SB use and managerial support	SB increased significantly after intervention compared to baseline and control	None
Ludwig and Geller (1991)[38]	2 pizza stores Blacksburg and Christiansburg, VA	Quasi-experimental SB law (55%) [BS workers only]	Education, managerial cooperation + pledge cards + delayed individual rewards and feedback information	SB use increased from baseline in intervention groups even after program termination whereas it did not in control group	Younger drivers increased their SB use more than older drivers did
Streff et al. (1993)[50]	Anonymous Blacksburg, VA	Pre-post	BC workers were given educational sessions and the possibility of signing pledge cards (which they all did)	SB increased significantly after intervention but returned to baseline levels after 2 months	Goal of intervention was to increase safety glasses use and to explore whether other safety behaviors (e.g., increase in SB) were spontaneously adopted
Ludwig and Geller (1997)[42]	3 pizza stores Blacksburg and Christiansburg, VA	Quasi-experimental	Managerial cooperation, workers involvement in goal setting and feedback information	SB increased after intervention	Intervention aimed at improving driving while at work Increase in SB was a consequence of a generalization of safe behaviors (maybe related to previously summarized study[38])

[a]In all pre-post studies, baseline data before the intervention served as the control. All quasi-experimental studies had one control group (unless otherwise noted).
[b]No mandatory safety belt laws in place unless otherwise noted (percent safety belt use in the general population in parentheses if provided). All workers in the company were intervened upon unless otherwise noted in brackets.
[c]Controls (if any) may have been placed in another plant of the same company or in another company. Only the names of the locations where the interventions took place are listed here. All studies in the United States unless otherwise noted.
BC, blue-collar workers; NHTSA, National Highway Traffic Safety Administration; SB, safety belt; WC, white-collar workers.

intervention concluded and, in some cases, some time afterwards (i.e., follow-up). The percentage of safety belt use among employees at baseline and at the end of the intervention was reported for all interventions. In 15 interventions, safety belt use was reported also for some subgroups of workers (e.g., blue- and white-collar workers).[30,32,33,35,37,47,48,52] However, not all the documents indicated the number of observations recorded during the study; in fact, this information was available only in 22 interventions.[28,33–35,38,40,43–45,48] In the interventions for which this was available, the number of observations ranged from 73[33] to 33,173.[32] In three interventions, the researchers excluded from the evaluation vehicles with no safety belts.[37,47,48]

Follow-up data were reported for 33 interventions. The follow-up time varied between studies and ranged from 2[30] to 39 weeks.[32] In some cases, special data collection was conducted several years after the end of the intervention.[49,52]

In the original evaluations, the proportions of safety belt use at baseline, end of the intervention, or follow-up were either simply reported,[30,36–39,45,46,52] or compared using statistical tests such as chi square, least squares regressions,[29,33,51] analysis of variance (ANOVA),[32,34,35,42,50] or other methods.[28,31,40,41,43,44,47,48]

Effectiveness of Interventions

Table 2 displays the proportions of safety belt use at baseline, end of the intervention, and at follow-up; the statistical significance of the changes; and the effectiveness of the interventions (defined as the percentage change in the proportion of safety belt use) at two different times.

Among the workers in whom an intervention was implemented, safety belt use at baseline ranged from a low of 5.6%[40] to a high of 71.8%,[45] although in most interventions, baseline rates were in the 10% to 20% range. Safety belt use at the end of the intervention rose in all interventions. The rates after the interventions ranged from 8.3%[40] to 90%.[52] The magnitudes of these increases varied substantially across interventions. For 31 interventions, the increase in use exceeded 100%[30,34–39,41,43,46–48,50,52]; for six interventions, the increases ranged between 50% and 99%[28,31,33,45,52]; and for the remaining 11 interventions, there was less than a 50% increase in use.[29,32,33,40–42,44,51] The increase in safety belt use achieved statistical significance in 19 of the 22 interventions for which it could be evaluated.[28,30,32–35,38,40,43–45,47,48,50,51] Safety belt use also increased in 10 of the 16 control groups. However, only in 5 of these 10 controls did the changes achieve statistical significance.[35,47,48]

Among the 33 interventions for which there were follow-up data, 11 continued to demonstrate increases in the proportion of safety belt usage beyond those reported at the end of the intervention.[29,32,33,38,42,45,52] Even among the 22 interventions for which safety belt use at follow-up decreased when compared to safety belt use at the end of the intervention, use was still higher than at baseline for all but three of them.[30,44,50] The magnitude of changes in safety belt use after follow-up compared to baseline varied across interventions. For 12 interventions, the increases were higher than 100%[33,35,37,38,47,48,52]; in seven interventions, the increases ranged between 50% and 99%[37,39,46,52]; and for ten interventions, the increase was below 50%.[28,29,31–34,40,42,44,51] Among the ten interventions for which there was at least one control group at follow-up, safety belt use compared to baseline rates increased for three,[35,47,48] although only in two the increases were statistically significant.

Conclusions

Despite the demonstrated effectiveness of safety belts, increasing the proportion of safety belt users in the population has proven difficult. Worksite-based programs aiming to promote safety belt use among employees, widely implemented in the 1980s, seem to have had a positive impact on increasing safety belt usage of employees. All the interventions examined in this review increased safety belt use, at least during the period of time the intervention was occurring. The impact of these interventions differed according to the subgroup of workers exposed to them. Younger, female, and white-collar workers increased their safety belt use to higher rates than older, male, and blue-collar workers. However, since the former groups tended to have higher baseline rates, the percentage increase due to the intervention was lower among these workers than among older, male, and blue-collar workers.

This positive effect of worksite-based programs has been documented in two reviews by Johnston et al.[57] and Eddy et al.[58] However, neither review provided an in-depth description of the content of the interventions or the evaluations reported in the original reports. Moreover, neither of these reviews quantified the magnitude of the increases in safety belt nor did they evaluate their statistical significance. Eddy et al.'s[58] review of 14 studies (all of which are included in our review), focused mostly on the methods used in each of the studies. The review by Johnston et al.[57] of 43 articles (only 15 of which are worksite-base programs and all of these are included in our review) focused on the impact of length of intervention and the number of strategies within each intervention.

Despite the fact that all the reviewed interventions seem to increase safety belt use, it remains difficult to evaluate which interventions work best. In this review, multiple-strategy interventions appear to lead to greater and longer-lasting changes in safety belt use. It is difficult to know, however, which had the largest

Table 2 Summary of outcomes: percent drivers wearing safety belts (number of observations, if available, in parentheses)

Intervention setting(s) and reference(s)	Subgroups	Before intervention (baseline) A	After intervention B	Percent change (B−A/A) × 100	Follow-up C	Percent change (C−A/A) × 100
Formica Corp. and	Intervention	5.6 (1307)	8.3[a] (1332)	48.2	7.4[a] (1436)	32.1
Allied Chemical Corp.[40]	Control	5.8 (495)	6.3 (727)	8.6	7.1 (632)	22.4
E.I. Du Pont (Berg Elec.)	Int a	44.0	90.0	104.5	—	—
Laughlin Air Force Base	Int b	49.0	87.1	77.8	92.0	87.8
Blue Cross Blue Shield	Int c	10.0	54.0	440.0	25.0	150.0
Exxon Co.	Int d	23.0	49.0	113.0	39.6	72.0
Teletype Corp.	Int e (BC)	6.0	20.0	233.3	38.0	533.3
	(WC)	19.0	36.0	89.5	51.0	320.0
Soc. of Automotive Eng.	Int f	19.9	52.0	161.3	—	—
Arkansas Electric Coop.[52]	Int g	6.8	19.0	179.4	—	—
	(No controls)					
Virginia Polytechnic Institute and State Univ.[44,49]	Int 1 (prize)	22.2 (785)	24.1 (932)	8.6	21.8 (463)	−1.8
	Int 2 (reward)	26.3 (728)	45.7[a] (1122)	73.8	37.9[a] (836)	44.1
	(No controls)					
Federal Mogul[30,49)]	Intervention (BC)	4.7 (2198)	9.0[a] (3369)	91.0	—	—
	(WC)	18.6 (390)	50.6[a] (1708)	172.0	—	—
	(all)	9.0 (2588)	26.0[a] (5077)	188.9	7.0[a] 1882)	−22.0
	(No Control)					
Radford Ammunition Plant[48]	Intervention (afternoon)	12.9 (381)	41.7[a] (992)	223.0	26.1[a] (1221)	102.3
	Control (morning)	16.8 (412)	31.2[a] (1072)	85.0	25.1[a] (1320)	49.4
Hubbell Lighting[47,49]	Intervention (BC)	6.7 (981)	41.7[a] (3341)	522.4	26.8[a] (2921)	300.0
	Control 1 (WC)	15.5 (717)	35.9[a] (3677)	131.6	27.4[a] (1853)	77.0
	Control 2 (BC)[b]	6.0 (6247)	13.4[a] (3016)	123.3	7.9[a] (3019)	32.0
	Control 3 (WC)b	17.7 (1338)	31.6[a] (677)	78.5	25.8[a] (731)	46.0
General Motors Technical Ctr.[39,52]	Intervention	36.0	72.0	100.0	60.0	66.7
	(No Control)					
Radford Ammunition Plant[46]	Intervention (gate 1)	6.7	23.1	244.8	11.0	64.2
	Control (gate 2)	20.0	25.2	26.0	16.7	−16.5
Virginia Polytechnic Institute and State Univ.[45,49]	Intervention					
	(faculty and staff)	19.3 (3284)	31.7[a] (1230)	64.2	—	—
	(students)	15.4 (4159)	20.1[a] (1112)	30.5	—	—
	(non campus)	15.6 (3750)	21.9[a] (1841)	40.4	—	—
	(police)	71.8 (196)	72.7 (22)	1.4	—	—
	(all)	16.6 (11,389)	24.3[a] (4205)	46.4	49.0	195.2
Burroughs Wellcome Co.[35]	Int 1 (E+E1+P+I)	—	—	—	—	—
	Int 2 (E+E1+P)	—	—	—	—	—
	Int 3 (E+E1+I)	—	—	—	—	—
	Int 4 (E+E1)	—	—	—	—	—
	Int 5 (E+Ed+P+I)	—	—	—	—	—
	Int 6 (E+Ed+P)	—	—	—	—	—
	Int 7 (E+Ed+I)	—	—	—	—	—
	Int 8 (E+Ed)	—	—	—	—	—
	(all interventions)	11.1 (896)	43.9[a] (822)	295.5	27.7[a] (439)	149.5
	Control	11.4 (2267)	32.4[a] (1774)	184.2	30.5[a] (2882)	167.5
Burroughs Wellcome Co.[31]	Intervention	32.0	52.8	65.0	38.0	18.8
	(No control)					
Johnson & Johnson[29]	Intervention	32.2	38.4	19.3	45.2	40.4
	Control[a]	18.6	18.2	−2.2	21.7	16.7
U. Texas Medical Branch[41]	Int 1 (E)	28.5	31.4	10.2	—	—
	Int 2 (E+O)	35.1	37.8	7.7	—	—
	Int 3 (E+O+iI)	18.3	38.4	110.0	—	—
	Int 4 (E+O+dI)	16.9	44.8	165.0	—	—
	Control	13.0	13.9	6.9	—	—
CIGNA[28]	Intervention	26.7 (352)	44.9[a] (731)	68.2	39.7[a] (633)	48.6
	(No control)					

(continued on next page)

Table 2 Summary of outcomes: percent drivers wearing safety belts (number of observations, if available, in parentheses)

Intervention setting(s) and reference(s)	Subgroups	Before intervention (baseline) A	After intervention B	Percent change (B−A/A) × 100	Follow-up C	Percent change (C−A/A) × 100
Reeves Bros. Curon[37]	Int 1 (E)	~17.5	~67.0	282.9	~60.0	242.9
	Int 2 (E+P_{1w})	16.6	67.5	367.0	58.9	255.0
	Int 3 (E+P_{1m})	26.9	67.1	149.0	59.0	119.0
	Int 4 (E+P_{3m})	31.9	69.4	118.0	57.7	80.9
Maryland Police[43]	Int 1 (E1+Ed+M)	—	—	—	—	—
	Int 2 (E1+M+Ed)	—	—	—	—	—
	(all)	20.7 (212)	42.3[a] (300)	104.4	—	—
	Control	13.4 (240)	10.4 (110)	−22.4	—	—
Radford Community Hospital[34,49]	Intervention (No control)	15.6 (929)	34.7[a] (11,289)	122.0	28.1[a] (1263)	44.0
Florida State Dept.[36]	Int 1 (E)	9.7	38.0	291.8	—	—
	Int 2 (E+memo)[c]	10.1	52.2	415.8	—	—
	Control	11.6	15.8	36.2	—	—
Norfolk Naval Base and Little Creek Naval Amphibious[32]	Int 1 (incentives)	51.3 (33,173)	61.3[a] (28,517)	19.0	64.0[a] (20,220)	24.8
	Int 2 (disincentives)	54.9 (17,221)	79.3[a] (18,305)	44.0	76.9[a] (4415)	40.1
	(No control)					
Anonymous[33]	Int 1 (HRA) w/law[d]	36.4 (129)	—	—	—	—
	w/o law	15.1 (73)	29.6[a] (81)	96.0	30.4[a] (92)	101.3
	Int 2 (HRA+E) w/law	17.2 (198)	24.8 (141)	44.2	34.7[a] (124)	101.7
	w/o law	9.5 (294)	12.6 (366)	32.6	14.3 (385)	50.5
	Control 1 w/law	19.9 (181)	11.8 (119)	−40.7	27.2 (114)	36.7
	Control 2 w/o law	8.8 (331)	13.7 (255)	55.7	7.9 (280)	−10.2
Transport Canada Training Institute[51]	Intervention[c]	65.5 (290)	78.9[a] (6075)	20.5	72.4[a] (675)	10.5
	Control[c]	~47.7 (83)	~47.7 (3038)	0.0	~47.7 (203)	0.0
2 pizza stores[38]	Intervention (BI)	41.0 (1,842)	68.0[a] (1437)	65.8	69.0[a] (1235)	68.3
	(C)	14.0 (1290)	69.0[a] (150)	392.9	41.0[a] (299)	192.9
	Control	45.0 (1,656)	~45.0	0.0	~45.0	0
Anonymous[50]	Intervention (No control)	12.8 (654)	35.1[a] (166)	174.2	12.7 (205)	−0.8
3 pizza stores[42]	Intervention	75.4	84.9	12.6	88.9	17.9
	Control	38.6	31.0	−19.7	35.8	−7.3

[a] $p<0.05$.
[b] These are workers from Federal Mogul, Blacksburg, VA.
[c] Numbers shown are the average of the two series of observations for the same type of intervention.
[d] Because of the high baseline safety belt use, this group was dropped from any further analysis.
[e] Numbers for driver and front-right passengers are aggregated.
BC, blue-collar workers; E, education (Ed, discussion, El, lecture); HRA, health risk appraisal questionnaire; I, incentives (iI, immediate incentives, dI, delayed incentives); M, monitoring; O, obtrusive observation; P, pledge card; WC, white-collar workers.

impact since only four studies performed incremental analysis of the effect of multiple strategies.[33,36,37,41] It is also difficult to know whether the order in which strategies are implemented makes any difference (although the only study which evaluated this concept reported no order effect[43]). The effect of particular strategies is also difficult to elucidate. For example, the impact of education is conflicting across interventions. Two studies showed no effect on safety belt use rates among workers exposed to educational campaigns,[33,40] whereas educational efforts which adopt a more participative approach (with discussion and participation of the workers) seem to have the opposite effect.[35,47] Pledge cards, which in one intervention seemed to have had an impact,[34] did not have any effect in two other interventions.[35,37] Incentives, widely used in most interventions and with positive effects on safety belt use, had no effect in another study.[35] Disincentives (i.e., penalties for not wearing safety belts) were proven to be superior to incentives in the one study that compared these two strategies.[32] The long-term impact of these programs and the generalizability of the behaviors learned while the interventions were in place were not properly assessed by most of the studies.

There are limitations both to these studies and to their generalizabilty today. Only one of these studies had the methodologic rigor of a randomized controlled trial. Most importantly, all were conducted at a time when the baseline safety belt usage rates were dramatically lower than today. The same interventions may be less effective among the smaller proportion of workers who persist in not wearing seat belts. There is a need for contemporary research using rigorous designs such as randomized controlled trials to compare differ-

ent types of interventions in contemporary worksites. These studies could be used to identify the most effective intervention strategies and to increase seat belt use, as well as demonstrating that it is possible to increase use among worksite populations today.

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