

# Body-worn video: A systematic review of literature

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## Abstract

Law enforcement use of video-based technology has substantially increased over the past decade. This systematic review examines the current evidence base for efficacy of body-worn video and the current case for implementation. Five articles were identified as pertinent to this review from a search of five electronic databases, with a further six articles of grey literature included. Inter-rater reliability was high amongst three independent screeners of literature. Articles were short listed for review if they explicitly identified police and recording devices as topic areas. Articles were then excluded if they did not involve an operational trial of body-worn video. Eleven articles were included for review; of the five peer-reviewed studies, two were randomised controlled trials. An abundance of evidence was provided; however, the majority of articles were methodologically weak. Body-worn video was shown to reduce use of force incidents, crime rates for certain crime types and court costs. Public response to body-worn video was varied, as was police officer and public opinion. Due to methodological limitations evident in most studies and the general lack of peer-reviewed material, further research is required; however, there are some considerable benefits reported in the current literature.

## Keywords

Body-worn camera, body-worn video, misconduct, oversight, policing, review, technology

## Background

Implementation and use of body-worn video (BWV) have grown considerably in the past decade. Building on the closed-circuit television (CCTV) environment, the panopticon posited by Foucault (1979) has become an increasing reality. Uptake amongst Western law enforcement agencies has been particularly comprehensive, with the majority of UK agencies currently featuring BWV (Rieken, 2013). Police departments in the United States are similarly moving quickly to equip officers with this technology (Miller, Toliver, & Police Executive Research Forum, 2014). Australian agencies have chosen to delay implementation; however, with trials of BWV, interest in the technology

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is high. Most Australian jurisdictions have previously trialled or are intending to perform a trial (Australian Broadcasting Corporation, 2016; Northern Territory Police Force, 2015; Queensland Government, 2015).

BWV has been noted as a solution to lost time in 'red tape' such as report writing in the United Kingdom (Sherman, 2013). Accountability is featured as a positive commonly put forth by exponents of the technology. This is a noted outcome of recording interactions with offenders, and also the commonly used GPS-enabled BWV technology (Wain & Ariel, 2014). The potential for increased accountability and enhanced evidentiary capability has garnered considerable media attention, despite use of BWV in court only being a recent occurrence (Church v Commissioner of Police, 2015). The balance of benefit and potential ethical and privacy issues has resulted in recommendations to significantly limit scope of captured data initially, until the benefit is considered to justify expansion of captured data (Mok, Cornish, & Tarr, 2015).

Theoretically, BWV has been discussed as a positive in several contexts. Head-mounted cameras are considered to have significant benefits in various industries requiring such equipment use, such as snow and motor sports (Brown, Dilley, & Marshall, 2008). Benefits have been noted in social research as a means of collecting continuous, audio-visual data through interpersonal interaction (Brown et al., 2008). The use of a 'visual memory prosthesis' is also noted as a benefit in supporting memory of key events (Hoisko, 2003). This factor translates strongly to law enforcement, which given the noted effect that witnessing a traumatic event may have on memory retention (Lacy & Stark, 2013), review of stimulus provided by BWV may be beneficial.

The use of cameras as a means of aiding investigations is not a recent addition to policing; however, their use as an effective behavioural change mechanism has not conclusively been established. A meta-analysis of CCTV installations performed by Welsh and Farrington (2002) found incongruent results. While it was found that CCTV had an overall desirable impact on crime, the reductions were not significant. Despite no effect being found on violent crimes, a significant effect was shown regarding vehicle crime (Welsh & Farrington, 2002). A small impact upon crime rates is attributable to CCTV implementation; however, it may be argued that this is a poor measure for effectiveness (Gill & Spriggs, 2005). It is conversely clear that CCTV interventions are effective as a deterrence to theft in a retail setting (Hayes & Downs, 2011); however, environmental factors and CCTV line of sight are also salient in crime prevention and behavioural change amongst offenders (Piza, Caplan, & Kennedy, 2014). There are a number of factors addressed by BWV that CCTV does not, such as line of sight, environmental factors and clarity of evidence gathering. Despite this, neither technology can be conclusively found to be effective in behavioural change or crime reduction.

Despite the eagerness of law enforcement agencies to embrace BWV, there are concerns surrounding available evidence for its efficacy. Given the nature of BWV, it may reasonably be expected to have a measurable impact upon behaviour of both the community and officers themselves. In this way, efficacy may be measured through a number of different factors. Primarily a reduction in complaints against police officers, particularly use of force complaints (Adams et al., 1999; Taylor, Alpert, Kubu, Woods, & Dunham, 2011), an increase in early guilty pleas (ODS Consulting, 2011), reductions in assaults on police (Ellis, Jenkins, & Smith, 2015) and an increased perception of police accountability (Katz, Choate, Ready, & Nuno, 2014) are reasonable measures of success.

Measures such as these are often considered regarding CCTV (Goold, 2003); however, with the salience of BWV, a larger effect is expected. While some measures may be difficult to operationalise, literature around use of force (Adams et al., 1999), for example, allows for an event to be deconstructed and measured with considerable reliability.

When evaluating the implementation of BWV in agencies thus far, the scarcity of evidence is problematic (Mateescu, Rosenblat, & Boyd, 2015; Roy, 2014; White, 2014). The paucity of current peer-reviewed material indicates a requirement for further research in the area. While implementation in many places has already begun, research is quickly catching up. Informed decision making as to the benefit of BWV is of great importance. Studies concerning new technology and policies utilised by law enforcement agencies are often reviewed by internal evaluations. As a result, it is unusual for these evaluations to be subjected to peer review or to be featured publicly. The intention of this review is to collate this grey literature and compare outcomes of such evaluations with peer-reviewed material as a means of contributing to the growing field of knowledge on BWV.

## **Methods**

### *Data sources*

A literature search was conducted between July and August 2015. The following databases were utilised in this literature search: EBSCO host search of International Security & Counter Terrorism Reference Centre database, Psychology and Behavioral Science Collection, Criminal Justice Abstracts with Full Text and SocINDEX with Full Text. Reference lists formed part of the search, along with available grey literature, Google and Google Scholar were also utilised. A timeframe of 1990–2015 was searched. Due to the recent introduction of BWV, relevant articles were not likely to be available prior to this time period.

Search terms and keywords in searches of all stated databases included: body-worn camera; body-worn video; BWV; BWC; BWVC; body-worn cameras on police; body-worn cameras for law enforcement; body-worn cameras and police use of force; body-worn video devices; body cameras; wearable video devices in police work; wearable video devices; and wearable camera.

### *Study selection*

Several criteria were implemented in study selection, and the threshold for inclusion was kept reasonably low. This threshold was designed to capture as much peer-reviewed material as possible for review. Selection was performed via standardised unblinded assessment by three reviewers. Inter-rater reliability was high; however, protocol was in place for consensus inclusion in the event of disagreement. Studies were selected through database search, and initial identification of relevance through abstract review. Abstracts were excluded in the event that they failed to explicitly identify police and recording devices as topic areas. Remaining articles were short listed for full text review.

Studies retained for full text analysis were reviewed based on whether an operational trial of BWV was conducted. Selected studies included: randomised controlled trials (RCTs), evaluations of trials, effects of BWV on the wider community, analysis

of crime rates throughout BWV trial periods, implications of BWV use and costing regarding BWV effects on the criminal justice system. Basic data analysis was required for inclusion. As a result of these search criteria, grey literature featured heavily.

### *Literature appraisal*

There is a considerable paucity of peer-reviewed articles regarding BWV. This is largely due to recent implementation of the technology. The literature that has been included is therefore representative of the currently available literature. The dearth of literature does not allow for meta-analysis to be undertaken, this is largely due to including few if any studies using comparable methodologies and measures. Studies which included comparative measures are featured in Table 1. Growth of research in this area is expected, particularly throughout the Australasian region, with several BWV programs being scheduled for late 2015, and early 2016.

### **Results**

Of the 91 records screened, 36 were retained for full text review and 11 were retained in the final analysis (Figure 1). All 11 articles evaluated trials of BWV, five peer-reviewed studies involved trials of BWV, two included RCTs and the remaining three primarily considered officer perception of BWV. Six articles of grey literature met the search criteria and were also included for analysis. These articles comprised evaluations and trials performed by police departments, or subsidiary services. Overall, the level and quality of evidence supplied was weak; however, this is as expected given the brief time that this technology has been available. Pertinent data have been extracted and presented in Table 1. All current relevant studies have been summarised as it is in the literature with appropriate limitations and findings presented in the discussion, and recommendations presented in the conclusion.

### *RCTs of BWV*

Two articles amongst peer-reviewed material featured RCTs. The first article detailed an RCT of BWV in the Rialto Police Department, California (Ariel, Farrer, & Sutherland, 2015). Use of force incidents and complaints against officers were utilised as measures. The police department had limited ( $n = 54$ ) 'frontline' officers, as such shifts were used as the unit of measurement to increase statistical power. The trial ran for 12 months, and during this time, police were assigned to experimental and control shifts, with and without BWV, respectively. With 19 shifts per week, from 54 frontline officers in six teams, data were collected from 988 shifts over 12 months. This consisted of 489 treatment and 499 control shifts. An internet-based video management system was utilised, along with the body-worn cameras (BWCs) provided to officers. There were 25 incidents of police use of force recorded, 17 from the control group and 8 from the experimental group. This resulted in an incidence rate ratio of 2.08 (95% CI) on the Poisson regression model, showing use of force incidence was around two times higher in the control group. The comparative number of incidents per 1000 interactions was statistically significant (standardised mean difference of 0.140, 95% CI). A before and after effect was

Table 1. Summary of included data.

Author, Year	Type of literature	Location	Type of study	Outcomes
<i>Crime rate data</i> ODS Consulting (2011)	Grey literature	Glasgow, Scotland	Mixed methods evaluation	Crime rate reductions in: Breach of peace (19%) Vandalism (21%) Minor assault (27%) Serious assault (60%) Overall crime post-BWV introduction (26%) Charge 80% less likely to progress to Sheriff court (Magistrate's court equivalent) post-BWV implementation
College of Policing (2014)	Grey literature	Essex, UK	RCT	Incidents attended by police resulting in a criminal charge: Treatment (81%) (significantly higher) Control (72%) Treatment group are 12% more likely to initiate a charge for a lesser offence than the control group
Ellis et al. (2015)	Grey literature	Isle of Wight, UK	Mixed methods evaluation	Increase in domestic assault incidents from 8 to 32 across the evaluation Reductions in incidence of threats to kill (44%) assault on police (36%) weapons offences (31%) public order offences (27%) assault (17%) Increases in incidence of breach of order (18–22) domestic assault (8–32) anti-social behaviour (108–136) domestic dispute between adults (1240–1355)

(continued)

Table 1. Continued

Author, Year	Type of literature	Location	Type of study	Outcomes
Katz et al. (2014)	Grey literature	Phoenix, AZ, USA	Interrupted time series study	A 42% increase in arrests made per day amongst BWV equipped officers.
<i>General complaints and use of force</i>				
Ariel et al. (2015)	Peer-reviewed journal article	Rialto, CA, USA	RCT	Use of force incidence 2.08 times higher in control group than treatment (95% CI) Use of force per 1000 interactions before and after intervention: 3.50 (SE ¼ 0.689); p < 0.001 (ARIMA) Difference between treatment and control groups in use of force: 0.7 per 1000, to 0.07; 1.750; SE ¼ 0.665; p < 0.01 (ARIMA) Difference between control and treatment groups in use of force incidents per 1000 community interactions: SMD ¼ 0.140 (95% CI)
Katz et al. (2014)	Grey literature	Phoenix, AZ, USA	Interrupted time series study	Reduction in general complaints amongst BWV equipped officers: 22.5% sustained complaints amongst BWV equipped officers: 53.1% use of excessive force complaints amongst BWV equipped officers: 47.7%
<i>Officer perception</i>				
Jennings et al. (2014)	Peer-reviewed journal article	Orlando, FL, USA	Cross-sectional survey study	Belief that BWV should be adopted: 62.7% BWV would reduce instances of use of force: 30.8%
Fouche (2014)	Peer-reviewed journal article	University of Georgia, Athens, GA, USA	Cross-sectional survey study	Belief that BWV increases documentation in criminal cases: 4.36/5 Likert scale BWV increases positive resolution of complaints against officers: 3.91/5 Likert scale

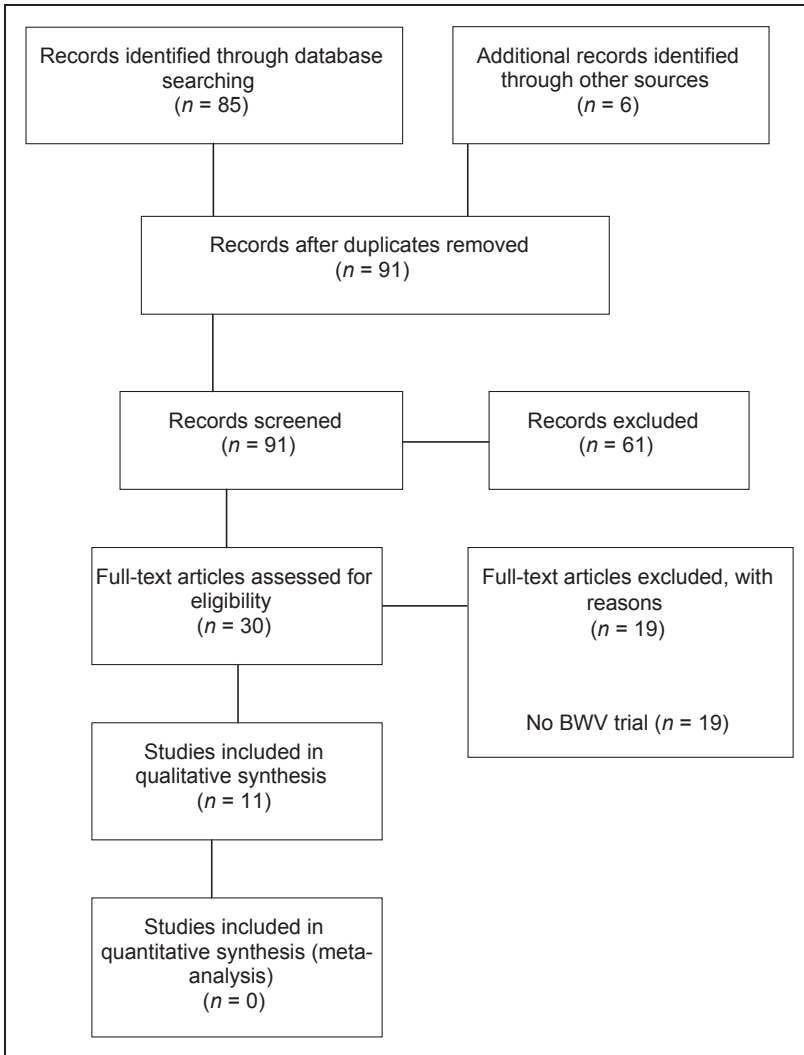
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Table 1. Continued

Author, Year	Type of literature	Location	Type of study	Outcomes
Katz et al. (2014)	Grey literature	Phoenix, AZ, USA	Interrupted time series study	Belief that there would be fewer contacts with citizens due to BWV: 63% before BWV introduction 37.1% after BWV introduction
<i>Community perception</i> Ellis et al. (2015)	Grey literature	Isle of Wight, UK	Before and after design	Belief that BWV will increase likelihood of conviction: 90% before intervention, 94.5% after will reduce assaults on police officers: 68.4% before intervention, 74.8% after will reduce crime and anti-social behaviour: 63.7% before intervention, 69.2% after Community awareness of BWV 25.6% before introduction, 58% after
<i>Costing</i> ODS Consulting (2011)	Grey literature	Glasgow, Scotland	Independent evaluation	Estimated savings in court, prosecution and police costs per year, post-BWV implementation: £125,000 (\$263,207.61 AUD)

Confidence intervals reported where possible.

ARIMA: Autoregressive integrated moving average; BWV: body-worn video; SMD: Standardized mean difference.



**Figure 1.** Flow chart of included studies.  
BWV: body-worn video.

shown to be significant on an interrupted time model,  $3.50$ ,  $SE = 0.689$ ;  $p < .001$  (autoregressive integrated moving average). For every 1000 interactions in the control group, 0.7 complaints were recorded, while 0.07 complaints were reported per 1000 interactions in the treatment group, resulting in a significant estimated parameter for the experimental phase of  $1.750$ ;  $SE = 0.665$ ;  $p < 0.01$ . There was therefore no significant difference between groups in complaints against officers. The Hawthorne effect, whereby individuals may modify their behaviour in response to the perception of being observed, was noted as a threat to validity. Stable unit treatment value assumption (SUTVA), in which an individual unit (participant) is assumed to be unaffected by



another participant's condition, is also a noted threat to validity. No measure of camera effect on citizen behaviour was included; however, a 4:1 benefit:cost ratio was provided for BWV.

A second article details a study undertaken in Wolverhampton, UK (Drover & Ariel, 2015). This study is an attempt to replicate the previously mentioned Rialto study. Camera use compliance rates, and the number of hours cameras were activated, were utilised as measures. An RCT was designed using shifts for data analysis, rather than individual participants. A one-month 'dry run' was undertaken in order to inform policy for a six-month trial. Data were presented for the one-month period only, with 43 cameras used during the trial. The three-shift system of the Rialto trial was implemented, resulting in 21 shifts per week of data collected, 63 shifts overall were recorded in the one-month test period. BWV recording of firearms incidents, public order and football deployments and emergency situations was not required as camera activation could present safety risks; this was also the case at the request of the victim. Hours that the cameras were checked out by officers totalled 10,349 of which hours spent recording totalled 1144, or an average of 11% of all shifts. It was found that compliance rates were difficult to enforce, with an 85% compliance rate reported at peak compliance. Resistance to change was encountered from police officers throughout the trial, and subsequently, innovative measures were required to make the technology part of the officers' daily routine. While daily reinforcement was required for compliance to the random allocation to remain high, participation was found to be best when involvement of senior police were present. The success of this trial is difficult to determine due to the minimal reported results, at the time this article was published, analysis of the results was pending.

### *Officer perception on function and outcomes of BWV*

Three peer-reviewed studies examined officer perception of BWV. The first article explores the perception of BWV by police officers in Orlando, Florida (Jennings, Fridell, & Lynch, 2014). This police department employs around 700 sworn and 100 'non-sworn' personnel, and data collection was performed via a survey designed to discern officer beliefs regarding BWV effect and usability. Survey respondents ( $n = 95$ ) were predominantly male and white, 88.5% and 85.4%, respectively, mean age was 35.64 years, with a mean of 6.66 (SD = 5.10) years of experience. From the 96% of respondents, 62.7% believe that BWV should be adopted. While only 18.2% of officers feel more safe wearing BWV, 77% of respondents feel comfortable wearing the camera unit. Of the respondents, 42.9% believed BWV would improve the 'by the book' behaviour of other officers, and 84.4% stated that it would not reduce their likelihood of responding to calls for service. Regarding complaints against officers, only 3.3% agreed that BWV would reduce their own use of force, while 20% believed it would reduce agency-wide use of force. It was found that 30.8% believed BWV would reduce the number of external complaints against officers. The majority of respondents agree with and show strong acceptance for the introduction of BWV; however, those who believe it will reduce use of force are in the minority.

A second study consists of a quasi-experimental evaluation of BWV, referred to as 'on-officer video cameras' or OVC in this article (Young & Ready, 2014). Four hypotheses were tested: (1) Activation of cameras and occurrence of an incident is correlated;

(2) An officer's consideration of cameras as legitimate is influenced by other officers' perception of cameras; (3) Officers who experience incidents together are more likely to change their prior opinion of cameras; and (4) Officers embedded in 'dense, shared-incident network positions' are more likely to change their opinion of cameras. The cohort consisted of 100 officers from five patrol districts; half of these officers were placed in the treatment group and assigned BWV, and the remaining 50 were a comparison group. Cameras in this trial were head mounted to allow representation of officer's field of vision. The demographics of officers in the comparison group were matched to the treatment group based on age, race, gender and patrol assignment. Data were collected from surveys twice in a period of three months, and in 'field contact forms' completed by officers once per month. Response rates were 89% and 90%, respectively. In these responses, 2202 incidents were reported, 912 (51%) of which involved BWV, while only 603 (66%) of these incidents involved activation of BWV. A weak linear relationship was therefore shown between BWV activation and consideration of legitimacy. Very little support was shown for all hypotheses, with non-significant results obtained for all measures. It is noted that during the fifth month of the evaluation, a 40% reduction in camera activation corresponded with policy change from mandatory to discretionary activation. A novel factor in this study is the notion of mobilising 'social capital' as a means of increasing uptake of BWV compliance. Further research into the affect of social networks and new technology acceptance was encouraged.

A third article is based in the University of Georgia (UGA) Police department, and considers officers' attitudes regarding BWV (Fouche, 2014). A Likert-scale-based survey was utilised to discern support for BWV uptake and perceived effectiveness. Officers ( $n=52$ ) participated in the two-month study commencing in January 2014, during which BWV was issued to all officers. The study was conducted via survey, participation was anonymous and data were collected online. A total of 61.54% of participants responded to the survey ( $n=32$ ); participants were asked five demographics questions, and seven questions based on the five-point Likert scale were used to rank belief statements about BWV. A score of  $>2.51$  indicates agreement and  $<2.51$  indicates disagreement. Three hypotheses were tested: (1) Most UGA Police Patrol officers support the use of BWCs; (2) Most UGA Police Patrol officers believe BWCs improve documentation in cases; and (3) Most UGA Police Patrol officers believe BWCs increase positive resolution of complaints against officers. Hypotheses 1, 2 and 3 resulted in mean outcomes of 2.82, 4.36 and 3.91 on the Likert scale, respectively, and as a result, all three hypotheses were accepted. Several trends were apparent, including that the 21–25 years group consisted of the highest level of agreement with BWV use, education levels had a noticeable effect on agreement levels. The highest mean scores regarding agreement with BWV use were amongst officers with a bachelor's degree. Officers with less experience ( $<2$  years) had a higher mean agreement rate than those of 3–10 years by 1.25 points. While these results showed agreement with BWV usefulness, support for wearing the camera is low and additional research was recommended.

### *Grey literature evaluations of BWV*

Six articles of grey literature were identified and met the criteria for review. The first article comprises an evaluation performed by the Police Executive Research Forum,

Washington, USA (Miller, Toliver, & Police Executive Research Forum, 2014). Research consisted of three components: surveys distributed to 500 law enforcement agencies nationwide, interviews of 40 police executives and thematic outcomes of a professional conference on BWV collected by observation. Initially 500 surveys were distributed, and questions included such topics as recording requirements, specific officers required to wear BWV, camera placement on body, and collection and storage and analysis of video. There was a 51% response rate to surveys (254 police departments), of which 75% of respondents reported not using BWV. Amongst the 63 agencies using BWV, nearly one-third did not have written policy governing BWV use. Hesitance to implement a written policy was thematically reported to be due to a lack of guidance on policy. During the second component of this research, 40 police executives whose departments were involved in BWV implementation were interviewed. Privacy concerns and consent to record were two key thematic outcomes while potential impacts on community relationships were posited as a reason for not using BWV to record all encounters. Two-party consent laws were a factor in a 'handful' of states; however, some states waived the right to two-party consent as a result of introducing BWV. Concern over public disclosure of BWV recordings in private residences was also reported. Data storage, management of officer expectations and implementation costs were also thematically evident.

A second article is a scoping report for BWV, located in Victoria Police Department, Canada (Laur, LeBlanc, Stephen, Lane, & Taylor, 2010). A survey was utilised to evaluate perceptions regarding evidence quality, effectiveness of BWV in relation to behavioural change of the public and officers and support for BWV implementation. Comprehensive background and information regarding the potential use of both BWV and In Vehicle Video (IVV) is provided, including technology types and models. Twenty police officers were issued BWV in order to evaluate officer perception over four months. Survey questions were based on video-based technology as a whole (both BWV and IVV), while also posing questions on each technology individually. Surveys were conducted in conjunction with a Constable's Masters project on the subject matter. There was a 75% response rate ( $n = 15$ ) to the survey, responses were indicated on a five-point, Agree–Disagree scale. Of the respondents, 53% agreed or strongly agreed that BWV/IVV had been a positive introduction, 47% agreed or strongly agreed that they act more professionally when using BWV, while 20% responded neutrally regarding an effect on professionalism. Regarding submission of evidence, 86% agreed or strongly agreed that use of BWV or IVV improves the quality of evidence. The majority of respondents disagreed with BWV being convenient to use (67%); however, 66% agreed or strongly agreed that people become less aggressive when they are aware that BWV and/or IVV is in use. BWV was generally unsupported by colleagues, with 78% disagreeing or strongly disagreeing that BWV was well received by co-workers; despite this, 75% supported the use of BWV without further improvements. Overall, 77.8% agreed that BWV should be implemented. A further six-month implementation and evaluation period was recommended.

A third study comprises an evaluation of BWV within the Paisley and Aberdeen areas in Glasgow, Scotland (ODS Consulting, 2011). This evaluation was completed by an independent research and analysis organisation. Overall, 77 BWV cameras were implemented, including 38 in Renfrewshire and 18 in Aberdeen, which was later increased to 39. Measures of success included reduction in crime, increase in early guilty pleas,

speed of resolution of any complaints against police or wardens and reductions in assaults on officers. Increased public re-assurance and reduced fear of crime were considered, while costing information was also provided. Difficulty establishing correlation between cameras and crime rate changes was noted; however, no effort was placed into controlling variables. Data were collected in Northfield and Mastrick (areas in which BWV was focussed in Aberdeen). In these places, crime rate reductions were noted in breach of peace (19%), vandalism (29%), minor assault (27%) and serious assault (60%). An overall crime rate reduction of 26% was shown for these areas. Over the same time period, a 1% reduction in crime rate is shown for the greater Aberdeen area, in which there was no BWV presence. Consumption of alcohol in designated places was also reduced by 50% during the trial period. In Renfrewshire, a reduction of 15% was shown in crime groups one through five; this includes crimes of violence, indecency, theft and vandalism. In particular, there was a 35% reduction in crimes of violence, while there was also a notable reduction in fire raising (arson) and malicious mischief of 23%. BWV cases were 80% less likely than average to progress to Sheriff courts (Magistrates court equivalent) and 71% less likely to proceed to JP court (no Australian equivalent). An estimated £140,000 of savings was made during the trial, resulting in a saving of £275,000 estimated per year of BWV implementation. A £50,000 saving in court costs, prosecution and police costs was estimated over the course of the two trials, resulting in a £125,000 saving estimated per year. Considerable caution is encouraged by the author when considering cost estimates involving BWV.

A fourth study is an evaluation of the Essex police department, UK and was performed by the College of Policing (2014). Charge rates were the primary measure utilised. An RCT design was implemented using 308 participants, all of whom were police officers. The Treatment group consisted of 80 officers, of which 18 officers were transferred from the treatment group to control group due to being on sick or holiday leave and a further 8 were randomly allocated to the treatment group from the control group. During the trial, 3 officers left the police force, while 228 police force members were included in the control group initially, and overall 238 remained at the end of the trial. Demographics were comparable between groups. There was no significant difference in allocation of high-risk incidents to officers in control and treatment groups. Data were collected over a five-month period during which time 30,480 incidents were attended by officers. Of these incidents, 7609 (25%) involved domestic abuse (DA), with 2761 (36%) of these incidents attended by at least one officer equipped with BWV. There were several important limitations in this study, one of which being that the use of cameras was not mandatory. There was no record of whether cameras were active at incidents, or if video was being used in the criminal justice process. There was also no consideration of the Hawthorne effect in the design of this study. Officers in control and treatment groups attended 5573 incidents; together, this is a strong indication of a SUTVA violation. A significantly higher proportion of incidents attended by police with BWV equipped resulted in a criminal charge (81% treatment, 72% control). Rates at which officers initiated charges were noticeably but not significantly higher amongst the treatment group. As the seriousness of the offence increased, charge rates became more comparable. BWV was shown to be effective at increasing the proportion of detections that were criminal charges.

A fifth article evaluated BWV implementation in the Isle of Wight, UK, and utilised public opinion, views of police officers and occurrence rates of crime as measures

in a before and after design (Ellis et al., 2015). Data were collected over one year both pre- and post-BWV implementation. A total of 991 members of the public were interviewed, of which 25.6% were aware of BWV prior to 'personal issue', 58% were aware after the technology was issued to officers, a significant increase (220.7,  $p < .001$ ,  $\varphi = -0.328$ ). Media publicity was noted as a heavily contributing factor in this increase of awareness. 1.2% were exposed to BWV prior to personal issue of the technology, which increased to 5.5% after personal issue. Areas in which there was a significant improvement in public opinion included increased perceived likelihood of conviction (90–94.5%), reduced complaints (75.6–81.1%), reduced assaults on police officers (68.4–74.8%) and reduced crime and anti-social behaviour (ASB; 63.7–69.2%). A total of 135 police officers responded to the law enforcement survey component of this study. Police had significantly lower confidence than the public that BWV would reduce assaults on officers, while also having significantly higher confidence that BWV would reduce complaints against them. Significantly more frontline police agreed that BWV should be compulsory than non-frontline (86.4% vs. 51.5%). Occurrence of crime data was also collected after one year of BWV use. Weapons offences were reduced by 41%; this was not a significant outcome due to the low number of offences. However, significant reductions were found in incidence of miscellaneous ASB, public order, rowdy and inconsiderate ASB, and assault crime types. It is important to note that effect sizes were small for all of these offences. Increases were found in domestic assault (from 8 to 32 occurrences), street drinking ASB, assaulting a child and domestic disputes between adults. The effect sizes were small, but significant increases were shown in all of these offence groups. Reductions were reported across several crime types, including threats to kill (44%), assault on police (36%), weapons offences (31%), public order (27%) and assault (17%). Increases in assault child, domestic assault and breach of an order were noted. In the period before implementation, only three domestic assaults were recorded as a crime, but no arrests were made. However, in the period after implementation, 21 were recorded, 10 of which involved camera footage, and 7 of which resulted in arrest. Overall complaints against police officers were reduced by 15% over the course of the study.

A sixth evaluation involved a BWV trial at the Phoenix police department, Arizona, in which 56 cameras were provided to officers (Katz et al., 2014). In this study, incident reports, activity logs, camera metadata, police databases, official complaint data, officer self-report survey, key stakeholder interviews and Phoenix city court data were utilised. Data were collected for 134 weeks, 67 prior to BWV implementation and 67 post-implementation. Officers were assigned to a geographic area in which BWV was to be used, and a comparison, non-use area. Overall, 81,257 incident entries were made within the BWV area, 38,094 (48%) of which involved a BWV-wearing officer as the primary responder. Limitations included the reportedly unique police behaviour relative to other cultures or countries, the absence of a control group and the replacement of officers who have been transferred or dismissed is also notable as it resulted in an inconsistent cohort. Mixed BWV and non-BWV patrols are also noted as a limitation. Activation compliance was reported at 91%, and the remaining 9% was attributed to accidental activation, testing, malfunctions and other errors. Mean time recording an incident attributed to a crime was 9.32 minutes, and mean number of activations per user during the trial was 415 (range of 1058). BWV was activated most commonly at property offences (21.3%),

violent offences (20.8%) and subject/vehicle stops (15%). Proportion of recorded events peaked in May 2013, with 42.2% documented; conversely, the lowest level of recording was in March 2014, with 13.2% indicating fatigue with BWV compliance. BWV was activated at 47.5% of domestic violence incidents, 38.7% of violent offences and 37% of the time when serving as backup to another officer. Officer perception showed that 61.8% believed BWV is easy to use; however, 58.8% indicated difficulty downloading and retrieving video. There was a decline in belief that there would be fewer contacts with citizens due to BWV over the course of the evaluation (63–37.1%). Thematic evidence was reported by officers that wearing BWV was not received well by other non-BWV co-workers. Officers were less likely to agree that BWV increased officer safety over time; despite this, officers were more likely over the course of the study to agree that BWV should be expanded to other departments. A mean increase of 0.04 arrests per day amongst BWV-equipped officers was shown, indicating a 42.6% increase. A 22.5% reduction in complaints amongst BWV-equipped officers was also reported. A reduction in complaints being sustained of 53.1% was also noted, and a 47.7% reduction in use of excessive force complaints was a notable outcome. Reductions were also noted in non-BWV-wearing officers, however not as large as those obtained amongst officers wearing BWV devices.

## **Discussion**

The quality of the evidence around BWV is largely weak. Despite this, the results presented throughout this systematic review show reasonable consistency, indicating that BWV is likely to provide an effective law enforcement option. Due to the nature of shift-based police work, the RCT studies included had to be modified to utilise shifts as the unit of measure rather than participants, potentially resulting in uncontrolled variables. This also resulted in the necessity to record inconsistent compliance rates to randomisation, as operational requirements meant control groups may be exposed to treatment conditions. Despite these issues recording data, evidence has been provided with reasonable level of consistency.

Given the aversion to adding another layer of surveillance to society without reasonable justification, trials of BWV are of considerable importance. This is especially due to the unfortunate circumstance of policy and guidelines following trials (Drover & Ariel, 2015; Miller et al., 2014). The perceived bi-directional benefit between policing and community is potentially the most influencing factor in the speed of BWV implementation. Particularly pertinent in this regard is the improved community perception of BWV based on increased exposure to the technology (Ellis et al., 2015). Crime rate data are provided primarily through grey literature and while this is contextually important, further peer-reviewed outcomes are needed to establish evidence of a consistent effect. The substantial reporting of crime rate reductions, and converse underrepresentation or non-reporting of stable and increasing crime rate categories presents further questions.

Irrespective of crime rates, complaints against officers and BWV perception indicate a particularly noteworthy effect that is most frequently featured in peer-reviewed material. The combination of reductions in use of force events (Ariel et al., 2015) and improved community perception (Ellis et al., 2015) indicate a considerable benefit to BWV use. The behavioural change resulting in these effects may be attributed to the salience of the

BWV unit on an officer, comparative to CCTV. While both of these technologies provide a comparable service, BWV is considerably more prominent and noticeable than CCTV. It may be the case that BWV provides a more directly attributable effect on deterrence of offending behaviours and improved community perception than CCTV. Estimated court savings (ODS Consulting, 2011) also indicates some benefit to the community financially; however, several caveats must be made in this area. Measuring success through fiscal, governmental savings from early guilty pleas may have ethical implications, similarly altering privacy legislation to allow trials of unproven technology which has no official policy at the time of trial may have negative ethical implications.

Important considerations arising from the reviewed studies relate to the discretion and compliance associated with using BWV amongst treatment group participants. A common challenge is the difficulty in designing 'Standard Operating Procedures' for BWV use and activation. Discretion in activation of BWV amongst treatment groups is a considerable threat to the internal validity of the research. However, non-compliance with 'Standard Operating Procedures' when an officer is required to activate BWV on attending certain events provides an issue for validity. Similarly, the ability to generalise results from such trials is compromised, as it is often unclear why a participant decided not to activate their device. This is a considerable area of concern for future BWV trials, the methodology must be carefully designed prior to undertaking the study to ensure that this variable does not confound trial results and impact on the integrity of the research outcomes.

As shown in Table 1, the early indications from these articles are a considerable positive outcome from BWV use. There are noticeable reductions in crime rates and incidents of offences against police shown in the literature. Where there are increases in arrest and charge rates reported, particularly amongst domestic assaults, it may be a result of the observer effect compounded by BWV, making officers more conservative when exercising discretion in arresting and charging offenders. While there is limited research around BWV efficacy, there are strong indicators that this technology may be an effective addition to day-to-day law enforcement function.

### *Implications*

Several RCTs were evident in peer-reviewed literature (Ariel et al., 2015; Drover & Ariel, 2015); however, further research of this standard is required. The inclusion of grey literature was necessary due to the dearth of peer-reviewed studies, and to account for a cross section of the application and perception of BWV amongst the community. However, it is equally important to consider the results of grey literature which may otherwise have remained as internal organisation evaluations and thus not contributing to the collective BWV knowledge area. Interestingly, the majority of grey literature was produced by police departments, or subsidiaries; however, methodology was considerably flawed amongst the reviewed studies. Recruitment sources indicate some sampling bias; however, this is not an easily avoidable factor when evaluating a policing program. Statistical power and external validity also featured as an issue within some of the included studies. The Hawthorne effect must also be factored into the results of any study in this area. Similarly, SUTVA violation is a frequent factor resulting from utilising shifts rather than individuals for data analysis. It is difficult to maintain SUTVA

integrity in a police force due to operational and staffing requirements potentially resulting in the pairing of officers from treatment and control groups (Ariel et al., 2015).

### ***Limitations***

The primary limitation of this systematic review is not including a meta-analysis; this is due to a lack of literature including comparable methodologies. As BWV research continues to develop, a meta-analysis is expected to become possible. Common measures are limited amongst current literature, and the lack of peer-reviewed literature was also a contributing factor. Strict selection criteria were maintained amongst data sources as a means of targeting literature with empirical evidence. It must also be noted that the studies presented are exclusively from countries other than Australia; as such, the different cultural and policing context may lend its self to differing results relative to overseas trials. It is particularly necessary to address these limitations prior to large-scale implementation of this technology.

### **Conclusion**

BWV is becoming more prominent as a technology utilised by law enforcement agencies worldwide. This addition to the modern model of western policing requires extensive research due to the potential implications of its use. There is some indication that BWV facilitates reductions in crime rates, complaints against officers and more effective documentation of evidence; however, this research is methodologically limited. Based on current results and the potential of BWV as a law enforcement mechanism, further research is required. From the available literature, BWV represents an innovative approach to modern policing which requires substantiation through peer-reviewed empirical research.

### ***Recommendations***

In order to improve research in this area, there are several fundamental recommendations that may be made regarding the methodology of future research. The difficulty in designing research in the law enforcement field is in not impacting upon the effectiveness of police, while being able to evaluate an intervention. In designing future research, experimental control groups must not be allowed to integrate with the treatment group, which has occurred in several previous BWV studies. It is also highly valuable to measure the response from the general public, as an indicator of behavioural change brought about by BWV. In conjunction with other data, a measure of whether BWV is improving relationships between the community and BWV-equipped officers is necessary. Studies which provide measures of the impact upon BWV-equipped officers are of importance in both compliance and effectiveness of the intervention itself. While this is an area of research which is currently in its infancy, there are some important benefits becoming evident through the research available, and measures such as these contribute valuable context. Through further peer-reviewed research, consisting of a strong design and methodology, a more comprehensive and complete picture of BWV efficacy is expected.



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