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SUBSTANTIVE REVIEW

Effectiveness of Sport-Based HIV Prevention Interventions: A Systematic Review of the Evidence

Z. A. Kaufman · T. S. Spencer · D. A. Ross

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Abstract Interest in sport as a tool for behavioral HIV prevention has grown substantially in the past decade. With dozens of organisations now using sport-based HIV prevention (SBHP) approaches and upcoming randomized controlled trials in South Africa and Zimbabwe, there is a pressing need to synthesize previous evaluation findings and identify gaps in existing research. A systematic review on the effectiveness of SBHP interventions was carried out, identifying both published and unpublished studies on SBHP interventions that measured effectiveness quantitatively. Study quality was scored using an adapted Newcastle-Ottawa Scale. Random-effects meta-analyses were carried out across studies for effects on six categories of HIV-related outcomes. The review identified 952 publications, 21 of which met inclusion criteria. No randomised controlled trials on SBHP interventions and no studies assessing biological outcomes were identified. Mean study quality score was 5.1 (SD 3.1) out of 20 points. Overall strong evidence was observed for positive effects on HIV-related knowledge ($RR = 1.26$, 95 % $CI = 1.15$–1.37), stigma ($RR = 1.13$, 95 % $CI = 1.02$–1.24), self-efficacy ($RR = 1.22$, 95 % $CI = 1.02$–1.41), reported communication ($RR = 1.24$, 95 % $CI = 1.06$–1.41), and reported recent condom use ($RR = 1.29$, 95 % $CI = 1.00$–1.59). Generally, the review found encouraging evidence for some short-term effects but relied predominantly on low-quality studies. More rigorous research on SBHP is needed to objectively assess effectiveness. Randomised controlled trials could play an important role in guiding policies, strategies, and funding related to SBHP.

Keywords Systematic review · HIV prevention · Sport · Effectiveness · Evidence

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Introduction

With more than 34 million people living with HIV and more than 2.5 million new infections in 2010, the need for effective and scalable HIV prevention interventions remains an urgent public health priority [1]. While the UN set a target to ensure that 95 % of the world's youth had accurate and comprehensive HIV prevention knowledge by 2010 [2], national health surveys reveal that only about 30 % of young people today in low- and middle-income countries have comprehensive HIV prevention knowledge [3].

Strong evidence exists supporting the impact of well-designed school-based HIV prevention interventions on knowledge, reported attitudes, and reported sexual risk behaviours [4]. To date, however, only three such interventions in sub-Saharan Africa have been evaluated via randomised controlled trials (RCT) with biological outcomes. None of these interventions demonstrated an effect on HIV incidence and only one demonstrated an effect on HSV-2 incidence [5–7]. While none have shown negative effects on HIV or other sexually transmitted infections (STIs), debate remains on whether school-based interventions are contributing effectively to the fight against HIV, at least in the short to medium term [8].

In the 1990s, several studies revealed the positive impact that basketball star Magic Johnson's public HIV status disclosure had on the attitudes of young Americans towards the infection [9–11]. Out of these powerful, yet short-lived, effects grew the concept of sport-based HIV prevention (SBHP): the idea that sports role models, activities, and metaphors could increase knowledge, improve attitudes, and change behaviours related to HIV [12]. Interest in this approach has grown internationally over the last decade, with support from prominent figures such as Michelle Obama, Michel Sidibé, and Peter Piot. Dr. Piot has said of the approach:

> "Soccer offers an exciting platform for intensifying HIV prevention efforts across Africa helping promote self esteem and supporting the development of protective communication and life skills [13]."

Today, more than a dozen nonprofit organisations are dedicated to SBHP, and numerous other organisations, sports teams, Olympic Committees and Ministries of Education have incorporated elements of SBHP into their work [14, 15]. Numerous toolkits and curricula have been developed, most notably those used by Grassroot Soccer (GRS), Kicking AIDS Out (KAO), and Right To Play (RTP). Some SBHP interventions are explicitly theory-based. The Grassroot Soccer model, for instance, is rooted in Social Learning Theory [16], using interactive teaching methods and role models with an aim to increase knowledge, improve attitudes and self-efficacy, and ultimately change sexual behaviour to reduce HIV incidence. More details on the GRS model and on other SBHP interventions can be found in the articles referenced in this review. Despite growing support for SBHP interventions, little is known about their effectiveness.

The purpose of this systematic review was to synthesize findings from all published and grey literature on SBHP interventions in order to:

1. Determine whether current evidence supports the effectiveness of SBHP
2. Identify gaps, weaknesses and limitations of existing research in order to guide future research in this area.

Methods

Inclusion Criteria

In order to be included, studies had to evaluate an SBHP intervention, defined as an intervention that explicitly uses sports themes, activities, metaphors, and/or role models in an effort to reduce HIV transmission. This included educational interventions as well as interventions aiming to increase uptake of health services that contribute to reducing HIV transmission and/or acquisition—i.e., medical male circumcision (MMC), HIV counselling and testing (HCT), STI treatment, or antiretroviral treatment. Studies that did not assess effectiveness quantitatively—either via an intervention/control or pre/post comparison—were excluded. Eligible study designs included RCT, non-randomised intervention studies, and cross-sectional or case–control studies comparing intervention and control groups. In order to be included, studies needed to assess one or more of the following HIV-related outcomes: knowledge, stigma, self-efficacy, reported communication, reported sexual behaviour, service uptake, or HIV, STI, or pregnancy incidence or prevalence.

Search Strategy

The review employed a two-pronged search strategy to identify published and unpublished studies. First, four electronic databases (MEDLINE, EMBASE, Global Health, and PsycInfo) were searched on August 2, 2011 to identify published articles on the topic, using search terms related to the problem/outcomes, intervention, and methods of interest (Annex 1; see Table 5 in Appendix). The search did not restrict on the basis of year published. The emerging studies were then deduplicated using the Ovid deduplication tool. Secondly, known researchers and staff at key organisations working in SBHP (including GRS, KAO, RTP, Moving the Goalposts, streetfootballworld Network, Beyond Sport, The Grassroot Project, Sport-and-Dev, UK Sport) were contacted and asked for any relevant published or unpublished studies on SBHP effectiveness (Annex 2; see Table 6 in Appendix).

Appraisal of Studies

Studies were appraised using an adapted Newcastle-Ottawa Quality Assessment scale (NOS) [17]. The adapted scale included all elements of good study design from the NOS (related to selection, comparability and outcome measurement) with additional elements accounting for random allocation, use and reporting of appropriate sample size calculations, sufficient study size, and appropriate statistical analysis. Each of ten elements of good study design was given a score between 0 and 2 (0 = No/Unclear; 1 = Partly; 2 = Yes). Scores were aggregated across elements to determine each included study's quality score (out of a possible 20 points). Table 1 describes the elements of good study design, along with criteria for assigning point values. Scores were tabulated across studies (to determine mean study quality) and across elements (to determine the most common strengths/weaknesses). Where multiple study reports were identified, the most complete report was used for appraisal.

Table 1 Elements of good study and appraisal criteria

Element	Description
Random sampling	Were the participants or clusters representatives of the population? (i. e. selected at random)[a]
Control group	Did the study include an appropriate control or comparison group? (partly if control group was too small or not comparable)[a]
Random allocation	Were participants randomly allocated to groups? (Reportedly random but unclear method = partly; randomised via clusters but clustering not accounted for in analysis = partly; clear/appropriate randomisation process = Yes)
Extended follow-up	Did the study follow participants beyond the intervention? (1–6 months follow-up = partly; 6+ months follow-up = Yes)[a]
Sample size calculations	Did the researchers use and report sample size calculations to establish or justify the size of the study? (Partly if reported but with inappropriate or unclear assumptions)
Sufficient power	Did the study have sufficient power to detect a realistic size of effect? (<150 participants = No; 15–499 participants = partly; 500+ participants = Yes)
Adjustment for confounding	Did the study adjust for the most important potential confounder(s)?[a]
Appropriate statistical analysis	Did the study report *p* values and/or confidence intervals? Or did the study only report crude % differences? (Partly if *p* values reported but unclear what tests were earned out)
Objective outcomes	Were outcomes self-reported (0 pts). measured biologically or via records (1 pt), assessed blindly (1 pt)?[a] Evidence of selective outcome reporting? (−1 pt)
Low loss-to-follow up	<15 % LTUF = Yes; 15–30 % LTFU = partly;>30 % LTFU = No[a] (unclear if not explicitly following the same participants)

[a] Element from the NOS scale

Study findings were analysed within outcome categories to determine the evidence of intervention effectiveness in improving knowledge, stigma, self-efficacy reported communication, reported sexual behaviour, service uptake and biological outcomes. Where one report or publication disaggregated results from multiple interventions or countries, these were treated as separate studies.

Meta-analysis

Random-effects meta-analyses were carried out for overall effects on knowledge, stigma, self-efficacy, reported communication, reported uptake of HCT, and reported condom use (i.e. condom use at last sex or consistent condom use in last 30 days). It was not possible to conduct such a meta-analysis for other attitudes or behaviours due to the heterogeneity of indicators used across studies. If not reported explicitly, pre-post and/or intervention-control percents of favourable responses were calculated for each study by taking the mean percent of favourable responses across questions or by converting a numeric score to a percent out of the total points possible. Relative differences were then calculated for each study by comparing post to pre and/or intervention to control, and estimates of effect (*RR*) with 95 % confidence intervals were then computed for use in random-effects meta-analysis. Two levels of sensitivity analysis were carried out—first by excluding studies classified as 'poor quality' (sensitivity level 1) and second by excluding unpublished studies (sensitivity level 2).

Results

Inclusion and Exclusion of Studies

The literature search identified 924 studies and the grey literature search yielded 28 additional studies. Of the 952 study titles reviewed, 869 were excluded for irrelevance or redundancy. Abstracts were then screened for 83 studies. Sixty-two of these studies were excluded, 54 after abstract review and eight more after full text review (Fig 1). The reasons for exclusion were: (a) the study did not quantitatively assess the effectiveness of an intervention (n = 45), (b) the intervention was not sport-based ($n = 13$), (c) the outcomes were not HIV-related ($n = 9$), and/or (d) the study design did not meet review criteria ($n = 15$). Some studies were excluded for more than one reason. Twenty-one studies [18–35] were included in the review. Nine of these studies had been published in peer-reviewed journals, four had been presented at international conferences, and eight were unpublished reports or Masters theses.

Characteristics of Included Studies

Seven of the included studies were quasi-experimental (i.e. non-randomized, prospective studies with intervention and comparison groups); four were cross-sectional, and ten utilized a pre/post (or time-series comparison) design. No RCTs of SBHP interventions were identified. Sixteen of the studies were conducted in sub-Saharan Africa, two in the Caribbean, and three in the United States. Most study participants were between 12 and 16 years old; only one study included participants over 30 years. Most of these studies assessed youth-targeted interventions delivered either with sports teams or school classes through curricula that used sports themes, activities and metaphors (note: 14 studies evaluated interventions either run by or adapted

Table 2 Characteristics of included studies ($n = 21$)

			Study details			Intervention details				Outcomes reported[a]					
Ref.	Authors	Years	Source	Study design	N	Country	Age group	Intervention	Length	K	A	C	B	S	Bio
[19]	Clark et al.	2006	AIDS & behavior	Quasi-experimental	304	Zimbabwe	12-14 years	GRS	4 sessions 8 h	✔	✔	✔			
[27]	Peacock-Villada et al.	2007	New Dir for Youth Development	Pre/Post	274	Zambia	10-18 years	GRS/Resiliency	6 weeks		✔				
[26]	Maro et al.	2009	Scand J Med Sci Sports	Quasi-experimental	764	Tanzania	12-15 years	EMIMA/KAO	8 weeks	✔	✔		✔		
[28]	Rhodes et al.	2009	AIDS education and prevention	Quasi-experimental	222	USA	Mean age: 29 years	HoMBReS	18 months	✔	✔		✔	✔	
[21]	Fuller et al.	2010	British Journal of Sports Medicine	Quasi-experimental	370	South Africa	11-15 years	Football-For-Health	11 sessions 16.5 h	✔					
[20]	Delva et al.	2010	AIDS care	Cross-sectional	892	Kenya	12-24 years	MYSA	Varied	✔	✔				
[22]	Fuller et al.	2011	British Journal of Sports Medicine	Pre/Post	389	Mauritius	12-15 years	11 For Health	11 sessions 16.5 h	✔					
[22]	Fuller et al.	2011	British Journal of Sports Medicine	Pre/Post	395	Zimbabwe	10-14 years	11 For Health	11 sessions 16.5 h	✔					
[24]	Kaufman et al.	2011	AIDS Care	Quasi-experimental	140	Dominican Rep.	10-20 years	Fútbol para la vida[b]	5 sessions 10 h	✔	✔	✔			
[32]	Rajan et al.	2008	136th APHA Annual Meeting	Pre/Post	2,197	Ethiopia	13-24 years	Sport for life[b] Youth Action Kit[b]	24-30 activities	✔	✔	✔	✔	✔	
[29]	Gray et al.	2009	IV SA AIDS Conference	Quasi-experimental	478	South Africa	13-18 years	Extra Time Magazine[b]	Just magazine	✔					
[23]	Kaufman et al.	2010	XVIII International AIDS Conference	Cross-sectional	246	Zimbabwe	15-19 years	GRS	10 h	✔	✔	✔	✔	✔	
[23]	Kaufman et al.	2010	XVIII International AIDS Conference	Cross-sectional	307	Botswana	15-19 years	GRS	10 h				✔	✔	
[25]	Kruse	2006	NORAD	Cross-sectional	80	Zambia	14-18 years	KAO	Unclear	✔	✔				
[18]	Mercy Corps	2007	mercycorps.org	Pre/Post	280	Liberia	16-30 years	Yes to Soccer[b]	14 activities 6 weeks	✔	✔				
[18]	Mercy Corps	2007	mercycorps.org	Pre/Post	360	Southern Sudan	14-25 years	Sports for Peace and Life[b]	15 activities 8 weeks	✔	✔				
[30]	Wardell	2009	Author	Quasi-experimental	94	St. Lucia	10-16 years	Football For Lives[b]	Unclear	✔	✔				
[33]	Kim	2010	Author	Pre/Post	69	USA	10-15 years	Grassroot Project[b]	8 weeks	✔	✔				
[31]	Luppe	2010	Author	Pre/Post	61	South Africa	9-20 years	GRS	8 sessions 4 weeks	✔					
[35]	Harvey	2011	Author	Pre/Post	102	USA	9-14 years	Grassroot Project[b]	8 weeks	✔	✔	✔			
[34]	Braunschweig et al.	2011	Author	Pre/Post	612	South Africa	14-17 years	Generation Skillz[b]	11 sessions	✔	✔	✔			

[a] *K* knowledge, *A* reported attitudes, *C* reported communication, *B* reported behaviours, *S* service uptake, *Bio* biomarkers

[b] Intervention adapted from GRS curriculum

from GRS). Rhodes et al. [28], however, assessed an intervention–HoMBReS—that recruited adult male soccer players to be lay health advisors and trained them to deliver health promotion and education to their teammates. More details about the individual interventions can be found in the referenced studies. No identified studies were published or presented prior to 2006. Eighteen studies assessed HIV-related knowledge, fourteen assessed reported attitudes, five assessed reported communication, six assessed reported behaviour, and four assessed uptake of HCT. No studies assessed biological outcomes and no studies assessed uptake of other HIV-related services (Table 2).

Study Appraisal

Table 3 presents the results of study appraisal. Two studies were classified as Good-quality, eleven as OK-quality, and eight as Poor-quality. None of the included studies were classified as having Very Good quality. The mean study quality score was 5.1 (SD 3.1) points out of 20 possible points. The most common limitations identified were lack of objective outcome measures (all studies relied on self-reported outcomes), lack of randomisation in both sampling and group allocation, and lack of extended follow-up. Only five studies adjusted analyses for confounders, only three reported that they had used sample size calculations to determine the study size, and only one followed participants for more than 6 months.

Knowledge

Of the 18 studies assessing HIV-related knowledge, 15 reported an overall positive effect, two found no effect, one found a negative effect. Of the 15 studies finding a positive effect, ten had very strong evidence of effect ($p < 0.01$), one had strong evidence ($p < 0.05$), and four did not present p values. Kim and colleagues [33] reported very strong evidence of effect but only reported the mean change in knowledge rather than pre and post scores, making it impossible to include their data in the meta-analysis. Knowledge questions varied across studies, though common questions assessed knowledge of HIV transmission, HIV prevention methods, understanding of asymptomatic infection, rejection of myths related to HIV, and knowledge of the distinction between HIV and AIDS. The strongest knowledge effect was observed in Kaufman and colleagues' [24] evaluation of Fútbol Para la Vida in the Dominican Republic, which found a nearly 40 % increase in knowledge from pre-to-post and very strong evidence of post-intervention difference between participants and controls, after adjusting for confounders and baseline responses ($AOR = 2.7$, 95 % $CI = 1.7$–4.2). The knowledge meta-analysis (Fig. 2) found strong evidence of positive effects across studies ($RR = 1.25$, 95 % $CI = 1.16$–1.34).

Stigma

Eight of eleven studies assessing stigma reported a positive effect. The Mercy Corps studies [18] in Liberia and Sudan reported absolute increases in willingness to purchase from an HIV-positive shopkeeper of 41 and 16 %, respectively. Kaufman and colleagues [24] found very strong statistical evidence ($p < 0.003$) of increased willingness to support an HIV-positive friend, while Clark and colleagues [19] found weak evidence of this ($p = 0.068$). Both studies found that the high rates of reported support for friends living with HIV was sustained over 4- and 5-month follow-up. Harvey observed an increase from 70.6 to 79.4 % in reported willingness to care for an HIV-infected relative, but this result was not statistically significant ($p = 0.31$). Kaufman and colleagues [23] (2010) found strong evidence that graduates from GRS programmes in Zimbabwe and Botswana reported greater willingness to care for an HIV-positive family member 2–5 years later ($p = 0.01$), but did not find an overall effect on HIV-related attitudes. The meta-analysis for stigma (Fig. 3) found strong overall evidence of effect ($RR = 1.21$, 95 % CI = 1.09–1.32).

Self-Efficacy

Three out of five studies reported increases in self-efficacy. After adjusting for baseline scores, relationship status and clustering, Rhodes and colleagues [28] found strong evidence of an effect of the HoMBReS intervention on self-efficacy to use condoms ($AOR = 1.7$, 95 %$CI = 1.1$–2.6). Rajan and colleagues [32] also reported an increase in self-efficacy to use condoms but did not report measures of effect or statistical probability. Kaufman and colleagues [24] found an increase from 56 to 97 % in participants' perceived ability to protect themselves from HIV, whereas graduates and non-graduates reported the same level of self-efficacy to protect themselves (95 %) in the Zimbabwe/Botswana long-term follow-up study [23]. Braunschweig and colleagues found strong evidence for a pre/post effect in participants' self-efficacy to resist peer pressure. The meta-analysis (Fig. 4) found strong evidence of an overall effect on self-efficacy ($RR = 1.22$, 95 % $CI = 1.02$–1.41).

Table 3 Appraisal of studies against elements of good study design

Study				Elements of good study design											
Ref.	Author	Years	Country	Random sampling	Control group	Random allocation	Extended follow-up	Sample size calculations	sufficient size	Adj. for confounding	Appr. stat. analysis	Objective outcomes	Low loss-to-follow-up	Quality score (out of 20)	Quality category[a]
[19]	Clark et al.	2006	Zimbabwe	No	Yes	No	Partly	No	Partly	No	Yes	No	No	6	OK
[27]	Peacock-Villada et al.	2007	Zambia	No	No	No	No	No	Partly	No	No	No	Unclear	1	Poor
[26]	Maro et al.	2009	Tanzania	No	Yes	Unclear	No	No	Yes	No	Partly	No	Partly	6	OK
[28]	Rhodes et al.	2009	USA	Yes	Yes	No	Yes	No	Partly	Yes	Yes	No	Unclear	11	Good
[21]	Fuller et al.	2010	RSA	No	Yes	Partly	Partly	Yes	Yes	No	Yes	No	Yes	12	Good
[20]	Delva et al.	2010	Kenya	No	Yes	No	N/A	No	Yes	Yes	Yes	No	N/A	8	OK
[22]	Fuller et al.	2011	Mauritius	No	No	No	No	Yes	Partly	No	Yes	No	Partly	6	OK
[22]	Fuller et al.	2011	Zimbabwe	No	No	No	No	Yes	Partly	No	Yes	No	Partly	6	OK
[24]	Kaufman et al.	2011	Dom.Rep.	No	Partly	No	Partly	No	Partly	Yes	Yes	No	No	7	OK
[32]	Rajan et al.	2008	Ethiopia	Yes	No	No	No	No	Yes	Unclear	Partly	No	No	5	OK
[29]	Gray et al.	2009	RSA	No	Yes	Partly	No	No	Partly	No	Yes	No	No	6	OK
[23]	Kaufman et al.	2010	Zimbabwe	No	Yes	No	N/A	No	Partly	Yes	Yes	No	N/A	7	OK
[23]	Kaufman et al.	2010	Botswana	No	Yes	No	N/A	No	Partly	Yes	Yes	No	N/A	7	OK
[25]	Kruse	2006	Zambia	No	Partly	No	No	No	No	No	Yes	No	N/A	3	Poor
[18]	Mercy Corps	2007	Liberia	No	No	No	No	No	Partly	No	No	No	Unclear	1	Poor
[18]	Mercy Corps	2007	S Sudan	No	No	No	No	No	Partly	No	No	No	Unclear	1	Poor
[30]	Wardell	2009	St Lucia	No	Partly	No	Partly	No	No	No	Yes	No	Unclear	4	Poor
[33]	Kim	2010	USA	No	No	No	No	No	No	No	Partly	No	No	1	Poor
[31]	Luppe	2010	RSA	No	Partly	No	No	No	No	No	Partly	No	Unclear	2	Poor
[35]	Harvey	2011	USA	No	No	No	No	No	No	No	Yes	No	Unclear	2	Poor
[34]	Braunschweig et al.	2011	RSA	Yes	No	No	No	No	Yes	No	Yes	No	Unclear	6	OK
Total across studies (out of 42)				6	20	2	6	6	21	10	32	0	5	Mean: 5.1	

[a] Poor = 0–4 points; OK = 5–9 points; Good = 10–14 points; Very Good = 15–20 points

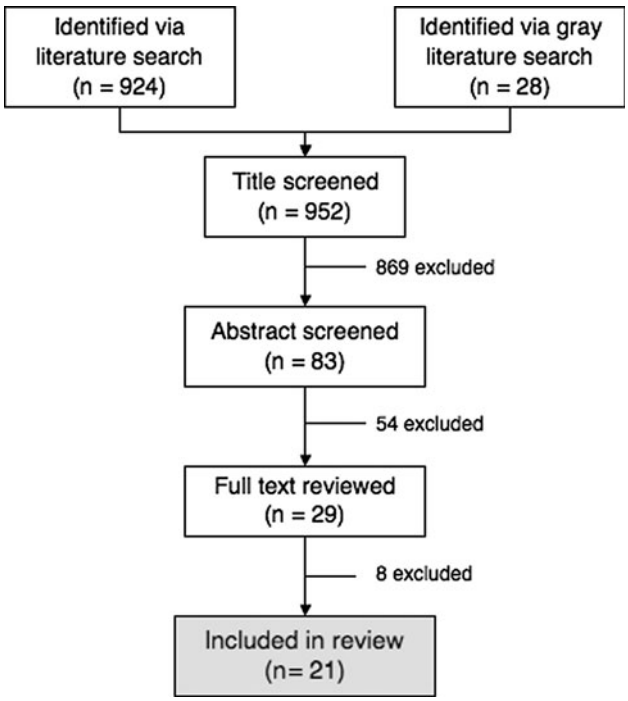

Fig. 1 Identification, screening and exclusion of studies

Other Attitudes

Five of eight studies reported an effect on other HIV-related attitudes and life skills. Peacock-Villada and colleagues [27] found an effect on reported decision-making skills in a study of the GRS Resiliency Programme in Zambia ($p < 0.05$). Maro and colleagues [26] found evidence of positive effects of the KAO-based EMIMA intervention on attitudes towards condom use and having an exclusive partner ($p < 0.01$). Rhodes and colleagues [28] found no effect on adherence to traditional masculine norms ($AOR = 1.2$, 95 % $CI = 0.6$–2.0). No other studies reported measures of gender norms.

Reported Communication

Of the five studies assessing reported communication, four studies found a positive effect on reported HIV-related communication (two with strong evidence, one with unclear evidence) and one multi-country study found no effect. Clark and colleagues [19] found that the proportion of graduates who could name three people with whom they could talk about HIV increased from 48 to 64 % after the intervention in Zimbabwe ($p < 0.01$), though this effect diminished at 5-month follow-up. Kaufman and colleagues [24] found that the proportion of GRS program graduates in the Dominican Republic reporting having spoken to a parent or friend about HIV increased from 24 to 54 % and from 34 to 56 %, respectively ($p < 0.003$). Harvey found weak statistical evidence of a pre/post increase in the proportion of Grassroot Project participants who reported talking to a friend about condoms ($p = 0.054$). Kaufman and colleagues [23] found no differences between GRS graduates and non-graduates in Zimbabwe and Botswana at 3–5 year follow-up in terms of reported communication. The meta-analysis for communication (Fig. 5) found strong evidence of effect ($RR = 1.24$, 95 % $CI = 1.06$–1.41).

Reported Sexual Behaviour

Of the six studies assessed an effect on reported sexual behaviour, five reported positive effects on at least one behavior and one study found no effect. Four out of four studies found evidence of a positive effect on condom use, though one study's [26] unconventional analysis methods precluded its inclusion in the meta-analysis. At 18-months post-intervention, Rhodes and colleagues [28] found that participants in the HoMBReS intervention were roughly 2.3-times more likely to report consistent condom use in the last 30 days than non-participants ($AOR = 2.3$, 95 % $CI = 1.2$–4.3). Delva and colleagues [20] found evidence of effect on reported condom use at first sex ($p = 0.033$) and last sex ($p = 0.04$) as well as reported frequency of condom use with current/last partner ($p = 0.037$), though the strength of effect diminished after adjusting for media exposure. The meta-analysis found overall strong evidence of an effect on recent condom use ($RR = 1.29$, 95 % $CI = 1.00$–1.59).

Two studies reported effects on reported sexual debut (both with very weak evidence). Two studies found very weak evidence of an effect on reported number of partners, while two found no effect. Rajan and colleagues [32] found evidence of an effect on reported transactional sex ($p = 0.011$). No studies found evidence of a negative effect on reported behaviours.

Reported Service Uptake

Three studies measured intervention effectiveness in increasing reported uptake of HIV counselling and testing. No evidence of an overall effect on HCT uptake was observed in the meta-analysis ($RR = 1.81$, 95 % $CI = 0.20$–3.42), though two of the three studies found very strong evidence of effect. Rhodes and colleagues [28] found very strong evidence of an effect of the HoMBReS intervention on reported HIV testing among male soccer players ($AOR = 2.5$, 95 % $CI = 1.5$–4.3, $p = 0.001$). Kaufman and colleagues [23] meanwhile, found no significant effect on reported HIV testing in Botswana and

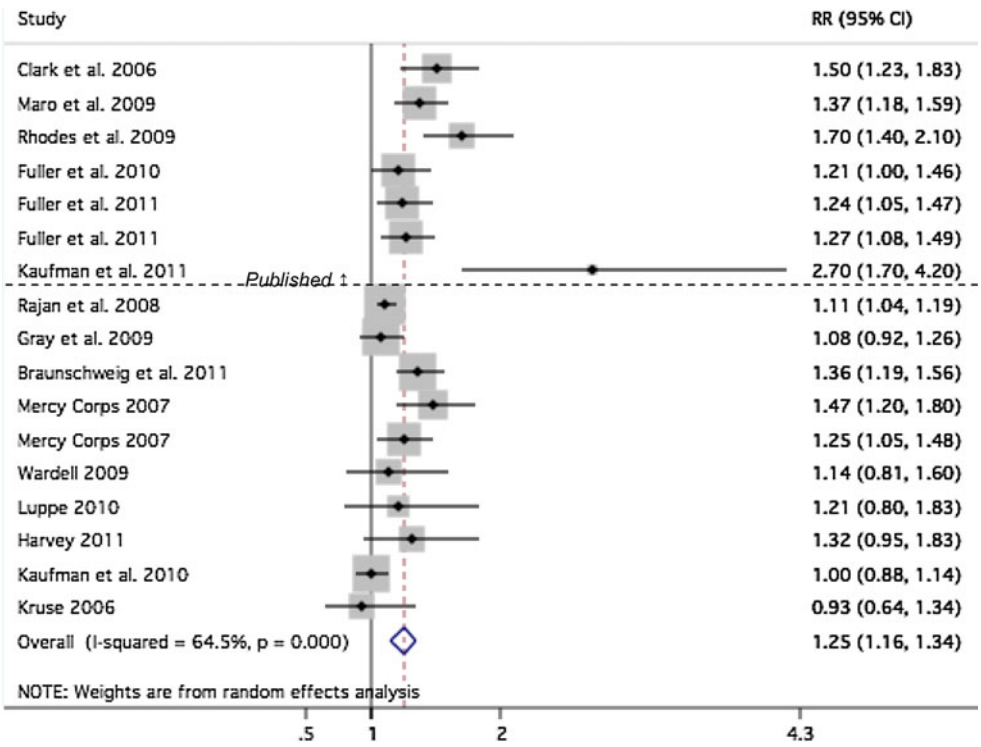

Fig. 2 Random-effects meta-analysis for effects on knowledge ($n = 17$ studies)

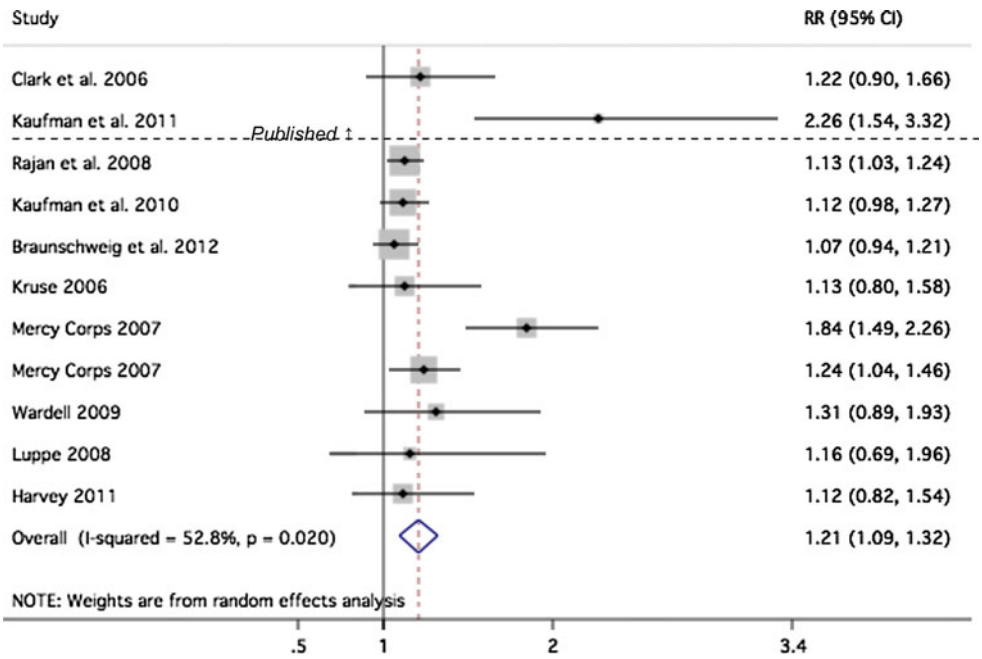

Fig. 3 Random-effects meta-analysis for effects on stigma ($n = 11$ studies)

Zimbabwe in cross-sectional follow-up surveys with GRS graduates 2–5 years post-intervention. No studies assessed the effectiveness of SBHP in increasing uptake of other HIV-related services.

Biological Outcomes

None of the studies included biological outcome measures, such as HIV, HSV-2 or pregnancy incidence.

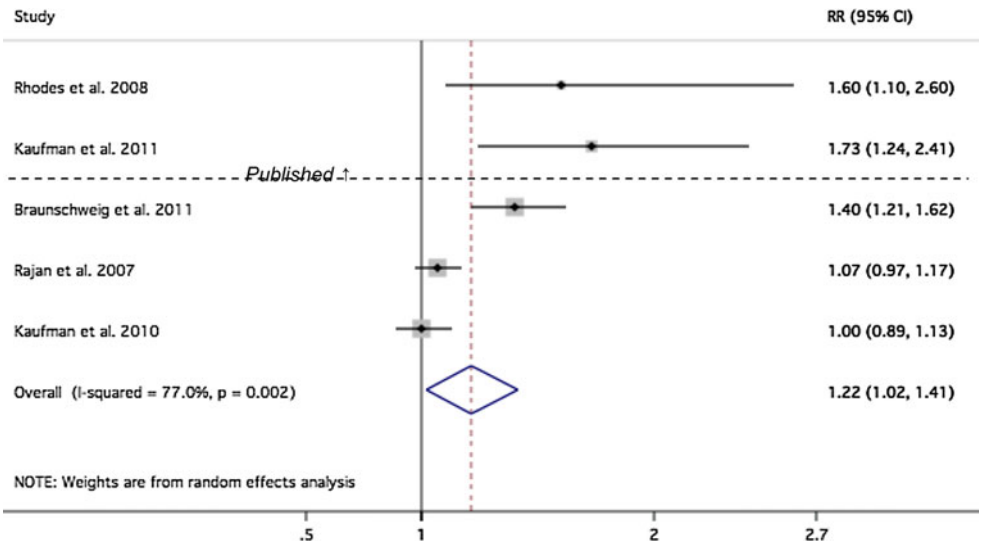

Fig. 4 Random-effects meta-analysis for effects on self-efficacy ($n = 5$ studies)

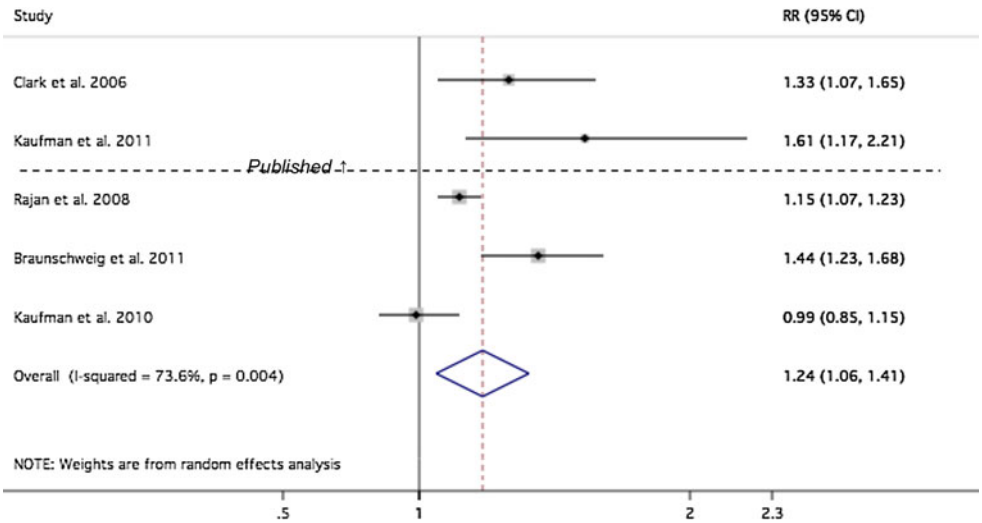

Fig. 5 Random-effects meta-analysis for effects on reported communication ($n = 5$ studies)

Results Summary and Sensitivity Analysis

Table 4 summarizes the main meta-analysis results as well as the results from the two levels of sensitivity analysis. The first level of sensitivity analysis, excluding Poor-quality studies, found consistent effects with the main analysis, with strong evidence of effects on knowledge ($RR = 1.26$, 95 % $CI = 1.15$–1.37), stigma ($RR = 1.13$, 95 % $CI = 1.02$–1.24), self-efficacy ($RR = 1.22$, 95 % $CI = 1.02$–1.41), reported communication ($RR = 1.24$, 95 % $CI = 1.06$–1.41), and reported recent condom use ($RR = 1.29$, 95 % $CI = 1.00$–1.59). The second level of sensitivity analysis, excluding unpublished studies, found larger effect estimates and wider confidence intervals across outcomes, with strong evidence of effects on knowledge ($RR = 1.37$, 95 % $CI = 1.22$–1.52), self-efficacy ($RR = 1.68$, 95 % $CI = 1.22$–2.14), reported communication (RR = 1.40, 95 % CI = 1.14–1.65), and reported HCT uptake ($RR = 2.50$, 95 % $CI = 1.10$–3.90) and no evidence of effect on stigma ($RR = 1.66$, 95 % $CI = 0.65$–2.67) and reported recent condom use ($RR = 1.51$, 95 % $CI = 0.81$–2.21).

Table 4 Summary of meta-analyses (including sensitivity analyses) across outcomes

Indicator	Main analysis		Sensitivity level 1[a]		Sensitivity level 2[b]	
	Studies	*RR* (95 % *CI*)	Studies	*RR* (95 % *CI*)	Studies	*RR* (95 % *CI*)
Knowledge	17	**1.25 (1.16–1.34)**	11	**1.26 (1.15–1.37)**	7	**1.37 (1.22–1.52)**
Stigma	11	**1.21 (1.09–1.32)**	5	**1.13 (1.02–1.24)**	2	1.66 (0.65–2.67)
Self-efficacy	5	**1.22 (1.02–1.41)**	5	**1.22 (1.02–1.41)**	2	**1.68 (1.22–2.14)**
Communication	5	**1.24 (1.06–1.41)**	5	**1.24 (1.06–1.41)**	2	**1.40 (1.14–1.65)**
HCT uptake	3	1.81 (0.20–3.42)	3	1.81 (0.20–3.42)	1	**2.50 (1.10–3.90)**
Recent condom use	3	**1.29 (1.00–1.59)**	3	**1.29 (1.00–1.59)**	2	1.51 (0.81–2.21)

[a] Excluding poor quality studies, based on study quality appraisal

[b] Excluding unpublished studies

Bold indicates strong evidence of effect ($p < 0.05$)

Discussion

Given the urgent need for effective HIV prevention efforts, it is crucial to ensure that policymakers and funders direct resources into interventions that maximize public health impact. School-based HIV prevention has proven promising in its scalability and potential, but disappointing in its inability to demonstrate biological effectiveness or sustained effects on reported behaviors. SBHP has gained great traction in recent years as a way of making youth-targeted HIV prevention initiatives more engaging and, perhaps, more effective [12].

This systematic review provides strong evidence that SBHP interventions have at least a short-term effect on HIV-related knowledge, stigma, self-efficacy, reported communication, and reported recent condom use. There is no evidence that these interventions increase uptake of HCT or other HIV-related services, as few studies have assessed this. Limited follow-up data suggests that intervention effectiveness on knowledge, attitudes, and communication may diminish over time. More rigorous intervention studies are needed to determine whether these effects are consistent across multiple settings and whether SBHP interventions have an effect on biological outcomes, such as HIV incidence and STI incidence.

The majority of studies identified in this review only assessed knowledge and stigma and none assessed biological outcomes. This is a major limitation in assessing SBHP effectiveness. Since knowledge and reported attitudes are quite distal factors in influencing HIV risk, we are limited in what we can ultimately conclude about the true effectiveness and health impact (i.e., reduction in new HIV infections) of these interventions. Moreover, since reported attitudes, reported communication, and reported sexual behaviour are subject to desirability bias [36], these intermediate variables may not be valid surrogates for HIV prevention.

The characteristics of the identified studies provide a useful picture of the current landscape of SBHP interventions and research. The geographical distribution suggests that SBHP interventions are most commonly implemented and/or evaluated in sub-Saharan Africa (15 of the 19 studies). Nearly all of the reviewed interventions targeted early adolescents (12–16 years), suggesting this is the primary target group for SBHP interventions. The fact that 14 of the 21 studies evaluated GRS interventions or interventions adapted from GRS either suggests that this is a predominant model that has been used in SBHP to date or that a disproportionate amount of research has been conducted on GRS, compared to other interventions. It is not possible, at this stage, to draw conclusions about the comparative effectiveness of different interventions (e.g., KAO vs. GRS) because studies used different indicators and methods to measure effectiveness and no head-to-head comparison has been made. Future studies should compare the effectiveness of different SBHP interventions against each other and against conventional school-based HIV prevention interventions.

The long-term follow-up evaluations of GRS in Zimbabwe and Botswana [23] found less encouraging evidence than the shorter-term evaluations in Zimbabwe [19], Zambia [27], South Africa [34] and the Dominican Republic [24]. This could support Clark and colleagues' [19] hypothesis that differences between programme graduates and non-participants may diminish over time due to diffusion, or it could be the result of limitations in the small, cross-sectional follow-up study.

The fact that only nine studies have been published in peer-reviewed journals either suggests that authors have not published their research or, more likely, that much of

the research on SBHP interventions has not been of sufficient quality to merit peer-reviewed publication. Indeed, this review's study quality assessment revealed that only two of the 21 studies could be classified as 'Good quality' while eight were classified as 'Poor quality'. A commitment from researchers, funders and implementers to carry out more rigorous, objective epidemiological research on these interventions' effectiveness is paramount.

Apart from the clear limitations of the included studies, this review also had several important limitations. First, since studies used different indicators and since few studies reported epidemiological measures of effect, conducting a meta-analysis for certain outcomes was not possible. Secondly, the lack of standardized reporting methods resulted in our inability to include some studies in meta-analyses, and selective outcome reporting may have meant some negative effects or non-effects that were not published or reported. Publication bias may have led the review to overestimate effect estimates, though this would have likely only affected the sensitivity analysis, as the grey literature search yielded 28 studies and identified several studies reporting negative or no effects.

Overall, there is strong evidence that well-designed and implemented SBHP interventions can reduce stigma and increase HIV-related knowledge, self-efficacy, reported communication and condom use by roughly 20–40 %. There is no evidence either way, however, on whether they can reduce HIV, STI or unintended pregnancy rates. There is also no evidence to suggest that these interventions have had negative effects. Thus, public health practitioners designing HIV prevention interventions may want to consider including sport-based components in their interventions or modelling interventions on existing SBHP models like GRS, but should ensure that these are evaluated rigorously. Further evidence of effectiveness, ideally from RCT with biological outcomes, is needed for policymakers to be able to compare the relative effectiveness and cost-effectiveness of SBHP interventions to other HIV prevention interventions, such as teacher-led sexual and reproductive health education in schools, MMC, HCT, condom promotion, and vaginal microbicides.

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Appendix

See Tables 5 and 6.

Table 5 Annex 1: Systematic review search terms

Outcome (HIV-related)	Intervention (sports-based)		Study design	
HIV	sport*	Volleyball*	Intervention*	Clinical
AIDS	Physical activity	Cricket*	Controlled	Cross-sectional
STI	Athlet*	Tennis*	Random*	Case-control
STD	Soccer*	Hockey*	trial*	Quasi-experimental
Human immunodeficiency virus	Football*	Rugby*	Compar*	Pre and post
	Basketball*	Baseball*		
	wrestl*	golf*		

* Indicates wildcard search term, allowing any variations on the term following the asterisk

Table 6 Annex 2: Contacts and details of grey literature search

Last	Title	First	Organisation	Location	Sent date	Reply date	Detail
Ahlgren	Mr.	Taylor	Sports for Peace and Life	Sudan	31-Jan-11	02-Mar-11	Suggested contacting Zak Kaufman
Geddes	Mr.	Mike	Kick4Life	Lesotho	20-Jan-11	16-Apr-11	Sent 2 citations
Oliver	Mr.	Ian	Sports for Life	Africa	06-Oct-11	02-May-11	Recommended Lifshitz
Okoko	Mr.	Lungi	Africare	Africa	06-Oct-11	02-May-11	Sent 10 reports
Sanders	Ms .	Deidra	Athletes United for Social Justice	USA	02-May-11	02-May-11	Sent 1 report
Bergholz	Mr.	Lou	Edgework Consulting	Global	30-May-11	30-May-11	Sent Maro study
Dillingham	Dr.	Rebecca	UVA School of Medicine/Global Health	Global	11-Jul-11	19-Jul-11	Referred Michael Sinclair
Sinclair	Mr.	Michael	Director, Kaiser Family Foundation Program in South Africa	South Africa	19-Jul-11	19-Jul-11	Referred Frieda Subklew and suggested contacting Football for Hope
Lifshitz	Mr.	Wayne	CARE	Global	20-Jul-11	20-Jul-11	Bounced
Generic			Sisonke HIV/AIDS Project (EDUCOAFRICA)	South Africa	20-Jul-11	20-Jul-11	Alison Lee responded, sent 1 paper, suggested contacting Grassroot Soccer
Generic			Umzingisi Foundation (YDF Curriculum)	South Africa	20-Jul-11	20-Jul-11	Nick Mould responded, said it would be tough to find studies, but that Umzingisi is interested in final report. Said Umzingisi administers pre and post surveys with participants, but no control. Suggested contacting Grassroot Soccer
Phillips	Ms .	Anna	Girls Kick It	Uganda	20-Jul-11	20-Jul-11	Out of contact until 5 Aug
Generic			National University of Rwanda Anti HIV/AIDS Youth Club	Rwanda	20-Jul-11	20-Jul-11	Bounced
Cronin	Dr.	Orla	Orla Cronin Social Science Research and Strategic Consultancy	Global	20-Jul-11	20-Jul-11	Sent 12 citations
D'Souza		Tanya	Right to Play	Global	20-Jul-11	20-Jul-11	Will Bennet responded, suggested contacting Grassroot Soccer
Subklew		Frieda	Research Director at LoveLife	South Africa	19-Jul-11	20-Jul-11	LoveLife study will be complete in September

Table 6 continued

Last	Title	First	Organisation	Location	Sent date	Reply date	Detail
Chalat	Ms .	Alexandra	Beyond Sport Awards	Global	20-Jul-11	21-Jul-11	Referred Lou Bergholz (Edgework Consulting) and Brooke Wurst (Triad Trust)
Rosenbauer	Ms .	Brooke	A Ganar (Partners of the Americas)	Latin America	20-Jul-11	21-Jul-11	No contributions
Tuohey	Mr.	Brendan	Peace Players	Global	20-Jul-11	21-Jul-11	Tal Alter responded, suggested contacting Grassroot Soccer
Nange		George	Kicking AIDS Out	Africa	20-Jul-11	21-Jul-11	Sent 6 citations
Knight		Joanna	UK Sport	Global	20-Jul-11	21-Jul-11	Asked for copy of review when finished. Sent 3 citations. Suggested contacting Davies Banda and Oscar Mwaanga
Barrell	Ms .	Clare	UK Sport	Global	21-Jul-11	21-Jul-11	Fwd'ed email to colleagues, Melissa and Marizanne, and asked them to contact me directly. No response from them
Generic			International Platform for Sport and Development	Global	20-Jul-11	23-Jul-11	Chris Middleton responded, suggested sportanddev.org "Docs" section
Chawansky		Megan	Women Win	Global	20-Jul-11	23-Jul-11	Fwd'ed email to Cassie Clark at U Johannesburg
Wurst		Brooke	CEO of Triad Trust	Africa	20-Jul-11	24-Jul-11	Will send info on new evaluation tool she is designing, but no papers now.
Rajan		Radha	International Center for Research on Women (ICRW)	USA	03-Oct-11	03-Oct-11	Referred to Efua Orleans-Lindsay
Orleans-Lindsay		Efua	FHI 360	USA	04-Oct-11	04-Oct-11	Shared slides from APHA annual meeting (Rajan et al.)
Wardell	Mr.	Chris	Football for Life	St Lucia, Belize	02-Jan-11		Bounced
Mwango	Mr.	Michael	EduSport	Zambia	19-Jul-11		No response
Forde Owuor	Ms .	Sara	Moving the Goalposts Kilifi	Kenya	19-Jul-11		No response
Tsoari	Mr.	George	PlaySoccer	South Africa	20-Jul-11		No response
Generic			Love Life	South Africa	20-Jul-11		No response
Generic			Sports Coaches' Outreach	Africa	20-Jul-11		No response

Table 6 continued

Last	Title	First	Organisation	Location	Sent date	Reply date	Detail
Peacock-Friedrich	Ms .	Paola	Football for an HIV Free Generation	Africa	20-Jul-11		No response
Generic			Laureus Sport for Good	Global	20-Jul-11		No response
Cranmer	Ms .	Ziba	Nike/Ashoka Changemakers	Global	20-Jul-11		No response
Generic			rSt. Paul's Anglican Children	Zambia	20-Jul-11		No response
Mwamba Bukula	Mr.	David	Roan Youth Development	Zambia	20-Jul-11		No response
Generic			Witaba Foundation	Kenya	20-Jul-11		No response
Kaila	Ms .	Kelly	Kalim Sports Council	Zambia	20-Jul-11		No response
Generic			Football for Peace	Global	06-Apr-11		No response
Woodcock	Dr.	Alison	Royal Holloway University of London	Global	21-Jul-11		No response
Booth	Dr.	Mark	Durham University	Global	20-Jul-11		No response
Pitchon	Mr.	Tom	Laureus Sport for Good	Global	20-Jul-11		No response
Evju		Bjorn	Norwegian Olympic and Paralympic Committee Confederation of Sports (NIF)	Global	20-Jul-11		No response
Hare		Darcy	Sport England	UK	20-Jul-11		No response
Hatton		Damian	Street Football World	Global	20-Jul-11		No response
Trotter		Lizzie	The Football Foundation	Global	20-Jul-11		No response
Mwa anga		Oscar	Lecturer, Solent University	Africa	20-Jul-11		No response
Kay	Dr.	Tess	Professor of Sport and Social Sciences	Global	20-Jul-11		No response
Ban da		Davies	Senior Lecturer, Sport Policy & Development	Africa	20-Jul-11		No response

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