

Evaluation of a School-based Physical Activity and Fundamental Movement Skill Intervention for Children Living in Low-income Communities: The Supporting Children's Outcomes using Rewards, Exercise and Skills (SCORES) Cluster Randomised Controlled Trial

Kristen Emilie Cohen (nee Weaver)

University of Newcastle, Australia



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Kristen Emilie Cohen (nee Weaver)

B Teaching (Secondary) / B Health and Physical Education (Hons)

University of Newcastle, Australia

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**Doctor of Philosophy** 

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### **Statement of Originality**

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968.

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**Name:** Kristen Emilie Cohen (*nee Weaver*)

**Date:** 22/12/2015

# **Thesis by Publication**

I hereby certify that this thesis is in the form of a series of published papers of which I am a joint author. I have included as part of this thesis a written statement from each co-author, endorsed by the Faculty Assistant Dean (Research Training), attesting to my contribution to the joint publications.

Signed:

Name: Kristen Emilie Cohen (nee Weaver)

**Date:** 22/12/2015

### **Supervisors**

# **Primary supervisor**

Professor David Lubans

Priority Research Centre for Physical Activity and Nutrition

School of Education

Faculty of Education & Arts

University of Newcastle, Australia

# **Co-supervisors**

Professor Philip Morgan

Priority Research Centre for Physical Activity and Nutrition

School of Education

Faculty of Education & Arts

University of Newcastle, Australia

Professor Ronald Plotnikoff

Priority Research Centre for Physical Activity and Nutrition

School of Education

Faculty of Education & Arts

University of Newcastle, Australia

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### Publications arisisng from this thesis

This thesis is presented as a series of six papers. I am the lead author on four papers and am co-author for two papers. At the time of submission, five of these papers were published and one was under review.

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#### **Presentations arisisng from this thesis**

I presented results arising from this thesis at two international and two national conferences (three oral presentations; one poster presentation). Co-authors presented results arising from this thesis at one international and one national conference (two oral presentations).

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# List of Abbreviations

BMI	Body mass index
BMI z-score	Body mass index z-score
CI	Confidence interval
CMT	Competence Motivation Theory
CONSORT	Consolidated Standards Of Reporting Trials
FMS	Fundamental movement skills
Kg	Kilogram
Min	Minutes
MVPA	Moderate-to-vigorous physical activity
Ν	Number
NSW	New South Wales
PA	Physical activity
PE	Physical education
RCT	Randomised controlled trial
SCORES	Supporting Children's Outcomes using Rewards, Exercise and Skills
SD	Standard deviation
SDT	Self-Determination Theory
SEIFA	Socio-economic indices for areas
SES	Socio-economic status
SPANS	Schools Physical Activity and Nutrition Survey
TGMD-2	Test of Gross Motor Development 2
WHO	World Health Organisation

*Note*. This list represents the abbreviations used in the main text of this thesis. Additional abbreviations in tables are defined in the bottom row.

# Definitions

Adolescent	Individuals 13-18 years of age.
Child	Individuals 5-12 years of age.
Fundamental	Gallahue and Donnelly define FMS as 'an organised series of
movement skills	basic movements that involve the combination of movement
	patterns of two or more body segments' [1]. In this thesis FMS
	will be categorised as locomotor skills (i.e., run, jump, skip,
	side gallop, gallop, and hop), object-control skills (i.e.,
	overarm throw, underhand roll, kick, two-hand strike, catch,
	and dribble) and overall FMS (i.e., locomotor skills and object-
	control skills).
Physical activity	The WHO defines physical activity as 'any bodily movement
	produced by skeletal muscles that requires energy expenditure'

Youth Individuals 5-18 years of age.

[2].

#### **Thesis Abstract**

### Background

Many Australian children are insufficiently active to accrue the associated health benefits. Physical activity levels are also consistently lower among children of low socio-economic status (SES) than children of middle- and high-SES. Physical activity levels decline dramatically during adolescence and evidence suggests that competency in a range of fundamental movement skills (FMS) may serve as a protective factor against this trend. Schools offer an ideal setting to promote physical activity and increase FMS competency in children. However, previous school-based interventions have had small effects on increasing children's physical activity, which may be attributed to the lack of a theoretical framework for guiding behaviour change, failure to address the multiple components that influence physical activity behaviour in and beyond the school setting, and methodological weaknesses. Currently, an evidence gap exists for effective, theoretically framed, multicomponent school-based physical activity and FMS interventions for children located in low-income communities.

### Objectives

This thesis by publication presents a series of studies that were conducted to address this gap in the literature. Overall, these studies relate to: i) the utility of FMS for promoting physical activity in children and the effectiveness of FMS interventions; and ii) the development of the primary school-based Supporting Children's Outcomes using Rewards, Exercise and Skills (SCORES) intervention and its evaluation via a cluster randomised controlled trial (RCT).

The primary aim of this thesis was to evaluate the impact of the SCORES intervention on moderate-to-vigorous physical activity (MVPA), cardiorespiratory fitness and FMS competency among children attending primary schools located in low-income communities. Further, the thesis presents a series of studies investigating four key secondary aims, which are briefly described below. As these studies provide important context for the primary aim, the thesis is presented in the following order:

Secondary Aim 1: To systematically review the evidence of interventions designed to improve FMS competency in typically developing children and adolescents.

A literature search with no date restrictions was conducted across seven databases. Studies included any school-, home-, or community-based intervention for typically developing youth with clear intent to improve FMS competency and that reported statistical analysis of FMS competence at both pre-intervention and at least one other post-intervention time-point. Study designs included RCTs using experimental and quasi-experimental designs and single group pre-post trials. Risk of bias was independently assessed by two reviewers. Twenty-two articles (six RCTs, 13 quasiexperimental trials, three pre-post trials) describing 19 interventions were included. All but one intervention were evaluated in primary/elementary schools. All studies reported significant intervention effects for  $\geq$  one FMS. Meta-analyses revealed large effect sizes for overall gross motor proficiency (standardized mean difference [SMD] = 1.42, 95% confidence interval [CI] 0.68 to 2.16, Z = 3.77, p < .0002) and locomotor skill competency (SMD = 1.42, 95% CI 0.56 to 2.27, Z = 3.25, p = .001). A medium effect size for object control skill competency was observed (SMD = 0.63, 95% CI 0.28 to 0.98, Z = 3.53, p = .0004). Risk of bias was high among the majority of studies.

Secondary Aim 2: To examine the association between FMS competency and objectively measured MVPA during time periods of the day that represent key physical activity opportunities (i.e., lunchtime, recess and after-school) among children attending primary schools located in low-income communities.

Using baseline data from the SCORES cluster RCT, multilevel linear mixed models were used to assess the cross-sectional associations between FMS and objectively measured MVPA. After adjusting for age, sex, BMI and SES (measured at the individual level), locomotor skill competency was positively associated with total MVPA (p = 0.002, r = 0.15) and after-school MVPA (p = 0.014, r = 0.13). Object-control skill competency was positively associated with total MVPA (p < 0.001, r = 0.20), lunchtime MVPA (p = 0.03, r = 0.10), recess (p = 0.006, r = 0.11) and after-school MVPA (p = 0.022, r = 0.13).

Primary Aim: To evaluate the impact of the Supporting Children's Outcomes using Rewards, Exercise and Skills (SCORES) intervention on MVPA, cardiorespiratory fitness and FMS competency among children attending primary schools located in low-income communities.

The SCORES intervention, which was a multi-component physical activity and FMS intervention for primary schools located in low-income communities, was evaluated using a cluster RCT. The socio-ecological model provided a framework for the 12month intervention, which included the following components: teacher professional learning, student leadership workshops, physical activity policy review, equipment packs, parental engagement via newsletters, FMS homework and a parent evening, and community partnerships with local sporting organisations. The sample included 25 classes from eight primary schools located in low-income communities. Participants were 460 children (54.1% girls) aged 8.5  $\pm$  0.6 years. Primary outcomes were objectively measured MVPA (ActiGraph GT3X and GT3X+ accelerometers), FMS competency (TGMD-2; six locomotor and six object-control skills), and cardiorespiratory fitness (20 meter multistage fitness test) assessed at baseline, midprogram (6-months) and posttest (12-months). Linear mixed models, adjusted for sex, age, BMI-z score, SES, ethnicity and school class (as a random factor), were used to assess the impact of the intervention. At mid-program, there were no significant intervention effects for any of the outcomes. At posttest, (study's primary time point), there were intervention effects for daily MVPA (adjusted mean difference, 12.7 MVPA mins/day; 95% CI 5.0 to 20.5), overall FMS competency (4.9 units; 95% CI -0.04 to 9.8), and cardiorespiratory fitness (5.4 laps; 95% CI 2.3 to 8.6).

Secondary Aim 3: To determine if changes in FMS competency and perceived competence mediate the effect of the SCORES intervention on MVPA and cardiorespiratory fitness among children attending primary schools located in low-income communities.

Mediation analyses were conducted using multilevel linear analysis in MPlus. There were significant treatment effects for locomotor skills (A = 1.76, SE = 0.88, p = 0.044) and overall FMS (A = 4.09, SE = 2.08, p = 0.049). Changes in MVPA were xxv

associated with changes in object-control skills (B = 0.86, SE = 0.15, p < 0.001), overall FMS (B = 0.51, SE = 0.10, p < 0.001) and perceived competence (B = 0.48, SE = 0.36, p = 0.027). Overall FMS had a significant mediating effect on MVPA (AB = 2.09, 95% CI 0.01 to 4.55). Overall FMS (AB = 1.19, 95% CI 0.002 to 2.79) and locomotor skills (AB = 0.74, 95% CI 0.01 to 1.69) had a significant mediating effect on cardiorespiratory fitness.

Secondary Aim 4: To determine if changes in individual, social and physical environmental constructs mediate the effect of the SCORES intervention on MVPA among children attending primary schools located in low-income communities.

Hypothesised mediators measured in children via questionnaire were enjoyment of physical activity, perceived sport competence, and perceived social support. Hypothesised mediators measured in parents via questionnaire were social support from family, access to physical activity facilities and equipment at home, and perceived access to physical activity opportunities in the local community. Mediation analyses were conducted using multi-level linear analysis in MPlus. There were significant intervention effects for social support from teachers (A = 1.73, SE = 0.88, p = 0.048) and perceived access to physical opportunities in the local community (A = 2.69, SE = 1.12, p = 0.016). There were significant associations between changes in perceived sport competence (B = 0.48, SE = 0.36, p = 0.027), perceived access to physical activity opportunities in the local community (B = 0.60, SE = 0.26, p = 0.021), and changes in total MVPA. Perceived access to physical activity opportunities in the local community mediating effect on total MVPA (AB = 1.61, 95% CI 0.06 to 3.95).

### Discussion

The studies included in this thesis contribute to the growing body of evidence for the utility of FMS to promote physical activity in children and the effectiveness of FMS and physical activity interventions. This thesis revealed that school- and community-based programs that include developmentally appropriate FMS learning experiences delivered by physical education (PE) specialists or highly trained classroom teachers significantly improve FMS competency in young people. In addition, object-control

skill competency was found to be a better predictor of children's MVPA during school-based physical activity opportunities than locomotor skill competency. In contrast, both object-control and locomotor skill competency were important for engagement in after-school MVPA. The SCORES intervention maintained daily MVPA, improved overall FMS competency and increased cardiorespiratory fitness among children attending primary schools in low-income communities. Of note, these effects were achieved without allocating additional curriculum time to PE or school sport. This provides evidence for the effectiveness of theoretically-framed, multi-component school-based physical activity and FMS interventions for children. Further, this was the first study to explore the mediating effects of FMS competency in a physical activity intervention in children. Improvements in overall FMS competency acted as a causal mechanism for physical activity behaviour change and subsequent improvements in cardiorespiratory fitness among children. Perceived access to physical activity opportunities in the local community was also identified as a mechanism of physical activity behaviour change in children. Additional research is needed to replicate the novel findings in this thesis and follow-up assessments beyond the post-intervention time point are needed to determine any sustained or long-term effects of future physical activity and FMS interventions.

## **Contribution Statement**

This thesis contains four peer reviewed publications that relate to the SCORES cluster RCT. I was the sole PhD student of this study and I was involved in all aspects of the design, implementation and evaluation of the intervention. A summary of the contributions that I made to this study is provided below.

### **Intervention development**

In collaboration with my supervisors, I lead the development of the following SCORES intervention components.

1)	Professional learning	• Content and resources for the Stage 2 teachers'
	workshops for teachers	professional learning workshops.
		• Content and resources for the whole-school
		professional learning workshops.
		• FMS activity book and activity cards.
2)	Student leadership	<ul> <li>Content and resources for the student leadership workshop.</li> <li>SCORES Leader handbook for students.</li> </ul>

- Policy and environment
   Conducted a review of effective school physical activity policies which guided the development of the school physical activity policies.
  - Implementation strategies and resources for the school physical activity policies.
  - Selected and ordered appropriate equipment that would promote physical activity and FMS development in the school.
- 4) Parental engagement Content for the four parent newsletters.
  - Content and resources for the parent evenings.
  - Content and resources for the FMS homework.

5) Community links • Local sporting organisations information sheets.

### Data collection, entry and management

With our research assistant, I was responsible for planning and coordinating the comprehensive study assessments. The participants completed three assessment sessions over the 12-month study period at their primary school. With our research assistant, I created a standardised protocol manual for completing and administering the assessments. I also conducted comprehensive training sessions for all study assessors. With assistance from our research assistants, I was involved in the assessments at all time-points, as well as conducted a detailed process evaluation. I assisted the study research assistants with data entry, and was responsible for cleaning all entered data.

### **Program implementation**

With support from my supervisors, I successfully implemented the five intervention components, as listed below, in the four intervention schools and following study completion, in the four control schools. Further, I was also the contact person for schools and parents during the study and was responsible for managing all enquires.

- Professional learning workshops for teachers
   Conducted one Stage 2 teachers' professional learning workshop.
  - Conducted four whole-school professional learning workshops.
  - Conducted three PE lesson observations for 12 Stage 2 teachers.
- 2) Student leadership Conducted four student leadership workshops.
- 3) Policy and environment
   Conducted four school physical activity policy meetings with school principals.
  - Conducted four whole-school workshops on

implementation of the school physical activity policies.

- Distributed sporting equipment to four schools.
- 4) Parental engagement
   Distributed the four newsletters to parents / carers of the study participants.
  - Organised and conducted four parent evenings.
  - Distributed and explained the FMS homework to four schools.
- 5) Community links
   Organised six visits to each school from local sporting organisations.
  - Distributed local sporting organisations information sheets.

# Data analysis

With support from my supervisors, I completed the statistical analysis for the studies in Chapters Four to Seven of this thesis.

## **Presentation of Results**

During my candidature, I presented results from my thesis at two international and two national conferences. These presentations are listed in the 'Presentations arising from this thesis' section.

# Awards received during candidature

In 2014, I won an award at the Priority Research Centre for Physical Activity and Nutrition for 'best published paper' in the Physical Activity and Nutrition in Schools theme. In 2015, I won a University award for best paper in the Faculty of Education and Arts.