



Examining the Effects of a HIIT-based Fitness Education Curriculum

Yang Liu¹; Baofu Wang¹; Jared Androzzi², Ph.D.; Xiangli Gu³, Ph.D.; and Senlin Chen¹, Ph.D.

¹Louisiana State University, Baton Rouge, LA, ²Winthrop University, Rock Hill, SC, ³University of Texas at Arlington, Arlington, TX

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Background - HIIT: What is it?

- **HIIT** (high-intensity interval training) refers to a type of physical training modality that alternates between intensive movement and interspersed recovery breaks.
- **Similar terms:**
 - High intensity intermittent exercise (HIIE)
 - Sprint interval training (SIT)
- **Example:** Tabata training (20s/10s)

Background – HIIT Utility

- **HIIT is a popular method to train athletes at all levels** (Eddolls, McNarry, Stratton, Winn, & Mackintosh, 2017)
- **HIIT is an appropriate & effective training method to improve fitness, body composition, cardiometabolic biomarkers, and physical activity (PA)** (Baquet et al., 2010 ; Lambrick et al., 2016; Weston et al., 2016)
- **HIIT is low cost:**
 - Short Duration
 - Minimal Space/Equipment Required

Background – Research Gap

- **Existing studies have mainly explored**
 - Health/fitness impact of HIIT
 - Context: Controlled lab experiments
 - Sample Size: Small (N)
- **Currently unavailable**
 - Larger-scale HIIT-based curriculum intervention on adolescents' PA and sedentary behavior in a real school context

Background - Youth Physical Activity

Longitudinal Study

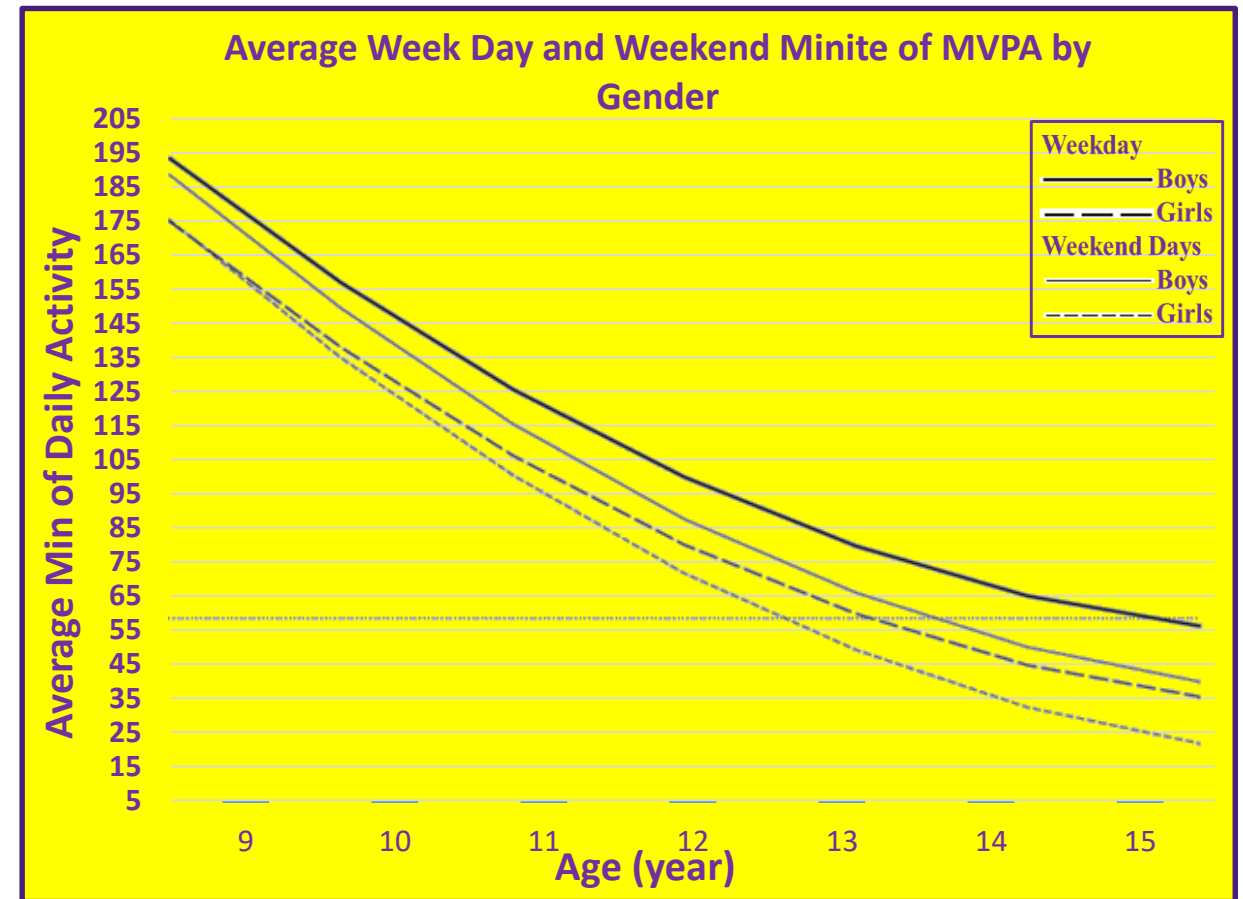
- ActiGraph uniaxial accelerometer
- Tracked from 9 to 15 years old
- N = 1032

Main Results: MVPA declines annually

- Weekdays: 37 mins per year
- Weekend: 39 mins per year

Cross-Sectional Study

- 42% of American children, ages 6-11 with ≥ 60 mins MVPA/day;
- 8% American adolescents, ages 12-19 with ≥ 60 mins MVPA/day.



Sources and Figures were cited from Nader et al. (2008;2009) JAMA; Troiana et al. (2008) MSSE.

Purposes

- This study is to explore
 - The extent to which a HIIT-based fitness education curriculum influences physical activity and sedentary behavior among adolescents;
 - And the mediation role of physical activity and fitness knowledge (PAF) on the intervention effect.

Methods

- **Design:** Quasi-experimental (non-randomization)
- **Participants:** $N = 233$ (boys = 36.1%)
 - 6th grade = 74; 7th grade = 77; 8th grade = 81
- **Context:** One middle school located in southeastern U.S.
- **Two Arms**
 - Intervention: received HIIT-based PE curriculum
 - Control: received regular local PE curriculum

Methods – HIIT curriculum module

- **Content:** Eight scripted lesson plans & ancillary materials
- **Lesson Length:** 20 – 30 min (embedded in 50 min PE)
- **Weekly Frequency:** 2 – 3 lessons
- **Duration:** 8 weeks
- **Features:** Themed HIIT exercises (i.e., TABATA)
 - One theme/week across 8 weeks
 - See table in next slide
- Teach concepts related to physical activity and fitness
 - e.g., F.I.T.T. principles and fitness training principles
 - Knowledge taught was reviewed in the following class

Methods – HIIT curriculum sequence & units

Week	Themes	Design Considerations	Exercises
1	Tabata	Frequency: 3x per wk Intensity: 65 – 90 % Heart Rate (HR)max (Increase intensity by week) Time: 10–20 min per lesson (20s/10s ratios) for 8 weeks; Type: HIIT training using fitness exercises and sports drills Training principles: Progression, overloading, specificity, & variation.	Push-ups, High Knee Run, Supine Flutter Kicks, Tuck Jumps
2	Basketball		Push-ups, Fire Feet, Sitting Twists Jump Squats (add arm thrust)
3	Kick Boxing		Alternating L/R Punches, Alternating L/R Kicks, Planks, Bounce Steps with Punches
4	Running or jump roping		Running in Place, Air Jump Rope Air Jump Rope Switching Legs, Burpees (Running and Jump Rope)
5	Zumba, dance, rhythmic movement		Arm Circles while Marching in Place, Step Back Knee Up Alternate, Twisting Jumps, Knees to Elbows
6	Student adopts, modifies, or creates a HIIT		Student Choice
7	Student adopts, modifies, or creates a HIIT		Student Choice
8	Group Presentation		Student Choice

Methods - Instrumentation

- **PA and sedentary behavior: YAP (youth activity profile)** (Saint-Maurice, & Welk, 2015)
 - Self-reported
 - 15 question items
 - Acceptable validity and reliability
- **Dimensions: PA at school (PAS), PA after school (PAAS), sedentary behavior (SB)**
 - PA overall (PA): PAS and PAAS together
- **Scoring**
 - Five-level Likert Scale
 - Five items to each dimension
 - Average all item score to each dimen.

PAS Example: How many days did you walk or bike to school? (If you can't remember, try to estimate)."
Question choices include "(a) 0 days (never)," "(b) 1 day," "(c) 2 days," "(d) 3 days," and "(e) 4–5 days (most every day)."

Methods - Instrumentation

- **PAF knowledge: PE Metrics** (National Association for Sport and Physical Education [NASPE], 2011)
 - Nine performance descriptors (PDs) & 29 question items
 - 14 relevant question items were selected to reflect knowledge level
 - **PD #1:** item 1 + item 4; **PD #3:** item 7 + item 8 + item 9; **PD #6:** item 13 + item 14, item 16 + item 17; **PD #7:** item 22 + item 23; **PD #8:** item 24 + item 25 + item 26
 - **PD meanings.** **PD #1:** knowledge of physical activity participation as part of a healthful lifestyle; **PD #3:** knowledge about the characteristics of health-enhancing physical activity; **PD #6:** Applying training principles for health-related fitness; **PD #7:** identifying principles to improve fitness; **PD #8:** knowing the factors related to body composition.

Methods - Instrumentation

- **PAF knowledge: PE Metrics** (NASPE, 2011)
 - **Example question:** Mary performs stretching exercises and runs most days of the week to be able to increase her.
 - A. Arm and shoulder strength.
 - B. Muscle endurance and abdominal strength.
 - C. Flexibility and aerobic endurance (correct answer).
 - D. Flexibility and body weight
 - **Evaluation**
 - Percentage of correctly responded items (%)
 - e.g., correct response = 20; score: $20/29 = 68.97\%$

Methods – Data Collection & Analyses

- **Assessments two time points:**
 - Baseline and post intervention for both groups
- **Path analyses**
 - Exam whether HIIT curriculum (HIIT vs. Control) would improve physical activity and sedentary behavior through PAF knowledge, after controlling for covariates (*i.e.*, gender, race, ethnicity, grade level, and body mass index).

- **Descriptive**
 - **Group by time PAF knowledge**
 - For mean & SD, please see another slide
- **Inferential**
 - **Baseline model (Figure 1)**
 - PAF knowledge favored control ($\beta = -0.15, z = -2.14, p = 0.03, r^2 = 0.02$)
 - No association between PAF knowledge and YAP dimensions
 - **Posttest model (Figure 2)**
 - PAF knowledge favored HIIT ($\beta = 0.27, z = 4.06, p < 0.01, r^2 = 0.07$)
 - No association between treatment and YAP dimension

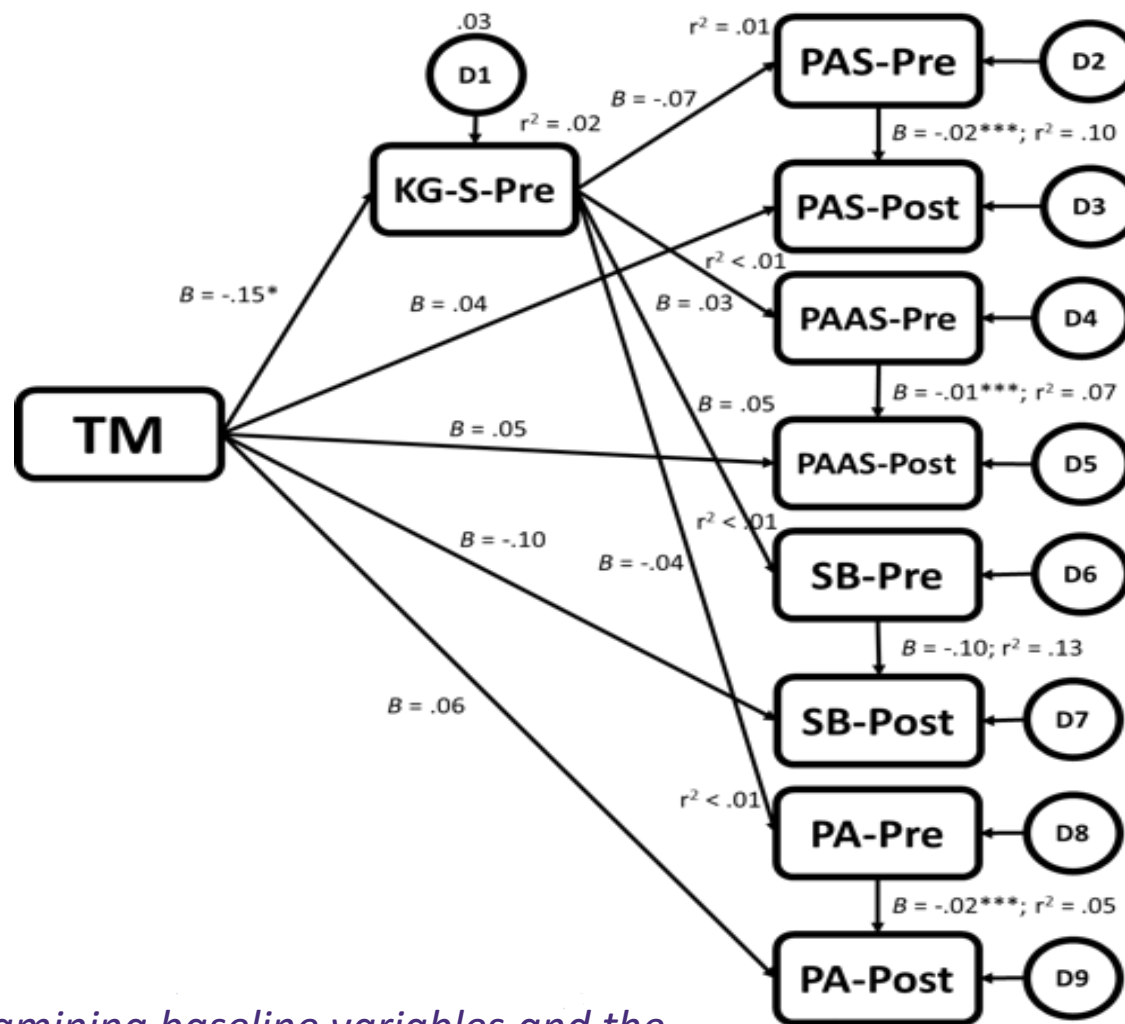
Results

- Inferential
 - Changes of outcome variables (Figure 2, 3, 4)
 - PAF knowledge change favored HIIT ($\beta = 0.37, z = 5.76, p < 0.01, r^2 = 0.14$; Figure 2)
 - PA change favored HIIT ($\beta = 0.15, z = 2.10, p = 0.04, r^2 = 0.09$; Figure 4)
 - Association between PAF knowledge change and SB behavior change ($\beta = 0.21, z = 3.01, p < 0.01, r^2 = 0.15$; Figure 3)
 - Knowledge change impacts the SB change beyond the impact of curriculum treatment ($\beta = .08, z = 2.67, p = .01, r^2 = .15$; Figure 3).

Results – Group by Time

			PAF Knowledge	Physical Activity and Sedentary Behavior			
				PAS	PAAS	SB	PA
HIIT							
	Pre	<i>M</i>	52.9%	2.66	3.35	3.04	3.01
		<i>N</i>	103	106	106	108	105
		<i>SD</i>	18.2%	0.7	0.9	0.78	0.61
	Post	<i>M</i>	62.1%	2.67	3.4	3.06	3.04
		<i>N</i>	98	103	102	100	102
		<i>SD</i>	16.4%	0.74	0.86	0.82	0.61
		Post - Pre	0.09	0.01	0.05	0.02	0.03
		Cohen's d	0.53	0.01	0.06	0.02	0.05
Control							
	Pre	<i>M</i>	58.2%	2.73	3.4	3.16	3.06
		<i>N</i>	111	114	111	111	111
		<i>SD</i>	17.4%	0.88	0.87	0.69	0.71
	Post	<i>M</i>	50.7%	2.61	3.36	3.16	2.98
		<i>N</i>	104	109	107	104	107
		<i>SD</i>	19.5%	0.74	0.99	0.74	0.69
		Post - Pre	-0.08	-0.12	-0.04	0.00	-0.08
		Cohen's d	-0.41	-0.15	-0.04	0.00	-0.11

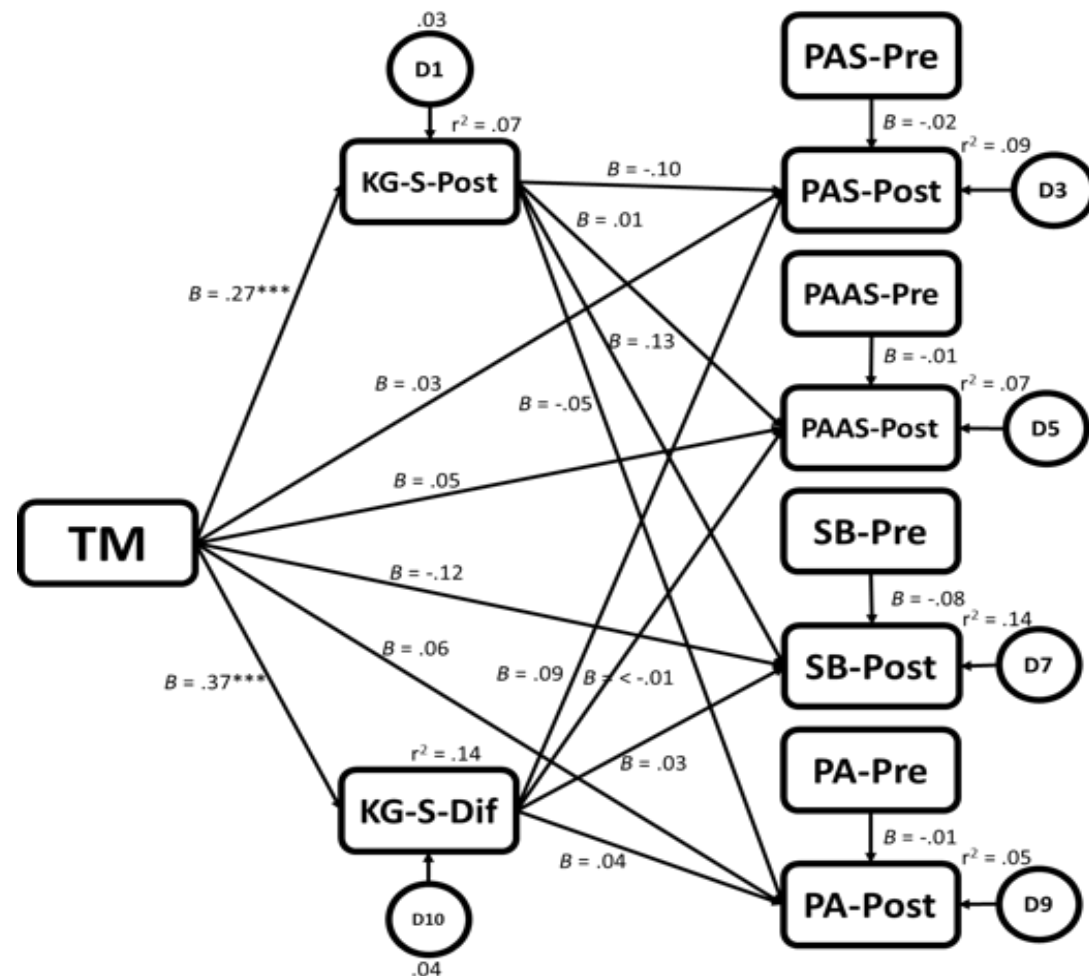
Results



Note. TM = curriculum treatment (HIIT vs. regular); KG-S-Pre = selected PAF knowledge (using 14 items) at pretest; PAS = physical activity at school; PAAS = physical activity after school; SB = sedentary behavior; PA = physical activity; Pre = pretest; Post = posttest.

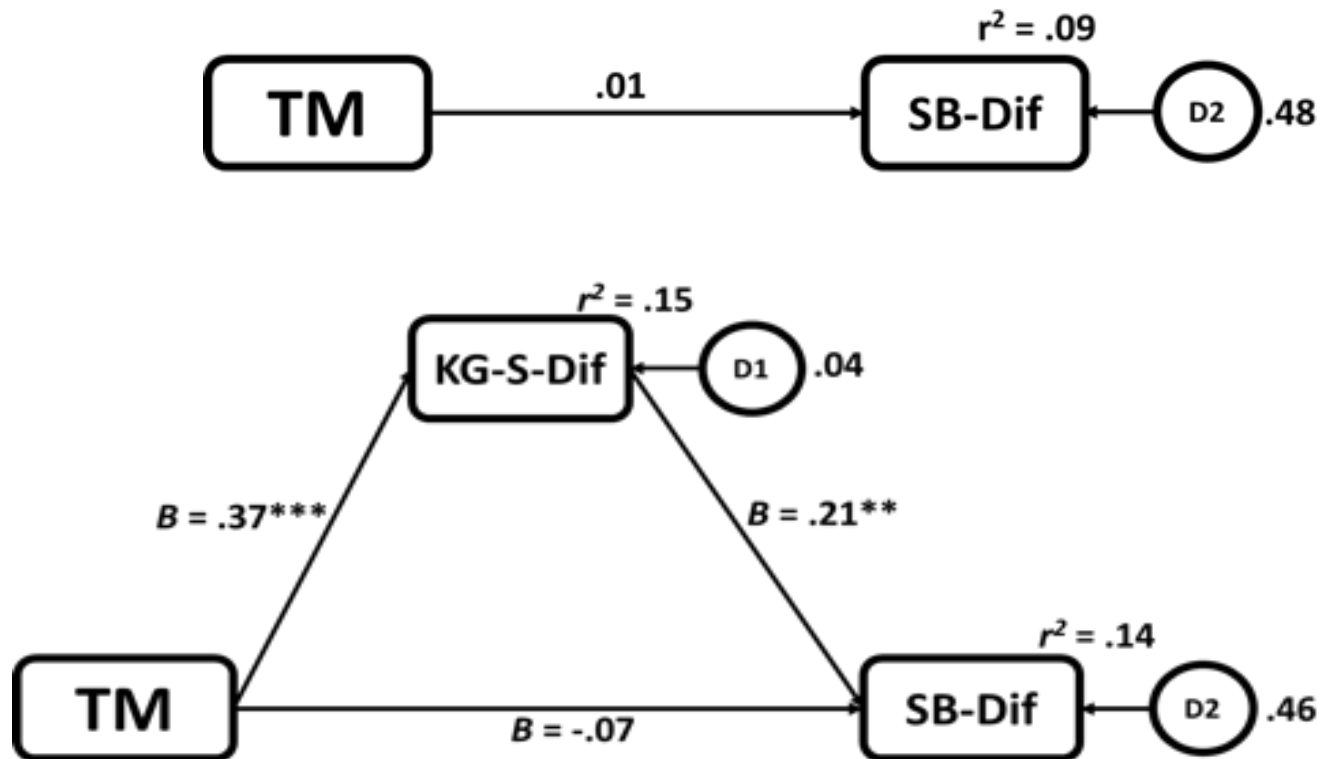
Figure 1. Model 1: Examining baseline variables and the impact of curriculum treatment on YAP dimension at posttest

Results



Note. TM = curriculum treatment (HIIT vs. Control); KG-S-Post = selected PAF knowledge (using 14 items) at posttest; KG-S-Dif = selected PAF knowledge (using 14 items) change: posttest minus pretest; PAS = physical activity at school; PAAS = physical activity after school; SB = sedentary behavior; PA = overall physical activity; Pre = pretest; Post = posttest.

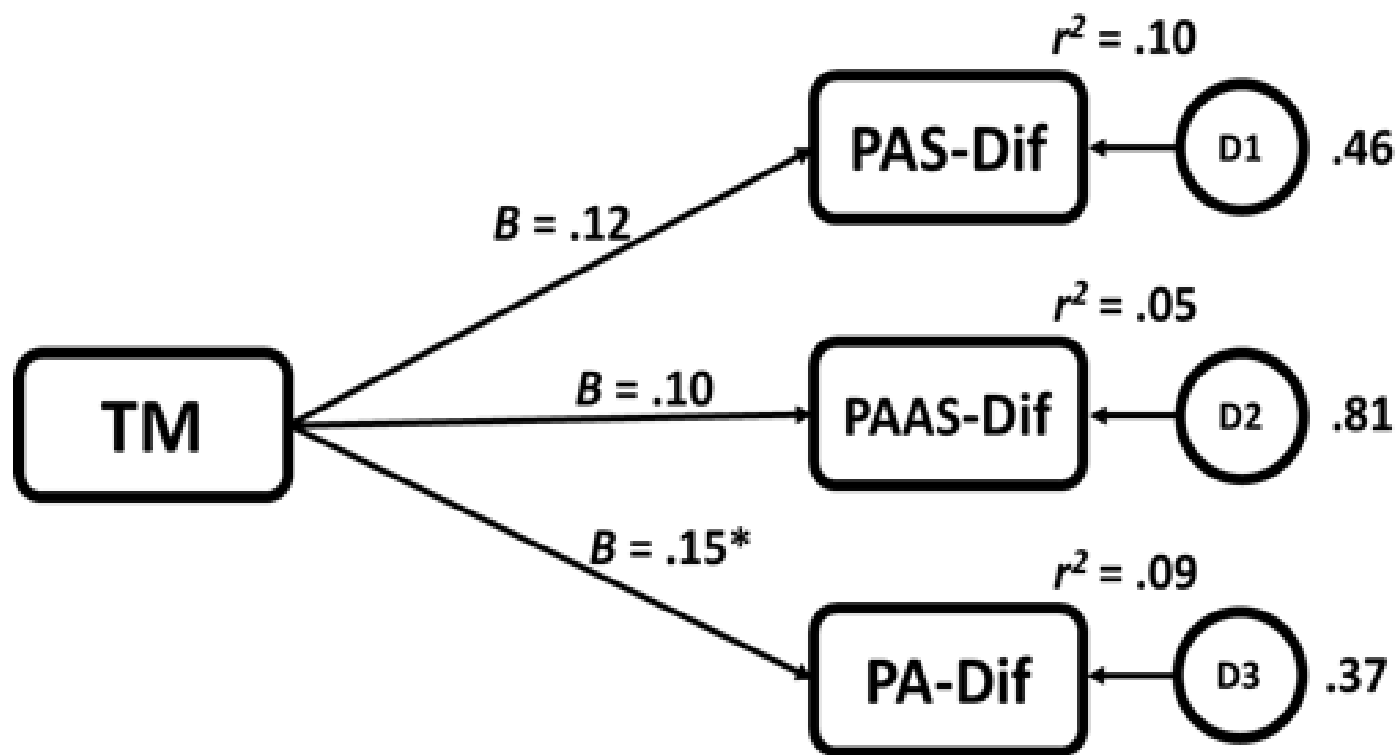
Figure 2. Model 2: Examining mediation of PAF knowledge between curriculum treatment and YAP dimensions at posttest



Note. TM = curriculum treatment (HIIT vs. regular); KG-S-Dif = selected PAF knowledge (using 14 items) change: posttest minus pretest; SB-Dif = sedentary behavior change: posttest minus pretest.

Figure 3. Model 3: Examining mediation of PAF knowledge change between the impact of curriculum treatment on SB behavior change

Results



Note. TM = curriculum treatment (HIIT vs. regular); PAS-Dif = physical activity at school change; PAAS-Dif: physical activity after school change; PA-Dif: overall physical activity change

Figure 4. Model : Examining the by group differences in the changes of PAS, PAAS, and PA.

Discussion

- HIIT-based PE curriculum intervention was able to improve adolescents' PAF knowledge.
- HIIT group members who have gained more knowledge tended to engage in less sedentary behavior.
- Adolescents' overall PA could be improved when exposed to HIIT-based intervention.

Conclusion

- The findings confirm the effects of the HIIT-based fitness education on middle school students' PAF knowledge and active-living behaviors.
- The experiment indicates the important role of improving students' PAF knowledge for reducing sedentary behavior.
- The findings provide empirical evidence to youth physical activity promotion.

LSU



Thank You



References

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