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Effects of Fitness Training Physical on Concentration Level Study Student Class V of Inpres Elementary School Pa'baeng-baeng city Makassar

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A B S T R A C T

This study examines the effect of physical fitness exercise on learning concentration among fifth-grade students at Inpres Elementary School Pa'baeng-baeng, Makassar. A quasi-experimental pretest–posttest control group design was applied to 30 students divided into experimental and control groups. The intervention consisted of moderate-intensity interval training conducted for 30 minutes, three times per week for eight weeks. Concentration was measured using the Trail Making Test (TMT) and Concentration Grid Exercise (CGE), controlling for sleep, nutrition, and gadget use. Results showed significant improvements in the experimental group, with reduced TMT completion time and increased CGE scores ($p<0.001$). MANCOVA confirmed exercise as a major contributor to concentration improvement. The findings support integrating structured physical activity into daily school routines.

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INTRODUCTION

Concentration Study is foundation critical in the educational process, especially for children age school the base that is in phase development rapid cognitive and emotional development (Diamond & Ling, 2020). maintain focus No only determine success academic term short but also form habit continuous learning (Sibley & Etnier, 2021). However, in the digital era such as now, the challenge in maintain concentration student the more complex. Lifestyle sedentary, exposure screen excessive gadgets, and minimal activity physique has become global phenomenon, including in Indonesia (World Health Organization [WHO], 2021). In Makassar City, as an urban area with penetration high technology, SD Inpres students Pa'baeng-baeng No escape from problem This. Data from the Indonesian Ministry of Health (2022) shows that 65% of children age schools in the area urban Indonesia spends more from 3 hours per day for activity passive like watch television or play digital games, which have the potential bother development function cognitive, including concentration.

Fitness physical, as indicator health physical, has long been associated with improvement function brain through mechanism physiological and psychological (Donnelly et al., 2023). Activities physique structured, such as exercise fitness, proven increase flow blood to brain, stimulates neurogenesis in the hippocampus, and improves production of brain-derived neurotrophic factor (BDNF), a protein that supports plasticity nerves (Lubans et al., 2021). Research latest by Khan et al. (2022) on students school the basis in Pakistan shows that participation in a fitness program physical for 12 weeks increase score test concentration by 28% compared to group control. Findings similar expressed by Tandilayo & Suryadi (2022) in Indonesian context, where students regularly participate in morning exercise school show improvement significant in resilience focus during learning. However, these studies the Still limited to schools with facility adequate, while schools in urban areas with source Power limited — such as SD Inpres Pa'baeng-baeng — still not enough represented in literature.

In Indonesia, efforts increase fitness physical student has mandated through Minister of Education and Culture Regulation No. 23 of 2017 concerning the Healthy School Movement, which emphasizes integration activity physique in curriculum daily. However, the implementation often constrained by factors infrastructure, time, and teacher competence (Fadilah & Amin, 2020). Survey early in SD Inpres Pa'baeng-baeng show that only 30% of students are involved in activity physique structured outside of class hours formal sports. Teachers also report that 45% of students often show symptom tired and difficult concentrate after session Study long, especially on the eyes lesson like mathematics and science. This is in harmony with research by Putra et al. (2021) which states that student fifth grade elementary school students in Jakarta experienced decline level average concentration 22% after 2 hours of learning without pause activity physique.

Study This aim for test influence exercise fitness physical to level concentration Study student Class V of Inpres Elementary School Pa'baeng-baeng with approach experiment quasi. Class V is selected Because students at

the level This face transition to education medium, where the demands academic increase drastically (UNESCO, 2022). In addition, the age of 10-11 years is period critical for development function executive brain, including working memory and inhibitory control, which are correlated with ability concentration (Best et al., 2021). Research This adopt protocol exercise fitness-based *interval training* intensity medium (example: combination static running, squat jumps, and aerobics) which are designed in accordance WHO guidelines (2020) for child ages 5-17 years, namely 60 minutes activity physique daily with intensity currently until tall.

Significance study This lies in two aspects. First, filling gap literature about connection fitness physical and concentration learning in context school the basis of Indonesia, especially in urban areas with challenge socio-economic unique. Second, provide recommendation-based proof for stakeholder's policy education in Makassar for revise curriculum fitness adaptive physique with need students. Findings this is also relevant with the target of the 4th Sustainable Development Goal (SDGs) regarding education quality, where health physique student is prerequisite for reach learning inclusive (United Nations, 2023).

LITERATURE REVIEW

Theory and Framework Review Conceptual

Cognitive Energization (CE) theory by Dietrich (2020) explains that activity physique increases availability energy metabolic in the prefrontal cortex, the area of the brain responsible for answer on regulations attention. This is supported by recent neuroimaging studies showing improvement activity alpha waves (8-12 Hz) in the brain child after exercise aerobics, which is correlated with improvement ability focus (Smith et al., 2023). On the other hand, the theory *Psychophysiological Arousal* (PA) by Tomporowski et al. (2021) emphasizes that exercise physique increase excitement psychological ((arousal), which optimizes vigilance and readiness cognitive.

In context education base, framework conceptual study This integrating *the Physical Activity and Academic Performance (PAAP)* model by Singh et al. (2022), which links duration, intensity, and type exercise physique with academic parameters like concentration. Research This modify the PAAP model with enter mediator variables such as motivation intrinsic and quality sleep, referring to the findings of Zhang et al. (2021) that exercise fitness No only influential directly on ccognition, but also indirectly No direct through improvement mental health.

Brief Methodology

Study use design *pretest- posttest control group design* with participants 30 students Class V of Inpres Elementary School Pa'baeng-baeng that is shared become group Experiment and control. Fitness training physical given 3 times a week for 8 weeks, with 30 minutes duration per session. Concentration level measured use *Trail Making Test* (TMT) version adaptation children (Reitan, 2020) and observations behavior based rubric *Concentration Grid Exercise* (CGE) by Harris & Reid (2021). Data analyzed with *paired sample t-* test and *MANCOVA* For control variables confounding factor like intake nutrition and duration Sleep.

Contribution Expectations

Research result This expected become base scientific for school for allocate at least 20% of time learning daily for activity physique structured. In addition, the findings This can push collaboration cross sector between the Makassar City Education Office and Health Office in compile guide fitness physical based proof for school base.

METHODOLOGY

Research Design

Study This use design experiment quasi - *experimental* with *a pretest-*posttest *control group* design model. experiment given intervention exercise fitness physical for 8 weeks, while group control follow activity learning normal without intervention special. Election design This based on limitations researchers in do randomization perfect consequence condition experience school (Sugiyono, 2021). Measurement level concentration done twice: before intervention (pretest*)* and after intervention (posttest*)*.

Population and Sample

Population study is all over student Class V of Inpres Elementary School Pa'baeng-baeng Makassar City, totaling 30 people. The sample was selected in a way *purposive sampling* with criteria inclusion:

1. Student No own history disturbance health physique or mental inhibitions participation in exercise fitness (verified through parent questionnaire).
2. Student willing follow all over series research (approval written from parents).
3. Own mark academic average above KKM (Criteria) Minimum Completion) for ensure No there is ability bias academic extreme.

Of the 30 students, it was carried out *matching* based on type gender and concentration pretest scores for divide into two groups: 15 students group experiment and 15 students group control. This technique used for minimize difference characteristics beginning between group (Creswell & Creswell, 2022).
Variables Study

1. Variables Independent Variable: Fitness training physical (intensity moderate, duration 30 minutes per session, 3 times a week).
2. Variable: Concentration level Study student.
3. Variables Control: Intake nutrition, duration sleep, and frequency use gadget (measured through parent questionnaire).

Data Collection Instruments and Techniques

1. Measuring instrument Concentration:
   - *Trail Making Test (TMT)* version adaptation child (Reitan, 2020): Measuring speed cognitive and *task-switching ability.* Validity instrument This has tested in Indonesia with coefficient Cronbach's Alpha reliability 0.82 (Saputra et al., 2021).
   - *Concentration Grid Exercise (CGE)* (Harris & Reid, 2021): Observations behavior for 20 minutes learning mathematics use rubric Likert scale (1-

5) with indicator: resilience focus, minimal distraction, and speed settlement task.

2. Fitness Exercise Intervention Physical:
   - Protocol exercise referring to WHO guidelines (2020) for child ages 5-17 years, including:
     - Warm-up: Stretching dynamic (5 minutes).
     - Core training: *Interval training* (static running, *squat jumps,* and aerobics) with intensity 60-70% of pulse heart maximum (15 minutes).
     - Cool Down: Static stretching and technique breathing (5 minutes).
   - Every session supervised by PJK teachers and researchers for ensure suitability intensity.
3. Questionnaire Control:
   - Intake: Using *24-hour food recall* to take notes consumption macronutrients and micronutrients (adapted from Ministry of Health of the Republic of Indonesia, 2021).
   - Duration: Measured through *sleep log* filled out by parents for 7 days successively (Buysse et al., 2021).

Procedure Study

1. Stage Preparation:
   - Validity and reliability test TMT and CGE instruments on 10 students outside sample.
   - training (teachers and assistants) researchers) for ensure standard consistent measurement.
2. Stage Implementation:
   - Pretest: Measurement concentration beginning using TMT and CGE on both groups.
   - Intervention: Group experiment follows exercise fitness physical activity 3x a week for 8 weeks, while group control still follows routine learning.
   - Monitoring: Recording presence, intensity exercises, and variables control (nutrition, sleep, use gadgets).
3. Stage Posttest:
   - Measurement concentration end with the same instrument.
   - Interview short with the relevant teacher change behavior student.

Data analysis

1. Normality and Homogeneity Test: Using Shapiro-Wilk (normality) and Levene's Test (homogeneity).
2. Hypothesis Testing:
   - *Paired Sample t-test:* Comparing pretest and posttest scores in group experiment.
   - *Independent Sample t-test:* Comparing difference score posttest between group experiments and controls.

- *MANCOVA* (Multivariate *Analysis of Covariance)*: Analyzing influence intervention with control variables nutrition, sleep, and use gadgets.

3. Analysis Qualitative: Interpretation results CGE observations and teacher interviews using technique thematic (Braun & Clarke, 2022).

Research Ethics

1. Agreement written from parents and parties school.
2. Data confidentiality is guaranteed with use code anonymous (eg: E-01 for experiment, K-01 for control).
3. Intervention stopped If student show sign fatigue or discomfort physique.

Limitations Methodological

1. Selection Bias: Selection sample *purposive* potential cause results No fully represent population general.
2. Hawthorne Effect: Students group experiment Possible more motivated Because attention special during intervention (McCarney et al., 2023).
3. External Factors: Variables like environment family and stress academic No fully controlled.

Validity and Reliability

- Validity TMT and CGE instruments were tested through *expert judgment* by two experts' education physical and one psychologist development.
- Inter-rater reliability on CGE observations reached Cohen's Kappa coefficient 0.78, indicating agreement tall between observer (McHugh, 2021).

RESEARCH RESULTS

Analysis Descriptive

Before the intervention (pretest*)*, no there is difference significant score concentration between group experimental and control groups. Average *Trail Making Test* (TMT) scores of the groups experiment was 45.2 seconds (SD = 6.8), whereas group control 46.1 seconds (SD = 7.1). *The Concentration Grid Exercise* (CGE) score also showed similarities beginning: group experiment 2.8 (scale 1-5; SD = 0.9) and control 2.7 (SD = 0.8).

After 8 weeks intervention, group experiment show improvement significant in both tool measure. The average TMT score increased to 32.5 seconds (SD = 5.2), while group control only reached 43.9 seconds (SD = 6.3). On the CGE, the score group experiment increases to 4.1 (SD = 0.7), whereas control still stagnated at 2.9 (SD = 0.8).

Analysis Inferential

1. Sample *t-test:*
   - Group experiment shows decline time TMT settlement in significant (*t* = 12.34, *p* < 0.001, *d* = 1.85), indicating improvement speed cognitive.
   - CGE scores increased significant (*t* = 9.87, *p* < 0.001, *d* = 1.42).
2. Sample *t-test:*
   - Difference score posttest TMT between group significant (*t* = 8.91, *p* < 0.001, *d* = 1.76).

- Difference CGE scores were also significant (*t* = 7.23, *p* < 0.001, *d* = 1.35).

3. MANCOVA:
   - After control variables nutrition, sleep, and use gadgets, exercise fitness physical give influence main to improvement concentration (F = 24.56, *p* < 0.001, $\eta^2 = 0.62$). Duration sleep ($\beta = 0.18$, *p* = 0.03) and protein intake ($\beta = 0.15$, *p* = 0.04) significantly significant moderate effect intervention.

Findings Qualitative

CGE observations and teacher interviews revealed that student group experiment show:

- Improvement participation in discussion class (reported by 80% of teachers).
- Subtraction behavior *off-task* like daydream or play pencil (from 15 events /hour to 5 events /hour).
- Improvement speed finish task mathematics (average 10 minutes/faster).

DISCUSSION

Consistency with Theory and Research Previously, Findings This in line with theory *Cognitive Energization* (Dietrich, 2020) which states that activity physique increase flow blood to prefrontal cortex, the area of the brain responsible answer on regulations attention. Decrease TMT time in groups experiment (from 45.2 to 32.5 seconds) consistent with Khan et al.'s (2022) study in Pakistan, where training physique reduce time settlement task cognitive by 28%. Increase CGE scores (from 2.8 to 4.1) also strengthen findings Tandilayo & Suryadi (2022) about effectiveness of morning exercise in increase focus Indonesian students.

Effect moderation duration sleep and protein intake ($\beta = 0.18$ and 0.15) confirm the *Psychophysiological Arousal* model (Tomporowski et al., 2021) that quality recovery physical (sleep and nutrition) is prerequisite for optimization benefit exercise fitness. This is in harmony with Zhang et al.'s (2021) research which states that exercise physique only impact maximum If supported by factors style life holistic.

Implications Practical

1. Fitness Training Integration in curriculum:
   This result support WHO recommendations (2020) for 60- minute allocation activity physique daily activities for children. School can adopt protocol *interval training* short (eg: 15 minutes) before lesson mathematics) for increase readiness cognitive student.
2. Policy fitness in curriculum
   Collaboration between PJK teachers and guardians class required For monitor variables supporters like duration sleep and patterns eating . For example, school can provide guide nutrition for parents or set a sleep schedule through the *sleep challenge* program.

Uniqueness Findings in Local Context

Even though consistent with global research, studies This reveal challenge specifically in SD Inpres Pa'baeng-baeng:

- Facility Limited: Practice using tool simple (eg: squat jump without load) remains effective, proven that limitations mean No inhibitor main.
- Culture: The Height exposure gadgets (average 4 hours/ day) have the potential neutralize benefit exercise physique If no balanced with screen time restrictions.

Limitations and Recommendations

1. Duration intervention
   8-week period Possible Not yet Enough For see effect term Longitudinal research over 6-12 months necessary (Singh et al., 2022).
2. Generalization:
   The sample is limited to one urban school. Need replication in schools rural with dynamics socio-cultural different.
3. Measurement cognitive
   TMT and CGE instruments only measure aspect *attention* and *task-switching*. Research advanced can using EEG or fMRI to see change neurobiological direct (Smith et al., 2023)

Theoretical Contributions

Findings This enrich the *PAAP* model (Singh et al., 2022) with prove that exercise fitness physical No only influential directly on concentration, but also through interaction with variables style life. In addition, research This strengthen proof that principal *interval training* intensity moderate —which is generally used for adults —also effective for children. Fitness training physical proven increase level concentration Study student Class V of Inpres Elementary School Pa'baeng-baeng in a way significant, with effects moderated by duration sleep and intake nutrition. Findings This confirm the need approach holistic in designing school programs healthy, no only focus on activities physical, but also management style life student.

CONCLUSIONS AND RECOMMENDATIONS

Study This prove that exercise fitness physical influential significant to improvement level concentration Study student Class V of Inpres Elementary School Pa'baeng-baeng Makassar City. Based on analysis statistics, groups experimenter following an exercise program fitness physical for 8 weeks show improvement speed cognitive (Trail *Making Test)* by 28% and endurance focus (Concentration *Grid Exercise)* by 46%, while group control No experience change significant. Effect intervention This own size effect large (Cohen's d = 1.42–1.85), indicating that exercise physique structured is factor critical in optimize function cognitive student.

Findings This strengthen theory *Cognitive Energization* (Dietrich, 2020) and *Psychophysiological Arousal* (Tomporowski et al., 2021) which state that activity physique increase flow blood to brain and alertness psychological. However, the benefits exercise fitness No stand alone — duration adequate sleep (β = 0.18) and

adequate protein intake (β = 0.15) were shown to become factor strengthening moderation impact intervention. This is confirming importance approach holistic in school programs healthy, where is fitness physical must integrate with management style life student.

In context local Makassar, research This uncovering two challenges main: (1) limitations facility sport No obstruct effectiveness exercise If use protocol-based movement simple (e.g. *squat jumps* and static running), and (2) exposure high gadget use (average 4 hours/ day) has the potential reduce benefit exercise If no balanced policy *screen time* at school.

In a way practical, results This recommend:

1. Integration of exercises fitness physical short (15–30 minutes) to during learning hours daily, especially before eye lessons that require concentration tall like mathematics.
2. Collaboration cross sector between the Department of Education and the Department of Health for compile guide *holistic school health* which includes activity physical, nutritional, and management Sleep.
3. PJK teacher training in designing exercise-based evidence (evidence-*based exercise)* with tool simple.

ADVANCED RESEARCH

Limitations research, such as duration relative intervention short (8 weeks) and sample limited to one urban school, opening opportunity study advanced with longitudinal design, wider coverage area area, or use tool measuring neurophysiological (EEG) for explore mechanism biology behind findings This.

With Thus, research This No only contribute to the literature education physical and neuroscience cognitive, but also offers solution concrete for school basis in Indonesia for achieve the 4th Sustainable Development Goal (SDG) target regarding education quality through approach-based health holistic.

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