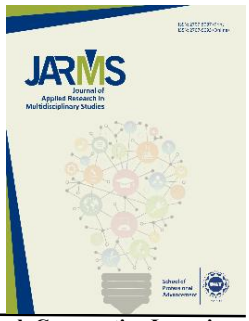
Journal of Applied Research and Multidisciplinary Studies (JARMS)
Volume 5 Issue 1, Spring 2024
ISSN(P): 2707-5087, ISSN(E): 2707-5095
Homepage: https://journals.umt.edu.pk/index.php/jarms

Article QR



Title: **Effects of Fundamental Movement Skills Training through Cooperative Learning Approach on Motivation and Confidence of Children with Developmental Coordination Disorder to Engage in Physical Activities**

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DOI: https://doi.org/10.32350/jarms.51.03

History: Received: January 17, 2024, Revised: March 27, 2024, Accepted: June 16, 2024, Published: June 30, 2024

Citation: Shahzad, N., & Jameel, H. T. (2024). Overview of Pakistan's transportation infrastructure from future perspective: A systematic literature review. *Journal of Applied Research and Multidisciplinary Studies*, *5*(1), 32-46. https://doi.org/10.32350/jarms.51.03

Conflict of Interest: Author(s) declared no conflict of interest

A publication of
School of Professional Advancements
University of Management and Technology, Lahore, Pakistan

Effects of Fundamental Movement Skills Training through Cooperative Learning Approach on Motivation and Confidence of Children with Developmental Coordination Disorder to Engage in Physical Activities

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Abstract

The current study examined the effects of Fundamental Movement Skills (FMS) training. These effects were probed into through cooperative learning approach on Motivation and Confidence (MC) of children with Developmental Coordination Disorder (DCD) to engage in physical activities. Twenty-eight (28) children with DCD participated in the current study. Participants were divided into two equal groups, that is, experimental and control group. Each group comprised fourteen participants. Boys and girls both participated in the study. Purposive sampling technique was employed to select the sample. Test of Gross Motor Development-2 (TGMD-2) and Pediatric Balance Scale (PBS) were used for the diagnosis of DCD. Canadian Assessment of Physical Literacy-2 (CAPL-2) was used to determine the MC level of participants. The results revealed significant difference in the progress of experimental and control group. Experimental group showed improvement at a highly significant level after the intervention.

***Keywords*:** Cooperative learning, Developmental Coordination Disorder (DCD), Fundamental Movement Skills (FMS), Physical literacy (PL)

Introduction

Developmental Coordination Disorder (DCD) is marked with below average body coordination and abilities to learn new motor skills and tasks. Limitations in learning and performing movement skills further interfere with activities and tasks of daily living (DSM-V). It is mainly considered as a childhood disorder, however, studies reflect that children diagnosed with DCD in early age may carry the symptoms and effects till adolescence. It has been observed that in about 30 to 70% cases, DCD symptoms persist in one form or another till adulthood and even after. These symptoms may appear in academic and other developmental areas (Biotteau et al., 2019). In academic field, the most prominent skills affected include the ability to write. The writings of children with DCD are not only adversely affected but also show more errors than the writings of the typically developing children of their age. Their handwriting may also appear more unintelligible (Barnett & Prunty, 2021). Significant difference has also been observed in the writings of children with and without DCD when speed and length constraints were added (Huau et al., 2015). Although, commonly prevalent, ranging from 2-7% in children, it is still not a well-recognized disorder (Caçola & Lage, 2019). Children with DCD may suffer from task-specific anxiety which can cause further deterioration of motor behavior. The already affected motor behavior is likely to deteriorate with the way children with DCD feel about performing a motor activity or a movement-related task. However, this evidence needs to be strengthened further (Harris et al., 2022).

Children with DCD have weak perceptual motor skills which aggravate their limitations in practical life, specifically road crossing (Wilmut & Purcell, 2020). Many studies conducted on co-morbidity suggest that about 50% of individuals diagnosed with neurodevelopmental disorders are at a serious risk of developing co-morbidity (Smits-Engelsman et al., 2017). DCD may co-occur with other childhood disorders. Studies have revealed that children with DCD may suffer from Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD). However, it is hard to draw a clear line to distinguish one disorder from another (Lino & Chieffo,

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2022). A myriad of children with ASD are at a risk of under-developed motor skills or DCD. Although, this situation is quite alarming, yet only a small portion of ASD population has received interventions based on physical activities (Bhat, 2020).Motor limitations in children with ASD have never been viewed as possible symptoms of DCD in the past. Recently, studies have been conducted to evaluate motor abilities against DCD diagnostic criterion. Surprisingly, over 90% of ASD cases have fulfilled that DCD criterion (Miller et al.,2021).

Rapid development in physical literacy (PL) has brought a flood of knowledge in the field of research. The entire PL construct depends upon four main domains, each belonging to different area of human development. Physical competence stems from physiological domain, Motivation and Confidence (MC) from affective domain, knowledge and understanding from cognitive domain, and daily behavior stems from behavioral domain of human development. Each domain is equally important in its own way and the role it plays in the overall personality development (Longmuir et al., 2015). The domain of MC stems from the theory of self-determination. Self-Determination Theory (SDT) is a macro theory that deals with the outcomes and origins of human agentic actions (Adams et al., 2017).It discusses about theme chanism of human motivation and has originated from psychologists' research on intrinsic and extrinsic motivation (Deci et al.,2017).

Motivation to participate in physical activities reduces to a great extent during adulthood. Although, this reduction is present both in men and women, yet women show lesser tendencies towards participation in comparison with men (Pratt et al.,1999).

The major driving force behind intrinsic motivation is to give children the freedom to choose. Similarly, the control to perform an activity is also a meaningful predictor for enhancing the intrinsic motivation (Alderman et al.,2006). Lesser the pressure children feel, greater are the chances to elevate the level of intrinsic motivation. Other predictors of intrinsic motivation majorly prioritize similar elements. Self-perception of competence, learning environment, and task goal orientation are also the significant predictors of intrinsic motivation (Ferrer-Caja & Weiss, 2000).

The current study examined the effect of FMS intervention based on cooperative learning on MCto engage in physical activities of children with DCD.

Methodology

Quasi-experimental pre and post-test design was employed to conduct the current study. Purposive sampling technique was used to select the sample. Sample was divided in two equal groups, that is, experimental and control group. The outcome variables were measured at the start and end of the intervention. The participants remained blinded of all the outcomes' assessors. The current study comprised three phases.

Phase I

Phase I consisted of five important steps. Step I included taking permission from the Federal Directorate to conduct this study in institutes working under their authorities. Afterwards, schools were visited once the permission was granted. Step II was based on holding meetings with school heads and presentations were delivered to the faculty about DCD. These presentations provided them with general awareness and orientation about DCD. They were informed about the red flags to be considered while identifying children with DCD. The completion of entire diagnostic process was targeted to ensure the authenticity of participants in step III. Moreover, parents' consent was also taken and the pretest was conducted respectively in step IV and V. Step VI was the final step in which interventional activities were designed and authenticated by the professionals. Separate activities were also designed for experimental and control groups. These activities were based on FMS with and without the cooperative learning approach. The pretest of all the participants was taken by using Canadian Assessment of Physical Literacy-2 (CAPL-2). This tool is quite valid and

reliable to measure PL in children between the ages of 8 and 12. A combined pretest was taken prior to dividing the participants in experimental and control groups. After the completion of pretest, groups were formed using purposive sampling technique. From all the visited schools, only two schools with maximum number of children at risk of DCD were selected. These nearby schools with maximum resemblance and equivalence were divided in experimental and control groups.

Phase II

During this phase, participants of both experimental and control groups were involved in physical activities. For experimental group, FMS activities based on cooperative learning approach were used, whereas participants of control group practiced FMS activities without cooperative learning approach.

Phase III

This phase comprised post-intervention process which included data collection on MC of experimental and control group, data analysis, and computation of results.

Participants

The participants of current study comprised 167 children between the ages of 8 and 12 studying in different primary level mainstream model schools of Islamabad. These participants were selected by following a systematic process mentioned in phase I and thereafter. After the orientation, teachers were asked to identify the children with DCD in their classes and to provide the list with complete data. Altogether, 18 schools were visited out of which 15responded with the list of children who were at risk of DCD. Three (03) schools claimed no child studying with them had apparent DCD symptoms. Children marked by teachers were considered to be at risk of developing DCD. Once the data was received from each school, the process of confirmation of diagnosis was started. Firstly, DCDQ-UR was sent to parents of all the children who were identified by teachers. Demographic sheet was also attached so that basic information regarding children could be gathered. In first attempt only 93 questionnaires returned. DCDQ-UR was again sent to remaining parents and 42 parents responded. Moreover, third attempt of sending questionnaire at home was also made to acquire maximum responses. After this attempt, 26 more parents responded and returned the questionnaires. After all the three attempts, altogether 161 questionnaires were returned by the parents.

Out of all 15 schools, 147 children were traced out by teachers who had probable DCD symptoms. Two (02) schools with considerable number of enrolled students as well as substantial number of students at risk of DCD were selected. Sample of the study was selected from these two schools. Moreover, both of these schools provided the myriad number of students among all 15 schools. Altogether, 35 children were screened by teachers who had probable DCD symptoms. Furthermore, to strengthen the diagnosis, Test of Gross Motor Development-2 (TGMD-2) and Pediatric Balance Scale (PBS) were applied. Both of these tests are used globally to measure children's gross motor and balance development. Moreover, these tests are equally reliable to ascertain the diagnosis of DCD in children. With the help of this tool, further confirmation of diagnosis can be made. Afterwards, all parents were called for meeting, so that they could be briefed about the study. Moreover, consent was also taken to engage their wards in the experimental process. Parents were ensured that their children would remain safe and data would only be used for research pursuits. It was also ensured that the entire process would be carried out without revealing children's identity. At the end of this process, 01 parents denied to give consent and 03 students did not fall in DCD diagnosis criteria. The experiment started with 31 students; however, by the end 28 students were left, with14 students in each group. Gender ratio in experimental and control groups was similar. This is because experimental group comprised 10

boys and 04 girls, whereas control group comprised 09 boys and 05 girls. It was also ensured that age representation in sample divided in experimental and control group was similar.

Instrument

For diagnosis, TGMD-2 and PBS scales were used. The former scale assessed locomotion and object manipulation, whereas latter was applied to measure the balancing skills of children. Both scales are reliable to measure the portions of FMS. TGMD-2 had the values 0.78 and 0.74 for internal consistency of locomotion and object manipulation, respectively. The composite internal consistency of scale was 0.80. Validity of PBS was tested on children between the ages of 6 and 15. The correlation score between PBS and Selective Control Assessment of Lower Extremity Scale was r=0.979 at significance level p<0.05. CAPL-2 is a reliable tool which measures PL). In the current study, it was used to obtain data regarding MC of children with DCD. MC is an integral domain of PL. A portion of items in CAPL-2 covers this domain and is considered reliable to gather data on MC of children between the ages of 8-12. Internal consistency score of this portion was at=0.82.

Intervention

Total duration of the intervention comprised 6 weeks. Three (03) sessions were conducted each week based on exclusive FMS domains. Every Monday, locomotion training was provided to both experimental and control groups. In the same way, every Wednesday was locked for object manipulation and on Friday, balance trainings were provided to both groups with and without cooperative learning approach separately. The entire intervention was designed in a way that both groups were engaged in similar FMS activities, however, with and without cooperative learning, respectively. Altogether, 18 different FMS activities were designed for experimental group alone based on cooperative learning. Similarly, 18 different activities were also designed for control group devoid of cooperative learning approach. On each intervention day, a different FMS activity training was provided to both experimental and control groups. As a whole, both experimental and control groups received 18 training sessions separately, based on FMS components. In parental meetings, parents were asked to restrict the extra physical activities of their wards during the intervention. Previous physical activity routine was to be followed so that intervening elements could be minimized and the actual effect of intervention could be explored. The duration of each session was 60 minutes divided as warm up, exclusive training, and cool down. Safety of participants was the priority. Therefore, the entire intervention process was completed with utmost care. Warm up and cool down sessions were considered mandatory so that any risk of injury could be avoided. Special consideration was given to materials used in the activities. Appraisers were hired to carry out all the activities. Different appraisers were hired for both groups. The same appraisers were used to collect pre-test and post-test scores.

General Instructions for Implementation of Training Program

Certain precautions were followed for the implementation of training programs. These instructions were aimed at the fulfillment of procedural demands, appropriateness and successful conduction of the entire training program. Proper warm up and cool down sessions were conducted before and after each training session in both experimental and control groups. Safety of participants was the primary concern of trainers and no leniency was permitted for any measure that may affect training environment. Each activity was repeated twice at least. Regular water breaks were also given to keep participants hydrated. Participants were asked to report if they feel any pain or discomfort during activities. Appraisers also guided the participants about how to perform the given activities.

Data Analysis

Exploratory data analysis was used to obtain the results from received data. Independent-sample t-test was applied to explore the statistical difference in PL before and after the intervention in experimental and control groups. Paired-sample *t*-test was also used to determine the inter-group difference before and after the intervention in experimental and control groups separately. Chi-square was applied to understand the frequency of effect of intervention on both groups. Moreover, equivalence of both groups was established at all necessary levels to obtain reliable results which maybe generalized later on.

Results

The current study was based on quasi-experimental design to determine the effect of FMS training through cooperative learning approach on MC of children with DCD. Sample was selected using purposive sampling technique. Moreover, sample was divided into two groups named as experimental and control groups. Six (6) weeks training was provided along with cooperative learning to experimental and control groups, respectively comprising equal number of children with DCD. Pre and post intervention data was obtained to determine the difference in progress. Results revealed significant improvement in the performance of experimental group. Control group also showed improvement, however, at an insignificant level. Independent sample t-test was applied to compare the performance of both groups before and after the intervention. Paired sample t-test was used to determine the improvement in each group separately. Same group's pre intervention data was compared with the data obtained after intervention to explore the achievement of group. Before intervention, equivalence level of groups was also determined to obtain reliable results. Stage-wise progress was also analyzed using Chi-square. This progress was studied on the basis provided by CAPL-2 manual.

Table 1

Age Characteristics of Children with DCD

Groups	*N*	*M*	*SD*	*SE*	*t*	*p*
Control	14	10.2	1.37	0.366	0.145	0.886
Experimental	14	10.1	1.23	0.329		

Ages of children with DCD were measured in years. Participants' ages in experimental group (*M*=10, *SD*=1.23, *SE*=329) and control group (*M*=10.2, *SD*=1.37, *SE*=366) were almost at the same stage. Data revealed no significant age difference among children with DCD in both groups. It is therefore explicit that prior to intervention, the sample was equally distributed on the basis of age.

Table 2

Comparison of Sub-area of Motivation and Confidence Domain between Experimental and Control Groups Before Intervention

Pre-Test Results	Experimental Group		Control Group		*t(26)*	*p*
	M	*SD*	*M*	*SD*		
Motivation and Confidence (MC)	20.03	2.59	18.76	3.42	1.10	0.28
Intrinsic Motivation	5.25	1.01	4.86	1.48	0.81	0.42
Perceived Competence	4.75	0.84	4.39	1.19	0.91	0.37
Predilection	5.35	0.76	5.49	1.13	0.37	0.71
Adequacy	4.59	0.94	4.36	0.79	0.69	0.49

Independent sample t-test was applied to ascertain the MC level of experimental and control group before the start of intervention. Table 2depicts that both experimental (*M*=20.03, *SD*=2.59) and control group (*M*=18.76, *SD*=3.42) were almost at the same level before the intervention. This

is because no significant difference was observed at the start (p=0.28). Even, no significant difference was found in sub-areas including intrinsic motivation (p=0.42), perceived competence (p=0.37), predilection (p=0.71), and adequacy (p=0.49).

Table 3

Comparison of Motivation and Confidence and Sub-areas between Experimental and Control Groups After Intervention

Post-Test Results	Experimental Group		Control Group		*t(26)*	*p*
	M	*SD*	*M*	*SD*		
Motivation and Confidence	27.06	1.29	22.11	2.78	6.01	<.001
Intrinsic Motivation	7.29	0.32	5.89	0.96	5.12	<.001
Perceived Competence	6.50	0.76	5.39	1.07	3.14	0.004
Predilection	6.89	0.38	5.74	0.66	5.64	<.001
Adequacy	6.49	0.53	5.15	0.78	5.25	<.001

Table 3 shows the values of MC and sub-areas. Significant difference was observed in the overall MC level *(p=<.001)* and all four sub-areas namely, intrinsic motivation (*p=<.001*), perceived competence (*p=0.004*), predilection (*p=<.001*), and adequacy *(p=<.001).*

Table 4

Within Group Comparison of Motivation and Confidence in Experimental Group Before and After Intervention

		M	*SD*	*MD*	*t(14)*	*p*	Cohen's d
Pre	Motivation and Confidence	20.03	2.59	7.03	10.39	<.001	2.78
Post	Motivation and Confidence	27.1	1.30				

Paired sample t-test was used to compare the effects of intervention on experimental and control groups separately. Pre and post-intervention values of each group were analyzed separately. The analysis of obtained data at pre (*M*=20.03, *SD*=2.59) and post (*M*=27.1, *SD*=1.30) depicts highly significant difference *(p=<.001*) in MC level of children included in experimental group.

Table 5

Within Group Comparison of Motivation and Confidence in Control Group Before and After Intervention

		M	*SD*	*MD*	*t*(14)	*p*	Cohen's d
Pre	Motivation and Confidence	18.8	3.42	3.35	3.69	0.003	0.98
Post	Motivation and Confidence	22.1	2.79				

Control group also showed significant difference (p=0.003) when before and after the intervention performance was compared. However, this difference was less significant than the difference shown by experimental group (p=<.001).

Table 6

Pre-Intervention Comparison in Motivation and Confidence Level on the Basis of Stages

Groups	*n*	Stages				χ^2	*p*
		Beginning	Progressing	Achieving	Excelling		
Experimental	14	2	11	1	-	1.71	0.42
Control	14	4	10	-	-		

Table 6 depicts stage-wise standings of participants of experimental and control groups at pre intervention level. Data shows that 02 participants were on stage 1, 11 on stage 02, and 01 was on

stage 3 in experimental group, whereas 04 participants were on stage 1, 10 on stage 2, and no participant was on stage 3 and 4 in control group before the start of intervention.

Table 7

Post-Intervention Comparison in Motivation and Confidence Level on the Basis of Stages

Groups	*n*	Stages				χ^2	*p*
		Beginning	Progressing	Achieving	Excelling		
Experimental	14	-	3	4	7	7.50	0.02
Control	14	-	9	4	1		

Table 7 reveals post-intervention data. It depicts that all participants of experimental and control groups crossed stage 1 in MC. Three (03) participants were at stage 2, 04 reached to stage 3, and 07 participants reached the highest stage from experimental groups. Whereas, in control group, 09 participants reached stage 2, 04 reached stage 3, and 1 entered stage 4.

Discussion

The current study was conducted to determine the effects of FMS training to improve MC of children with DCD if used with cooperative learning approach. FMS are generally accepted as the prerequisites to learn mature movements made by children and adults. The earlier these skills are learnt or given exposure, the better it is for age appropriate bodily growth. If children have an early exposure and opportunity to flourish their FMS, they may have greater chances to master more complex movements later in their lives. Moreover, FMS also provide base for sports specific movements and also help children in learning physical tasks rapidly and precisely. Participants were divided into experimental and control groups. Experimental group received FMS training with cooperative learning whereas control group received FMS training without cooperative learning approach. After 6 weeks of training post-intervention data was obtained and analyzed. The results revealed that significant difference could be observed in MC of children with DCD in post-intervention data towards engagement in physical activities. Improvement was observed in overall MC as well as in sub-areas. All four sub-areas exhibited significant improvement. These results revealed that apart from improvement shown in participants' intent and interest, their perception to carry out a physical task also grew.

The findings are consistent with the conclusion of similar study conducted on neuro-typical students as it suggested that sustained CL practices can enhance motivation of students and give them experience of joy and relatedness (Fernandez-Rio, Sanz, Fernandez-Cando, & Santos, 2017). If the progress is visualized according to CAPL-2 manual, it would be observed that both experimental and control groups showed certain progress. This progress is evident in performance-related stages that the manual offers. According to the manual, there are four stages or levels designed as beginner, progressing, achieving and excelling based on a child's performance. These stages were developed according to gender, age, and ability parameters. Stage division was first made on the basis of gender, then on age, and lastly, on the basis of ability level of an individual. Individuals with underdeveloped motor development fall in beginner stage, those closer to achieving the age appropriate milestones are considered in progressing stage, individuals with age appropriate motor development fall in achieving category, whereas individuals who excel in physical growth and can take up motor tasks quickly and efficiently are considered in excelling stage (Longmuir et al., 2018). Control group also displayed stage or level improvement; however, participants of experimental group exhibited more progress and shift of stages than the participants of control group. During the intervention, it was observed that participants of experimental group showed greater keenness to take part in activities. This may be due to less imposition of constraints while performing the activities because generally, engagement is physical activities is associated with personal and environmental constraints in individuals with DCD. Moreover, it has also been

reported that children with DCD show less interest in competitive physical games (Barnett, Dawes, & Wilmut, 2013).

Therefore, the focus of intervention was participation and cooperation, not competition. CL approach also fosters group processing where participants learn from each other and get benefit from peer orientation (Hancock, 2004). In present study, children performed the activities in small heterogeneous groups which helped them learn from each other. The elements of support, fun, responsibility, and self-accountability during activities made children feel more relaxed rather than being fatigued. Cooperative learning helps children engage in responsible roles (Zakiah, 2019). Fulfilling small responsibilities and meeting up group expectations help children gain confidence in themselves to accept bigger goals and remain ready to participate. On the other hand, failure in task completion usually leads to disappointment (Oyama, Manalo, & Nakatani, 2018). In fact, children with DCD are more prone to stress and feelings of shame due to difficulties they face in performing motor task (Zaguri-Vittenberg, Weintraub, & Tal-Saban, 2024). Therefore, through cooperative learning approach chances of feelings of individual disappointment were minimized so that children could become interested and motivated to perform motor tasks. In gist, FMS training provided through cooperative learning approach can be considered beneficial to increases children's motivation and confidence to engage in physical activities. This may further lead them to adopting an active lifestyle.

Conclusion

The current study focused to determine the effects of FMS training through cooperative learning approach on MC of children with DCD. Pre-and post-data analysis revealed significant difference in post-intervention data received from participants of experimental and control groups. Control group did not remain devoid of progress but that progress was not prominent enough to be considered as significant. The findings proved that FMS training, if imparted through cooperative learning, may be helpful in keeping the children motivated to adopt an active lifestyle and also give them confidence to learn and engage in certain age appropriate motor tasks in a better and age appropriate manner.

Limitations

This study followed quasi-experimental design and participant allocation was not completely based on randomization. It was ensured that randomization was present in group allocation, however, not at participant level. The selection of participation was thoroughly purpose based. The sample was small, however, considering the purpose of study and present scenario of prevalence and diagnosis of children with DCD, maximum representation of population was ensured. Moreover, gender proportion was not equal among study participants which may impact the generalization of results for girls being less in number. There was a slight difference in number of participants falling in each age bracket representing experimental and control groups. Future studies may increase the duration of intervention to make the results even more acceptable and capable to be generalized.

Recommendations

One of the priority areas to work on is to keep children motivated for participation in physical activities. Families and schools have equal responsibilities to raise this concern and take concrete steps to prepare children for possible health hazards if an ardent lifestyle is ignored.

Considering the alarming situation as depicted by the data, it is highly recommended that future researchers should explore MC level not only of children with DCD, however, of neuro-typical children towards engagement in physical activities as well. Studies should not only be limited to level exploration, however, must also find multiple ways to bring positive changes in this

area. The area is worth-studying also because of rapidly increasing influence of technology on preferences, interests and tendencies in our day to day life.

Teachers of physical education need to focus on FMS development of children at their early age to develop age appropriate movement patterns which would eventually contribute in more specific and complex motor skills required in their later life. Random play and sports specific drills have their own importance but they are conditioned with time and situation. However, focus on FMS training should be all time priority at an early age.

In Pakistan, there is a dire need to conduct studies on diagnosis and prevalence of children with DCD. Data needs to be improved and streamlined to determine the ratio of children with DCD in the country. The same study with bigger sample and randomization may add to the already drawn out findings of the current study.

Conflict of Interest

The author of the manuscript has no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

The data associated with this study will be provided by the corresponding author upon request.

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