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PHYSICAL ACTIVITY IN CHILDREN WITH DOWN SYNDROME: THE ROLE OF AGE AND NUTRITIONAL STATUS

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ABSTRAK

Anak dengan sindrom Down sering mengalami gangguan pertumbuhan, komposisi tubuh, dan fungsi fisik yang dapat memengaruhi aktivitas fisik serta meningkatkan risiko masalah kesehatan jangka panjang. Penelitian ini bertujuan menganalisis hubungan usia dan status gizi dengan tingkat aktivitas fisik pada anak sindrom Down usia 3–10 tahun. Studi *cross-sectional* dilakukan pada 31 anak sindrom Down di Malang, Indonesia. Status gizi dinilai berdasarkan grafik pertumbuhan khusus sindrom Down, dan aktivitas fisik diukur menggunakan Kuesioner Aktivitas Fisik (PAQ-C dan EY-PAQ) yang dibantu oleh orang tua dalam pengisiannya. Analisis menggunakan korelasi Spearman dengan signifikansi $p < 0,05$. Usia tidak berhubungan secara signifikan dengan aktivitas fisik ($r = -0,233$; $p = 0,207$). Sebaliknya, berat badan menurut usia ($r = 0,371$; $p = 0,040$) dan tinggi badan menurut usia ($r = 0,428$; $p = 0,016$) berhubungan secara signifikan dengan aktivitas fisik. Status gizi berhubungan secara signifikan dengan tingkat aktivitas fisik, sedangkan usia tidak. Temuan ini mendukung pentingnya intervensi gizi dan aktivitas fisik sejak dini pada anak dengan sindrom Down.

ABSTRACT

Physical Activity in Children with Down Syndrome: The Role of Age and Nutritional Status. Children with Down syndrome commonly experience impairments in growth, body composition, and physical function that may affect physical activity and long-term health. This study aimed to analyze the association between age and nutritional status with physical activity levels in children with Down syndrome aged 3–10 years. A *cross-sectional* study was conducted on 31 children with Down syndrome in Malang, Indonesia. Nutritional status was assessed using weight-for-age and height-for-age based on Down syndrome–specific growth charts, while physical activity was measured using PAQ-C and EY-PAQ with parental assistance. Spearman correlation was used, with $p < 0.05$ considered significant. Age was not significantly associated with physical activity ($r = -0.233$; $p = 0.207$). In contrast, weight-for-age ($r = 0.371$; $p = 0.040$) and height-for-age ($r = 0.428$; $p = 0.016$) were significantly associated with physical activity. Nutritional status was significantly associated with physical activity, whereas age was not. These findings support the importance of early integrated nutritional and physical activity interventions in children with Down syndrome.

INTRODUCTION

Down syndrome is the most common chromosomal disorder associated with a variety of clinical manifestations, both physical, intellectual, and metabolic, resulting from trisomy of chromosome 21 and affecting approximately 1 in 700 live births globally.[1,2] In Indonesia, prevalence increased from 0.12% in 2010 to 0.21% in 2018.[3]

Unique developmental challenges, including altered growth trajectories and reduced physical function, are often faced by children with Down syndrome.[4] Abnormalities that occur in children with Down syndrome such as hypotonia and motor delays impact children's eating ability, balance, and physical activity participation, while endocrine disorders and metabolic abnormalities can affect linear growth and long-term nutritional status.[1] Children with Down syndrome also have a tendency towards obesity due to abnormal or excessive accumulation of body fat due to a positive energy imbalance, which has a negative impact on health.[5]

Children with Down syndrome generally have a lower basal metabolic rate and a different body composition, characterized by increased fat mass and decreased lean mass, which increases the risk of obesity and nutritional deficiencies. Furthermore, feeding difficulties such as sucking or swallowing disorders, food selectivity, neophobia, and delays in independent eating are also common and significantly impact diet quality.[6]

Emerging evidence highlights that children and adolescents with Down syndrome have lower physical activity compared to typically developing peers, contributing to high rates of sedentary behavior and increased cardiometabolic risk. Physical activity is a critical component of pediatric health, with structured exercise and activity interventions shown to improve fitness components such as muscular strength, balance, and cardiorespiratory capacity in this population.[7]

Individuals with Down syndrome also experience delays in achieving developmental milestones, which may be linked to reduced physical activity at an early age.[8] Age has also been identified as an influential factor in shaping physical activity patterns across childhood and adolescence. Children with developmental disabilities may follow different patterns influenced by physiological, social, and environmental factors.[7]

Understanding how age and nutritional status influence physical activity is essential for designing effective interventions that are developmentally appropriate and responsive to the needs of children with Down syndrome. However, research on this issue in Indonesia remains limited. This study aimed to analyze the association between age and nutritional status with physical activity levels among children with Down syndrome aged 3–10 years in Malang, Indonesia.

METHODS

A cross-sectional study was conducted in Malang City, Indonesia, between May and October 2025. Data collection was carried out in the community of children with Down syndrome in Malang City. The study involved 31 children aged 3–10 years classified into preschool age (3–5 years) and school age (6–10 years) diagnosed with Down syndrome. Participant selection was carried out using consecutive Sampling.

The sample size in this study was calculated using the sample size formula for a single-group mean. The researchers set a significance level (alpha) of 5% (Z/alpha = 1.96) and a test power of 90% (Z/beta = 1.28). Based on clinical considerations and related literature, the standard deviation value was set at 8.0 with a minimum mean difference (d) of 5.1 considered significant.

The inclusion criteria of this study were Children aged 3-10 years who were clinically diagnosed with Down syndrome by a pediatrician and confirmed by chromosome testing at the

Down syndrome community in Malang, and whose parents signed an informed consent form confirming the child's consent to participate in the research. Children with comorbid conditions such as metabolic disorders, severe infectious diseases, heart failure, autoimmune conditions, or malignancies were excluded. Non-ambulatory children were also excluded. Parents provided written informed consent to participate and agreed to data collection.

Anthropometry measurements included weight-for-age and height-for-age. Assessments of anthropometry measurements used Down syndrome-specific growth charts. Nutritional status, obtained from weight-for-age, is grouped into underweight, normal, and overweight, while nutritional status, obtained from height-for-age, is grouped into stunted, normal, and tall. Physical activity was measured using the Physical Activity Questionnaire for Older Children (PAQ-C) and the Early Years Physical Activity Questionnaire (EY-PAQ), which parents helped complete. Statistical analysis was performed using descriptive and inferential statistics. Univariate analysis was used to summarize participants' demographic and clinical characteristics. Bivariate analysis was conducted using Spearman's rank correlation to assess associations among age, nutritional status (weight-for-age and height-for-age), and physical activity levels. Correlation coefficients were reported as Spearman's rank correlation coefficients (rs), and statistical significance was set at $p < 0.05$. Ethical approval was obtained from the Ethics Committee of Saiful Anwar General Hospital. Number. 400/294/K.3/102.7/2025.

RESULTS

A total of 31 children with Down syndrome were included in this study. The demographic and clinical characteristics of the study sample are shown in Table 1. Among all participants, 12 children (38.7%) were aged 3–5 years, and 19 (61.3%) were aged 6–10 years. Regarding physical activity levels, the majority were categorized as high physical activity (71.0%), followed by moderate (22.6%) and low (6.5%). In terms of nutritional status based on weight-for-age, 29.0% of children were underweight, 67.7% had normal weight, and 3.2% were overweight. For height-for-age, 6.5% were classified as stunted, 90.3% had normal stature, and 3.2% were tall.

Table 1. Demographic and clinical characteristics of children with Down syndrome included in the study (n=31)

Variables		Amount	Percentage (%)
Age	3-5 years old	12	38.7
	6-10 years old	19	61.3
Physical Activity	Low	2	6.5
	Moderate	7	22.6
	High	22	71.0
Weight-for-age	Underweight	9	29.0
	Normal	21	67.7
	Overweight	1	3.2
Height-for-age	Stunted	2	6.5
	Normal	28	90.3
	Tall	1	3.2

The bivariate analysis of the study sample is shown in Table 2. The correlation between age and physical activity levels is known, with the Spearman correlation coefficient being -0.233 and a p-value of 0.207. The correlation coefficient $r = -0.233$ indicates that age and physical activity are weakly related. The negative direction of the relationship indicates that as age increases, the child's

physical activity will decrease. Meanwhile, with a p-value of 0.207 > 0.05 (α = 5%), there is no significant relationship between age and the physical activity levels of children with Down syndrome. This suggests that although older children tended to have slightly lower activity levels, age alone did not significantly predict physical activity intensity in this sample.

Table 2. Association between age and physical activity levels among children with Down Syndrome

Age	Physical Activity Levels			Correlation Coefficient (r)	p-value
	Low	Moderate	High		
3-5 years	0 (0%)	2 (6.5%)	10 (32.3%)	-0.233	0.207
6-10 years	2 (6.5%)	5 (16.1%)	12 (38.7%)		

The association between nutritional status as indicated by weight-for-age and physical activity levels of children with Down Syndrome is presented in Table 3. The correlation value between nutritional status (weight-for-age) and physical activity levels is known, with a Spearman correlation coefficient value of 0.371 and a p-value of 0.04. The correlation value of 0.371 indicates that nutritional status (weight-for-age) and physical activity are weakly related. The positive direction of the relationship indicates that the better the nutritional status (weight-for-age), the greater the increase in physical activity among children with Down syndrome. Meanwhile, with a p-value of 0.04 < 0.05 (α = 5%), there is a significant relationship between nutritional status (weight-for-age) and physical activity in children with Down syndrome.

Table 3. Association between nutritional status (weight-for-age) and physical activity levels among children with Down syndrome

Weight-for-age	Physical Activity Levels			Correlation Coefficient (r)	p-value
	Low	Moderate	High		
Underweight	1 (3.2%)	4 (12.9%)	4 (12.9%)		
Normal	1 (3.2%)	3 (9.7%)	17 (54.8%)	0.371	0.040
Overweight	0 (0%)	0 (0%)	1 (3.2%)		

The association between nutritional status as indicated by height-for-age and physical activity levels of children with Down Syndrome is presented in Table 4. The correlation between nutritional status (height-for-age) and physical activity levels is 0.428 (Spearman's r), with a p-value of 0.016. The correlation value of 0.428 indicates that nutritional status (height-for-age) and physical activity are moderately related. The positive direction of the relationship indicates that the better the nutritional status (height-for-age), the greater the increase in physical activity among children with Down syndrome. Meanwhile, with a p-value = 0.016 < 0.05 (α = 5%), it can be concluded that there is a significant relationship between nutritional status (height-for-age) and physical activity of children with Down syndrome.

Table 4. Association between nutritional status (height-for-age) and physical activity levels among children with Down Syndrome

Height-for-age	Physical Activity Levels			Correlation Coefficient (r)	p-value
	Low	Moderate	High		
Stunted	1 (3.2%)	1 (3.2%)	0 (0%)		
Normal	1 (3.2%)	6 (19.4%)	21 (67.7%)	0.428	0.016
Tall	0 (0%)	0 (0%)	1 (3.2%)		

DISCUSSION

This study examined the relationship between age and nutritional status among physical activity levels in children with Down syndrome aged 3–10 years in Malang City, Indonesia. The main findings indicate that age was not significantly associated with physical activity levels, whereas nutritional status, measured by both weight-for-age and height-for-age, showed significant positive correlations with physical activity.

Age and Physical Activity

This study found that age had no significant relationship with physical activity in children with Down syndrome. This result suggests that within this sample, physical activity level does not meaningfully change with age. The negative direction of the relationship indicates that as age increases, the child's physical activity will decrease. This finding implies that from early childhood to middle childhood, age alone may not be a strong determinant of activity levels among children with Down syndrome, particularly in community-based settings where opportunities for movement may be similar across age groups.

A cross-sectional study in Korea assessed the physical activity levels of two groups of individuals with Down syndrome: adolescents and school-aged children using the Fitbit and and a parent-representative questionnaire. The study distinguished between weekday and weekend physical activity levels. The study findings indicate that physical activity patterns of adolescents and school-aged children with Down syndrome in Korea vary by age group and differ between weekdays and weekends. A significant decline in physical activity levels was observed in adolescents. Unfortunately, physical activity levels in children with Down syndrome tend to decline with age. These findings demonstrate variations in physical activity levels by age group.[9] Similarly with a descriptive qualitative study in the Kingdom of Saudi Arabia reported that physical activity participation decreases with increasing age in children and adolescents with Down syndrome, while sedentary behavior increases.[7]

In pediatric health research, mixed results have been reported regarding age-related changes in activity patterns; some studies demonstrate a decline in physical activity with age due to increased sedentary behaviors.[10] Compared to typically developing peers, children with Down syndrome have lower physical activity levels and physical fitness, with a higher prevalence of sedentary behavior, regardless of age.[11]

From a developmental perspective, children with Down syndrome exhibit delayed acquisition of motor milestones, hypotonia, and joint laxity, which can limit spontaneous engagement in physical play regardless of age. Children with Down syndrome have the characteristic of having limited motor development and decreased muscle tone, which contributes to decreased spontaneous physical activity. Apart from age, adequate nutritional status supports neuromuscular

development, which is critical for participation in moderate-to-vigorous physical activities. Consequently, without targeted interventions, increasing chronological age does not necessarily translate into improved functional mobility or higher activity participation.[1,6]

The lack of statistical significance in this study may be explained by several factors. First, the relatively narrow age range (3–10 years) may limit the detection of age-related behavioral transitions that become more prominent during adolescence. Second, the small sample size and the predominance of school-aged children reduces statistical power, potentially obscuring moderate associations. Third, environmental and parental influences, such as structured therapy programs and caregiver involvement, may homogenize activity patterns across age groups in younger children, overriding biological age effects.

Nutritional Status and Physical Activity

In contrast to age, nutritional status demonstrated significant positive associations with physical activity. Children with better weight-for-age and height-for-age indices were more likely to engage in higher levels of physical activity. These findings suggest that nutritional reserves may support greater participation in physical movement, possibly through improved muscle strength, endurance, and overall physical capacity.

The observed positive relationship between nutritional status and physical activity aligns with previous studies reporting that better body composition and muscle strength facilitate greater engagement in physical activity among children with Down syndrome.[11] This study is in line with a case-control study in Poland that compared children with Down syndrome with a group of their typically developing peers and found that children with Down syndrome had a higher body mass index (BMI) and fat percentage, as well as lower levels of physical activity compared to children without Down syndrome ($p < 0.0001$). Furthermore, the majority of children with Down syndrome were classified as sedentary based on their low daily step count, which contributes to an increased risk of obesity and poor nutritional status.[12]

Children with Down syndrome are known to have altered body composition, characterized by reduced lean mass and increased fat mass, which contributes to decreased physical fitness and higher fatigue during exertion. Undernutrition, on the other hand, may further compromise muscle development and energy availability, thereby reducing tolerance for physical activity. Thus, both undernutrition and excess adiposity can act as barriers to active participation.[13,11] Conversely, children with undernutrition or stunting may experience reduced muscle mass, lower endurance, and delayed motor development, limiting their capacity to engage in active play and structured exercise.[6]

The correlation observed between height-for-age and physical activity may also reflect the cumulative effects of chronic nutritional adequacy on skeletal growth and musculoskeletal development. Linear growth impairment in Down syndrome is associated with endocrine dysfunctions, including thyroid disorders and growth hormone abnormalities, which may also affect exercise tolerance and motor performance.[14]

Given the high risk of metabolic syndrome and insulin resistance in children with Down syndrome, it is necessary to individually adjust the distribution of macronutrients and total energy intake to the patient's metabolic status, taking into account body composition, biochemical parameters, and physical activity levels. Therefore, nutritional interventions in children with Down

syndrome should not only target weight management but also focus on improving dietary quality to support physical activity engagement.[15,6]

Clinical and Public Health Implications

These results suggest that in young children with Down syndrome, nutritional status may play a more critical role in determining physical activity participation than age alone, highlighting the importance of integrated nutrition and physical activity interventions from early childhood. Physical activity is a critical component of pediatric health, with structured exercise and activity interventions shown to improve fitness components such as muscular strength, balance, and cardiorespiratory capacity in children with Down syndrome.[7] The findings of this study highlight the importance of integrating nutritional monitoring with physical activity promotion in children with Down syndrome. While age alone may not be a reliable predictor of activity levels in early childhood, nutritional status appears to play a critical role in enabling active participation. This supports current expert recommendations that emphasize individualized dietary planning combined with structured physical activity programs tailored to functional ability rather than chronological age.[16] Therefore, nutritional interventions in this population should not only target weight management but also focus on improving diet quality to support physical activity engagement. Community-based rehabilitation programs and school inclusion initiatives should therefore incorporate adaptive physical education and nutrition counseling for caregivers.

The significant correlation between nutritional status and physical activity in this study reinforces the hypothesis that children with better physical growth indices showed higher activity levels in this sample and conversely, undernutrition may lead to poorer stamina and reduced participation in physical movement. These findings highlight the urgency of structured physical activity programs during early childhood, including engaging skill development in preschool years, structured exercise routines during school years and regular monitoring of growth and sedentary behaviors. Family involvement including parent guidance, therapy-based play, and inclusive physical education are critical to ensure sustained improvement.This study has a small sample size, so the statistical power to detect correlations is typically weak to moderate. Cross-sectional design and inability to infer causality, purposive sampling limiting generalisability, and potential caregiver-report bias. However, studies with larger sample sizes and longitudinal designs are needed to confirm these initial findings.

CONCLUSION

Nutritional status is significantly associated with physical activity levels among children with Down syndrome aged 3–10 years, while age alone does not show a significant correlation. Children with better weight-for-age and height-for-age tend to have higher physical activity levels, indicating that adequate growth and nutrition play an important role in supporting functional activity. These findings support the need for early integrated nutrition and physical activity interventions in children with Down syndrome.

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